SCHEME & SYLLABUS B.Sc Medical

(4 year programme as per NEP)
Programe Code: UG046



Department of Life Sciences and Allied Health Sciences (UIS)
Sant Baba Bhag Singh University
2022

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.

B. Sc. in Medical (Bachelor of Science in Medical)

(4 year Programme as per NEP)

B.Sc (Medical) is a four year undergraduate programme. 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 recognized Board/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 research also.
- **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 specialised 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, students" welcoming for all

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



CURRICULUM STRUCTURE AS PER NEP

B.Sc (Medical) degree programme will have a curriculum with Syllabi consisting of following type of courses:

- I. **Major Courses** / **Core Courses** (**CR**): A course, which should compulsorily by studied by a candidate as a core requirement is termed as a Core course. These courses are employability enhancement courses relevant to the chosen program of study. Program core comprises of Theory, Practical, Project, Seminar etc. Project work is considered as a special course involving application of knowledge in solving/ analyzing/exploring a real-life situation/ difficult problem.
- II. Elective Courses: Elective course is generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or with provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill. Accordingly, elective course may be categorizes as:
 - A. Discipline Specific Elective (DSE) Course: Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.
 - B. Project (I): An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.
- III. Ability Enhancement Courses (AEC): The Ability Enhancement Courses (AEC) may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). AECC courses are the courses based upon the content that leads to Knowledge enhancement; these are mandatory for all disciplines.

SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

- A. Ability Enhancement Compulsory Courses (AECC): Environmental Science, English Communication/MIL Communication.
- B. Skill Enhancement Courses (SEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

2. NOMENCLATURE USED:

A. Graduate Core Courses

- i. Core Courses. Major Courses (MC)
- ii. Theory subject (T)
- iii. Practical (P)

B. Ability Enhancement Courses/Minor Courses (AEC):

- i. Ability Enhancement Compulsory Courses (AECC)
- ii. Skill Enhancement Courses (SEC).

C. Elective Courses (EL-Major)

i. Discipline Specific Elective (DSE)

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- AECC refers to Ability Enhancement Compulsory Course
- SEC refers to Skill Enhancement Course
- DSE refers to Discipline Specific Elective
- PT Physical Training



Course Scheme for B.Sc. Medical (As Per NEP)

Semester 1

I. Theory Subjects

S No.	Course Type	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	Major (Core)	BOT161	Botany I : Plant Biodiversity	4:0:0	4:0:0	4	4
2	Major (Core)	CHM161	Chemistry I : Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	4:0:0	4:0:0	4	4
3	Major (Core)	ZOO161	Zoology I : Animal Biodiversity	4:0:0	4:0:0	4	4
4	Minor (AEC)	ENG121	Communication Skill-I	2:0:0	2:0:0	2	2
5	Minor (Skill)	PT161/ PT163/ PT165	NSO/NCC/NSS	2:0:0	Non-credit	2	NC

II. Practical Subjects

1	Major (Core)	ВОТ163	Botany I : Plant Biodiversity (Practical)	0:0:4	0:0:2	4	2
2	Major (Core)	СНМ163	Chemistry I : Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons (Practical)	0:0:4	0:0:2	4	2
3	Major (Core)	ZOO163	Zoology I : Animal Biodiversity Practical	0:0:4	0:0:2	4	2
4	Minor (AEC)	ENG123	Communication Skill-I Lab	0:0:2	0:0:1	2	1
			Total			30	21

Total Contact Hours: 30

Total Credit Hours: 21

Major/CR- Core Course

Minor/AEC-Ability Enhancement Compulsory Courses

Course Scheme for B.Sc. Medical (As $Per\ NEP$)

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	Total Credit Hours
1	Major (Core)	BOT162	Botany II : Plant Ecology and Taxonomy	4:0:0	4:0:0	4	4
2	Major (Core)	CHM162	Chemistry II : Chemical Energetics, Equilibrium & Functional Groups Organic Chemistry-I	4:0:0	4:0:0	4	4
3	Major (Core)	ZOO162	Zoology II : Comparative Anatomy and Developmental Biology of Vertebrates	4:0:0	4:0:0	4	4
4	Minor (AEC)	ENG114	Communication Skill-II	2:0:0	2:0:0	2	2
5	Minor (Skill)	PT162/ PT164/ PT166	NSO/NCC/NSS	2:0:0	Non-credit	2	NC
	II. Practical Su	bjects	GBBSU	Sill o			
1	Major (Core)	BOT164	Botany II: Plant Ecology and Taxonomy (Practical)	0:0:4	0:0:2	4	2
2	Major (Core)	CHM164	Chemistry II: Chemical Energetics, Equilibrium & Functional Group Organic Chemistry-I (Practical)	0:0:4	0:0:2	4	2
		(1)	Zoology II : Comparative Anatomy and	90	5 -1 F-		

Developmental Biology of Vertebrates

Total

Communication Skill-II Lab

0:0:4

0:0:2

0:0:2

0:0:1

Total Contact Hours: 30

30

2

21

Total Credit Hours: 21

3

Major (Core)

Minor (AEC)

Major/CR- Core Course

Minor.AECC-Ability Enhancement Compulsory Courses

ZOO164

ENG116

Practical

Course Scheme for B.Sc. Medical (As Per NEP) $\,$

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 Hours
1	Major (Core)	BOT261	Botany III : Anatomy and Embryology of Angiosperms	4:0:0	4:0:0	4	4
2	Major (Core)	CHM261	Chemistry III : Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Group Organic Chemistry-II	4:0:0	4:0:0	4	4
3	Major (Core)	ZOO261	Zoology III: Animal Physiology and Biochemistry	4:0:0	4:0:0	4	4
4	Minor (AEC)	EVS001	Environmental Science	3:0:0	3:0:0	3	3
5	Minor (SEC-I)	BOT265 CHM265 ZOO265	Elective subject (Skill Enhancement Course)-I (any one of the following) Medicinal Botany Basic Analytical chemistry Medical Diagnostics	2:0:0	2:0:0	2	2

II. Practical Subjects

1	Major (Core)	ВОТ263	Botany III : Anatomy and Embryology of Angiosperms (Practical)	0:0:4	0:0:2	4	2
2	Major (Core)	CHM263	Chemistry III : Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Group Organic Chemistry-II (Practical)	0:0:4	0:0:2	4	2
3	Major (Core)	ZOO263	Zoology III : Animal Physiology and Biochemistry Practical	0:0:4	0:0:2	4	2
Total						29	23

Total Contact Hours: 29

Total Credit Hours: 23

Major/CR- Core Course

Minor/AECC-Ability Enhancement Compulsory Courses

SEC-Skill Enhancement Course

Course Scheme for B.Sc. Medical (As $Per\ NEP$)

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 Hours
1	Major (Core)	BOT262	Botany IV: Plant Physiology and Metabolism	4:0:0	4:0:0	4	4
2	Major (Core)	CHM262	Chemistry IV : Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics	4:0:0	4:0:0	4	4
3	Major (Core)	ZOO262	Zoology IV : Genetics and Evolutionary Biology	4:0:0	4:0:0	4	4
4	Minor/ AEC	SSC001	Gender Equity	3:0:0	3:0:0	3	3
5	Minor (SEC-II)	BOT266 CHM270 ZOO266	Elective subject (Skill Enhancement Course)-II(any one of the following) Floriculture Green Methods in Chemistry Seiculture	2:0:0	2:0:0	2	2

II. Practical Subjects

1	Major (Core)	ВОТ264	Botany IV : Plant Physiology and Metabolism Practical	0:0:4	0:0:2	4	2
2	Major (Core)	СНМ264	Chemistry IV: Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics Practical	0:0:4	0:0:2	4	2
3	Major (Core)	ZOO264	Zoology IV : Genetics and Evolutionary Biology Practical	0:0:4	0:0:2	4	2
			Total	MIN I		29	23

Total Contact Hours: 29
Total Credit Hours: 23

CR- Core Course

AEC-Ability Enhancement Compulsory Course

SEC-Skill Enhancement Course

Course Scheme for B.Sc. Medical (As Per NEP)

Semester-V

I.	Tł	1eo	rv	Su	bi	ec	ts

S No.	Type of Course	Sub Code	Subject Name	Contact Hours (L:T:P)	Credits (L:T:P)	Total Contact Hours	Total Credit Hours
1	Major (DSE-I)	BOT361 BOT365 BOT369	Discipline specific Elective course-I (any one of the following) Botany V - A : Cell and Molecular Biology Botany V - B : Analytical Techniques in Plant Sciences Botany V - C : Mycology and Phytopathology	4:0:0	4:0:0	4	4
2	Major (DSE-I)	CHM361 CHM365	Discipline specific Elective course-I (any one of the following) Chemistry V: Molecules of Life Chemistry V: Organometallic, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy Chemistry V: Industrial chemicals and Environment	4:0:0	4:0:0	4	4
3	Major (DSE-I)	ZOO361 ZOO365 ZOO369	Discipline specific Elective course-I (any one of the following) Zoology V - A : Cell Biology, Biotechnology, and Reproductive biology Zoology V - B : Applied Zoology Zoology V - C : Aquatic Biology	4:0:0	4:0:0	4	4
4	Minor (AEC)	SSC006	Human values and professional ethics	3:0:0	3:0:0	3	3
5	Minor (SEC-III)	BOT373 CHM375 ZOO373	Elective subject(Skill Enhancement Course)-III (any one of the following) Ethnobotany Fuel Chemistry Apiculture	2:0:0	2:0:0	2	2
	II. Practica	l Subjects					
		The second second	Disabiling anguiffic Floative Prostical L (any ang of	Particular Arms	A 1 1 1 1 1		· · · · · · · · · · · · · · · · · · ·

1	Major (DSE-I)	BOT363 BOT367 BOT371	Discipline specific Elective Practical-I (any one of the following) Botany V - A : Cell and Molecular Biology Practical Botany V - B : Analytical Techniques in Plant Sciences Practical Botany V - C : Mycology and Phytopathology Practical	0:0:4	0:0:2	4	2
2	Major (DSE-I)	CHM363 CHM367	Discipline specific Elective Practical-I (any one of the following) Chemistry V: Molecules of Life (Practical) Chemistry V: Organometallic, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy (Practical) Chemistry V: Industrial chemicals and Environment (Practical)	0:0:4	0:0:2	4	2
3	Discipline specific Elective Pract of the following) ZOO363 Zoology V - A : Cell Biology, Bi and Reproductive biology Practic ZOO367 Zoology V - B : Applied Zoology		Discipline specific Elective Practical-I (any one	0:0:4	0:0:2	4	2
		•	Total	•		29	23

Total Contact Hours: 29 Total Credit Hours: 23

DSE-Discipline Specific Elective SEC-Skill Enhancement Course

Course Scheme for B.Sc. Medical ($As\ Per\ NEP$)

Semester-VI

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 Hours
1	Major (DSE-II)	BOT362 BOT366 BOT370	Discipline specific Elective course-II (any one of the following Botany VI - A : Economic Botany and Biotechnology Botany VI - B : Bioinformatics Botany VI - C : Archegoniate	4:0:0	4:0:0	4	4
2	Major (DSE-II)	CHM362 CHM366 CHM370	Discipline specific Elective course-II (any one of the following Chemistry VI: Chemistry of main group elements, theories of acids and bases Chemistry VI: Analytical method in chemistry Chemistry-VI: Inorganic Materials of Industrial	4:0:0	4:0:0	4	4
3	Major (DSE-II)	ZOO362 ZOO366 ZOO370	Discipline specific Elective course-II (any one of the following) Zoology VI - A : Immunology and Biostatics Zoology VI - B : Reproductive Biology Zoology VI - C : Insect, Vector and Diseases	4:0:0	4:0:0	4	4
4	Minor (SEC-IV)	BOT374 CHM374 CHM376 ZOO374	Elective subject (Skill Enhancement Course) - IV (any one of the following) Mushroom Culture Technology Basic Pharmaceutical Chemistry Chemistry of Cosmetics and Perfumes Aquarium Fish Keeping	2:0:0	2:0:0	2	2
5	Minor (ID/SEC)	CSE014	Basics of Computer Sciences	2:0:0	2:0:0	2	2

II. Practical Subjects

1	Major (DSE-II)	BOT364 BOT368 BOT372	Discipline specific Elective Practical-II (any one of the following) Botany VI - A: Economic Botany and Biotechnology Practical Botany VI - B: Bioinformatics Practical Botany VI - C: Archegoniate Practical	0:0:4	0:0:2	4	2
2	Major (DSE-II)	CHM364 CHM368 CHM372	Discipline specific Elective Practical-II (any one of the following) Chemistry VI: Chemistry of main group elements, theories of acids and bases (Practical) Chemistry VI: Analytical method in chemistry (Practical) Chemistry-VI: Inorganic Materials of Industrial Importance (Practical)	0:0:4	0:0:2	4	2
3	Major (DSE-II)	ZOO364 ZOO368 ZOO372	Discipline specific Elective Practical-II (any one of the following) Zoology VI - A: Immunology and Biostatics Practical Zoology VI - B: Reproductive Biology Practical Zoology VI - C: Insect, Vector and Diseases Practical	0:0:4	0:0:2	4	2
4	Minor (ID/SEC)	CSE016	Basics of Computer Sciences Lab	0:0:1	2	1	
			Total			30	23

Total Contact Hours: 28
Total Credit Hours: 21

DSE-Discipline Specific Elective SEC-Skill Enhancement Course

Course Scheme for B.Sc. Medical (As Per NEP)

Semester-VII

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 Hours
1		BOT361 BOT363 BOT365 BOT367	Discipline specific Elective course- III (any three of the following) Botany VII - A: Water relationship, Growth and Development Botany VII - B: Plant Biochemistry and Metabolism Botany VII - C: Evolution Botany VII - D: Remote sensing and Ecological Modelling Botany VII - E: Forestry	4:0:0 4:0:0 4:0:0	4:0:0 4:0:0 4:0:0	4 4 4	4 4 4
2	Major (DSE-III) Any one specialization	CHM361 CHM363 CHM365 CHM367 CHM371	Discipline specific Elective course- III (any three of the following) Chemistry VII A: Main Group Chemistry Chemistry VII B: Organic Reaction Mechanism-I Chemistry VII C: Chemical Thermodynamics: and its applications Chemistry VII D: Industrial Chemical analysis & Quality Control Chemistry VII E: Nano-Science & Nano Chemistry	4:0:0 4:0:0 4:0:0	4:0:0 4:0:0 4:0:0	4 4 4	4 4 4
3	ZOO361 ZOO363 ZOO365 ZOO367 ZOO369		Discipline specific Elective course- III (any three of the following) Zoology VII - A: Biosystematics, Taxonomy & Evolution Zoology VII - B: Populations Ecology & Environmental Physiology Zoology VII - C: Tools and Techniques for Biology Zoology VII - D: Structure & Function of Invertebrates Zoology VII - E: Structure & Function of Chordates	4:0:0 4:0:0 4:0:0	4:0:0 4:0:0 4:0:0	4 4 4 4	4 4 4
4	Minor/ (SEC-IV)	RM403	Research Methodology & IPR	4:0:0	4:0:0	4	4

IIPractical Subjects

1	Major (SEC)	RLS401	Review of literature & Seminar	0:0:8	0:0:4	8	4
2	Major	BOT471	Discipline specific Elective Practical-III (any one of the following) Botany VII A: Practical course on Water relationship, Growth and Development, Plant Biochemistry and Metabolism Botany VII B: Practical course on Remote sensing and Ecological Modelling and Forestry	0:0:4	0:0:2	4	2
3	(DSE-III) Any one	CHM471	Discipline specific Elective Practical-III Chemistry VII F:Inorganic Chemistry Practical-1	0:0:4	0:0:2	4	2
4	specialization	ZOO471 ZOO473	Discipline specific Elective Practical-III (any one of the following) Zoology VII - A : Ecology, Environmental Physiology, Systematics, Taxonomy and Evolution Practical Zoology VII - B : Structure and Functions of Animals Practical	0:0:2	4	2	
		•	Total			28	22

Total Contact Hours: 28
Total Credit Hours: 22

DSE-Discipline Specific Elective SEC-Skill Enhancement Course

Course Scheme for B.Sc. Medical (As Per NEP)

Semester-VIII

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 Hours
2	Major (DSE-IV) Any one specialization	BOT462 BOT464 BOT466 BOT468 BOT470 CHM462 CHM464 CHM466 CHM468	Discipline specific Elective course- IV (any three of the following) Botany VIII- A: Reproductive and developmental biology of angiosperms Botany VIII- B: Metabolic integration Botany VIII- C: Plant Natural Resources, Conservation And Sustainable Development Botany VIII- D: Advanced Industrial Botany Botany VIII- E: Ethnobotany and Pharmacognosy Discipline specific Elective course- IV (any three of the following) Chemistry VIII A: Chemistry of Natural Products & Heterocyclic Chemistry Chemistry VIII B: Chemical Kinetics & Chemical Equilibrium Chemistry VIII C: Coordination Chemistry Chemistry VIII D: Bio-Organic Chemistry	4:0:0 4:0:0 4:0:0 4:0:0 4:0:0 4:0:0	4:0:0 4:0:0 4:0:0 4:0:0 4:0:0 4:0:0	4 4 4 4 4	4 4 4 4 4
3		ZOO462 ZOO464 ZOO466 ZOO468 ZOO470	Chemistry VIII E: Industrial Chemistry Discipline specific Elective course- IV (any three of the following) Zoology VIII - A: Basic Endocrinology Zoology VIII - B: Ichthyology Zoology VIII - C: General and Applied Entomology Zoology VIII - D: Wildlife and its conservation Zoology VIII - E: Cellular Neurobiology and Neuron Organisation	4:0:0 4:0:0 4:0:0	4:0:0 4:0:0 4:0:0	4 4 4 4	4 4 4

II. Practical Subjects

	II. I l'actical Su	,				-	
1	Major (SEC)	DPR402	Dissertation/Project report	0:0:12	0:0:6	12	6
2		BOT472 BOT474 BOT476	Discipline specific Elective Practical-IV (any two of the following) Botany VIII - A: Practical course on reproductive biology of angiosperm Botany VIII - B: Practical course on Metabolic integration Botany VIII - C: Practical course on advanced Industrial Botany	0:0:4 0:0:4	0:0:2 0:0:2	4 4	2 2
3	Major (DSE-IV) Any one specialization	CHM472 CHM474	Discipline specific Elective Practical-IV (both are compulsory) Organic Chemistry Practical-1 Physical Chemistry Practical-I			4 4	2 2
4		ZOO472 ZOO474 ZOO476	Discipline specific Elective Practical-IV (any two of the following) Zoology VIII - A : Endocrinology and Ichthyology Practical Zoology VIII - B : General and Applied Entomology Practical Zoology VIII - C : Wildlife and Cellular Neurobiology Practical	0:0:4 0:0:4	0:0:2 0:0:2	4 4	2 2
			Total			32	22

Total Contact Hours: 32
Total Credit Hours: 22

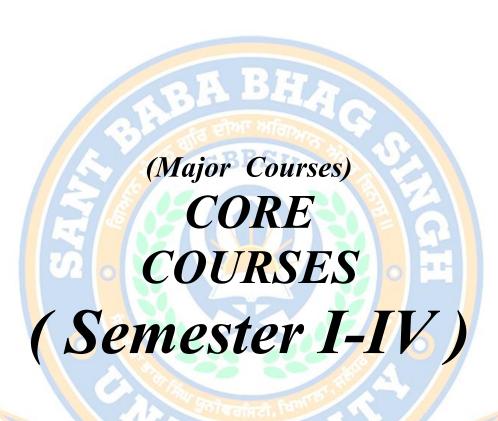
DSE-Discipline Specific Elective SEC-Skill Enhancement Course

Course Scheme Summary

Semester	L	Т	P	Contact hrs/wk	Credits	CC	AEC	SEC	DSE	ID
1	16	0	14	30	21	18	3			
2	16	0	14	30	21	18	3			
3	17	0	12	29	23	18	3	2		
4	17	0	12	29	23	18	3	2		
5	17	0	12	29	23	U	3	2	18	
6	14	0	14	30	23	1/3		4	18	1
7	16	0	12	28	22	2	36	8	14	
8	12	0	20	32	22	7		6	16	
Total	125	0	110	237	178	72	15	24	66	1







KHIALA, DISTT. JALANDHAR (PUNJAB)



ZOOLOGY I: ANIMAL BIODIVERSITY

Semester	I
Course Code	Z00161
Course Title	Zoology I : Animal Biodiversity
Type of course	Theory
LTP	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 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 economical 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 and the 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 classes Pisces: 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, Biting mechanism in snakes

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

S.	Title	Author(s)	Publisher
No.			
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

ZOOLOGY I: ANIMAL BIODIVERSITY PRACTICAL

Semester	I		
Course Code	Z00163		
Course Title	Zoology I : Animal Biodiversity Practical		
Type of course	Practical		
LTP	0 0 4		
Credits	2		
Course	10+2 Medical		
prerequisite			
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	By the end of this course, students will be able to		
Outcomes (CO)	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.		
	कि सीभा भवित्रभाव के		

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 Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, CucumariaandAntedon, 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

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.

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



ZOOLOGY II : COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

Semester	II		
Course Code	Z00162		
Course Title	Zoology II : Comparative Anatomy and Developmental Biology of Vertebrates		
Type of course	Theory		
LTP	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 physiology of 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
Gingal to the System of Explosion of Board.

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.

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

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	
LTP	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 and development of human. 2. Impart knowledge about histology of gonads.		
Course Outcomes (CO)	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.

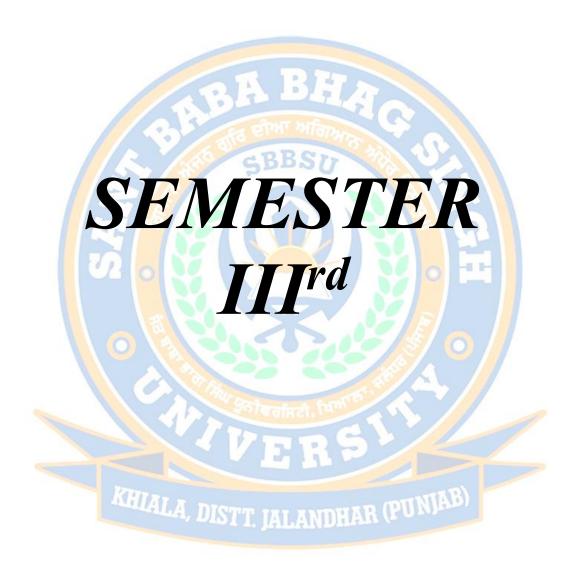
4. Study of placental development in humans by ultrasound scans.

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.

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



ZOOLOGY III: ANIMAL PHYSIOLOGY AND BIOCHEMISTRY

Semester	III	
Course Code	Z00261	
Course Title	Zoology III: Animal Physiology and Biochemistry	
Type of course	CORE	
LTP	4:0:0	
Credits	4	
Course prerequisite	B.Sc. Medical I year	
Course Objective	The aim of this course is to enable the students to	
	1. Impart knowledge about the physiological processes and metabolism.	
	2. Develop the basic understanding of endocrine system and its interaction with	
	other systems.	
Course Outcomes	By the end of this course, students will be able to	
(CO)	1. Understand the various physiological processes like digestion, respiration,	
	excretion, osmoregulation, etc.	
	2. Impart knowledge about interactions and interdependence of physiological and	
	biochemical processes.	
	3. Familiarize with endocrine system and its role in reproduction.	

UNIT-I

Nerve and muscle: Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction

IINIT-II

Digestion: Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids **Respiration:** Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood **Excretion:** Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism **Cardiovascular system:** Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle

UNIT-III

Reproduction and Endocrine Glands: Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle. Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal

UNIT -IV

Carbohydrate Metabolism: Glycolysis, Krebs Cycle, Pentose Phosphate Pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain

Protein metabolism: Transamination, Deamination and Urea Cycle

Enzymes: Introduction, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation

S.No	Title	Author	Publishe r
1	Principles of Anatomy and Physiology	Tortora, G.J. and	John Wiley & Sons
	8 th edition	Derrickson, B.H.	
2	Vander's Human Physiology,11 th	Widmaier, E.P., Raff, H.	McGraw Hill
	edition	and Strang, K.T.	
3	Textbook of Medical Physiology, 12th	Guyton, A.C. and Hall,	Harcourt Asia Pvt. Ltd/
	edition	J.E	W.B. Saunders Company
4	Biochemistry, 6 th edition	Berg, J.M., Tymoczko, J.	W.H
		L. and Stryer, L	Freeman and Co.
5	Principles of Biochemistry, 6 th edition	Nelson, D.L., Cox, M.M.	W.H. Freeman and Co.
		and Lehninger, A.L	

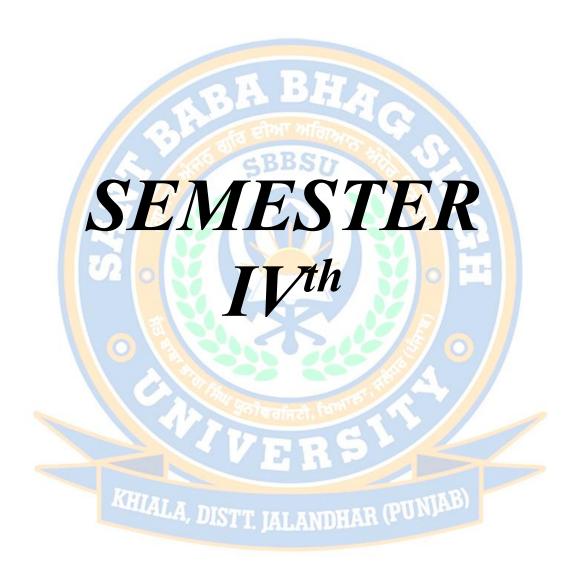
ZOOLOGY III: ANIMAL PHYSIOLOGY AND BIOCHEMISTRY PRACTICAL

Semester	III	
Course Code	ZOO263	
Course Title	Zoology III: Physiology and Biochemistry Practical	
Type of course Practical		
LTP 0 0 4		
Credits	2	
Course prerequisite B.Sc. Medical I year		
Course Objective	The aim of this course is to enable the students to	
	1. Impart practical knowledge about basic idea of the biological processes	
	in the body and cellular respiration.	
	2. Study animal physiology through slides and specimens.	
Course Outcomes (CO)	By the end of this course, students will be able to	
	1. Gain knowledge in the fundamentals of biochemistry of all the	
	biomolecules like the carbohydrates, proteins, lipids, nucleicacids, their	
	classification, structure and metabolism.	
	2. Understand latest techniques regarding mammalian physiology.	
	3. Perform tests regarding blood and urine.	

LIST OF EXPERIMENTS

- 1. Preparation of hemin and hemochromogen crystals
- 2. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland.
- 3. Study of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage
- 4. Qualitative tests to identify functional groups of carbohydrates (Glucose, Fructose, Sucrose, Lactose), amino acids and proteins and lipids in given sample.
- 5. Estimation of total carbohydrates by Dubois/anthrone method and total proteins by Lowry's method.
- 6. Study of activity of salivary amylase under optimum conditions.
- 7. Determination coagulation and bleeding time of blood in man/rat/rabbit.
- 8. Determination of blood groups of human blood sample.
- 9. Recording of blood pressure of man.
- 10. Analysis of urine for urea, chloride, glucose and uric acid.
- 11. Estimation of haemoglobin content.

S.No	Title	Author	Publi <mark>sh</mark> er
1	Principles of Anatomy and Physiology	Tortora, G.J. and	John Wiley & Sons
	8 th edition	Derrickson, B.H.	
2	Vander's Human Physiology,11 th	Widmaier, E.P., Raff, H.	McGraw Hill
	edition	and Strang, K.T.	
3	Textbook of Medical Physiology, 12th	Guyton, A.C. and Hall, J.E	Harcourt Asia Pvt. Ltd/
	edition		W.B. Saunders
			Company
4	Biochemistry, 6 th edition	Berg, J. M., Tymoczko, J.	W.H
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ZOOLOGY IV: GENETICS AND EVOLUTIONARY BIOLOGY

Semester	IV
Course Code	ZOO262
Course Title	Zoology IV : Genetics and Evolutionary Biology
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc. Medical I year
Course Objective (CO)	The aim of this course is to enable the students to 1. Aware about genetic material, chromosomes, their structure and function, basis of genetics/inheritance and changes occurring in animal species during various evolutionary eras. 2. Explain fundamental terminology and concepts in the fields of genetics and evolution.
Course Outcomes (CO)	By the end of this course, students will be able to 1. Understand the concept of Mendel's laws in genetics, and central dogma in biology. 2. Know about the various theories of evolution. 3. Understand the genetic basis of evolution and speciation

UNIT-I

Introduction to Genetics: Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information

Mendelian Genetics and its Extension: Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance

UNIT-II

Linkage, Crossing Over and Chromosomal Mapping: Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics – an alternative approach to gene mapping

Mutations: Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor Mutations.

Sex Determination: Chromosomal mechanisms, dosage compensation

UNIT-III

History of Life : Major Events in History of Life

Introduction to Evolutionary Theories: Lamarckism, Darwinism, Neo-Darwinism

Direct Evidences of Evolution: Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse

Processes of Evolutionary Change: Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

UNIT-IV

Species Concept: Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)

Macro-evolution: Macro-evolutionary Principles (example: Darwin's Finches)

Extinction: Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution.

S.No	Title	Author	Publisher
1	Principles of Genetics, 8th edition	Gardner, E.J., Simmons, M.J.,	Wiley India
		Snustad, D.P.	
2	Concepts of Genetics, 16 th edition	Klug, W.S., Cummings, M.R.,	Benjamin Cummings
		Spencer, C.A	
3	Genetics- A Molecular Approach,	Russell, P. J.	Benjamin
	3 rd edition		Cummings.
4	Evolution, 3 rd edition	Ridley, M.	Blackwell Publishing
5	Evolutionary Biology	Douglas, J. Futuyma	Sinauer Associates.

ZOOLOGY IV: GENETICS AND EVOLUTIONARY BIOLOGY PRACTICAL

Semester	IV		
Course Code	ZOO264		
Course Title	Zoology IV : Genetics and Evolutionary Biology Practical		
Type of course	Practical		
LTP	0 0 4		
Credits	2		
Course prerequisite	B.Sc. Medical I year		
Course Objective	The aim of this course is to enable the students to		
	1. Aware about genetic material, chromosomes, their structure and func		
	basis of genetics/inheritance and changes occurring in animal species during		
	various evolutionary eras.		
	2. Understand the concept of Mendels laws in genetics.		
Course Outcomes (CO)	By the end of this course, students will be able to		
	1. Understand the Mendelian inheritance and gene interaction using suitable		
	examples.		
	2. Understand linkage, recombination and gene mapping.		
	3. Know fossil evidences in support of evolution.		
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LIST OF EXPERIMENTS

- 1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
- 2. Study of Linkage, recombination, gene mapping using the data.
- 3. Study of Human Karyotypes (normal and abnormal).
- 4. Study of fossil evidences from plaster cast models and pictures
- 5. Study of homology and analogy from suitable specimens/ pictures
- 6. Charts:
 - a) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
 - b) Darwin's Finches with diagrams/ cut outs of beaks of different species
- 7. Visit to Natural History Museum and submission of report

S.No	Title	Author(s)	Publisher	
1	Principles of Genetics, 8th edition	Gardner, E.J., Simmons, M.J., Snustad, D.P.	Wiley India	
2	Principles of Genetics, 5th edition	Snustad, D.P., Simmons, M.J	John Wiley and Sons Inc.	
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ZUULUGY V - A	: CLLL	BIOLOGY.	BIOTECHNOLOGY	AND REPRODUCTIVE BIOLOGY

Semester	V	
Course Code ZOO361		
Course Title Zoology V - A : Cell Biology, Biotechnology and Reproductive Biology		
Type of course Theory		
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc. Medical II year	
Course Objective	The aim of this course is to enable the students to	
(CO)	1. Enable the students to learn various aspects of cell biology and techniques of	
	biotechnology.	
	2. Aware the students about various reproductive processes and the modern	
	techniques to assist these processes.	
Course Outcomes	By the end of this course, students will be able to	
(CO)	1. Understand various processes that occurs in and between cells.	
	2. Understand various techniques to study DNA.	
	3. Describe the changes that occur in the reproductive system male and female and	
	the role of hormones.	

UNIT-I

Introduction to Cell and Molecular Biology: Discovery of cell, basic properties, eukaryotic and prokaryotic cells, viruses. Structure and functions of Plasma membrane: Chemical composition of membrane, structure and function of membrane proteins, Fluid Mosaic Model, Membrane potential and nerve impulse

Interaction between cell and their environment: Interaction of cell with extracellular material, Tight Junctions, Gap Junctions and Plasmodesmata mediating intracellular communications, cell wall.

Membrane Trafficking: Endoplasmic Reticulum, Golgi complex, Types of vesicle transport and their functions, lysosomes.

Cytoskeleton and Cell motility: Study of cytoskeleton, microtubules, intermediate filaments, microfilaments.

UNIT-II

Biotechnology: Recombinant DNA technology and its applications, Cloning vectors: Plasmids, Cosmids, Phasmids, Lamda Bacteriophage, BAC, YAC, MAC and Expression vectors.

Restriction enzymes: Nomenclature, detailed study of Type II

Construction of genomic and cDNA libraries, Southern, Northern and Western Blotting, DNA sequencing (Sanger Method), Polymerase Chain Reaction.

UNIT-III

Reproductive Endocrinology: Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

UNIT-IV

Reproductive Health: Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning

S.No	Title	Author	Publisher
1.	Botany V - Cell and Molecular Biology	P.K. Gupta	Rastogi publications
2.	Knobil, E. et al. (eds).	The Physiology of Reproduction.	Raven Press Ltd
3.	Animal Physiology	Mohan P. Arora	Himalyan Publishing, House
4.	G Karp, EDP & De Robertis	Cell and Molecular Biology	EMF, WB Saunders, Co Philadelphia, 8 th Edn 1995.
5.	Albert	Essential Cell Biology	, New York , 3 rd Edn , 1997

ZOOLOGY V - A : CELL BIOLOGY, BIOTECHNOLOGY AND REPRODUCTIVE BIOLOGY PRACTICAL

Semester	V	
Course Code	ZOO363	
Course Title	Zoology V - A : Cell Biology, Biotechnology and Reproductive biology Practical	
Type of course	Practical	
LTP	0 0 4	
Credits	2	
Course prerequisite	B.Sc medical IInd year	
Course Objective (CO)	The aim of this course is to enable the students to 1. To impart practical knowledge about basic animal cell structure and cytological details of reproductive cells and organs. 2. Understand various aspects and the techniques of cell biology.	
Course Outcomes (CO)	By the end of this course, students will be able to 1. Understand the cyclic events of cell division and types of cell division. 2. Perform routine blood analysis. 3. Gain knowledge about histological and biological processes of reproduction and learn about the reproductive health.	

List of experiments:

- 1. Study of cell cycle through model.
- 2. Cells present in human blood (WBC, RBC count and hemoglobin estimation)
- 3. Study the phenomenon of osmosis using blood.
- 4. Blood clotting and bleeding time
- 5. Erythrocyte sedimentation rate
- 6. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.

S.No	Title	Author	Publisher
1.	Botany V - Cell and Molecular Biology	P.K. Gupta	Rastogi publications
2.	Knobil, E. et al. (eds).	The Physiology of Reproduction.	Raven Press Ltd



ZOOLOGY V - B : APPLIED ZOOLOGY

Semester	V	
Course Code	Z00365	
Course Title	Zoology V - B : Applied Zoology	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc Medical II year	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Aware about the various types of parasites and their relationship with their hosts.	
	2. Learn the basic principles involved in the culture and breeding of common edible and ornamental fishes.	
Course Outcomes (CO)	By the end of this course, students will be able to	
	1. Identify various methodology and perspectives of applied branches of zoology for the possibilities of self-employment.	
	2. Gain knowledge about various disease related vectors and their impact	
	on human.	
	3. Understand concepts of fisheries, poultry, dairy and pest management	
	techniques.	

UNIT-I

Introduction to Host-parasite Relationship: Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis; Epidemiology of Diseases: Transmission, Prevention and control of diseases: Tuberculosis, Typhoid

UNIT-II

Rickettsiae and Spirochaetes: Brief account of Rickettsia prowazekii, Borrelia recurrentis and Treponema pallidum; Parasitic Protozoa: Life history and pathogenicity of Entamoeba histolytica, Plasmodium vivax and Trypanosoma gambiense

UNIT-III

Parasitic Helminthes: Life history and pathogenicity of Ancylostoma duodenale and Wuchereriabancrofti; Insects of Economic Importance: Biology, Control and damage caused by Helicoverpaarmigera, Pyrillaperpusilla and Papiliodemoleus, Callosobruchuschinensis, Sitophilus oryzae and Triboliumcastaneum; Insects of Medical Importanc: Medical importance and control of Pediculus humanus corporis, Anopheles, Culex, Aedes, Xenopsyllacheopis

UNIT-IV

Animal Husbandry: Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle; Poultry Farming: Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs. Fish Technology: Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed

S.No	Title	Author(s)	Publisher
1	Preventive & Social Medicine, 16th	Park, K.	B.B Publishers
	Edition		
2	Medical Parasitology, 2 nd Edition	Arora, D. R and Arora, B	CBS Publications
3	Agricultural Pests of India and South	Atwal, A.S	Kalyani
	East Asia		Publishers
4	Agricultural Entomology	Dennis, H	Timber Press
5	Reproduction in Farm Animals	Hafez, E. S. E	Lea&Fabiger Publisher

ZOOLOGY V - B : APPLIED ZOOLOGY PRACTICAL

Semester	V		
Course Code	ZOO367		
Course Title	Zoology V - B : Applied Zoology Practical		
Type of course	Practical		
LTP	0 0 4		
Credits	2		
Course prerequisite	B.Sc Medical II year		
Course Objective (CO)	The aim of this course is to enable the students to 1. Get aware about various types of causative agents of diseases and their importance. 2. Learn the basic principles involved in the breeding of fishes, poultry and animals.		
Course Outcomes (CO)	By the end of this course, students will be able to 1. Analyse the relationship among animals and microbes. 2. Know the art of maintenance of aquarium. 3. Understands the principles of poultry and diary along with pest management techniques.		
LIST OF EXPERIMENTS	SBBSU		

LIST OF EXPERIMENTS

- 1. Study of Plasmodium vivax, Entamoeba histolytica, Trypanosoma gambiense, Ancylostoma duodenale and Wuchereria bancrofti and their life stages through permanent slides/photomicrographs or specimens.
- 2. Study of arthropod vectors associated with human diseases: Pediculus, Culex, Anopheles, Aedes and Xenopsylla.
- 3. Study of insect damage to different plant parts/stored grains through damaged products/photographs.
- 4. Identifying feature and economic importance of Helicoverpa (Heliothis) armigera, Papiliodemoleus, Pyrillaperpusilla, Callosobruchuschinensis, Sitophilus oryzae and Triboliumcastaneum
- 5. Visit to poultry farm or animal breeding centre. Submission of visit report
- 6. Maintenance of freshwater aquarium

S.No	Title	Author(s)	Publisher
1	Medical Parasitology, 2 nd Edition	Arora, D. R and Arora, B	CBS Publications
2	Agricultural Entomology	Dennis, H	Timber Press

ZOOLOGY V - C : AQUATIC BIOLOGY

Semester	V	
Course Code	ZOO369	
Course Title	Zoology V - C : Aquatic Biology	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc Medical II year	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. To get the knowledge of different types of habitats in ecosystem and their	
	importance for the living being.	
	2. To get the knowledge about water bodies, their pollution and control of the	
	pollution.	
Course Outcomes (CO)	By the end of this course, students will be able to	
	1. Examine monitoring techniques and ecological responses of freshwater	
	organisms in association with water quality deterioration.	
	2. Understand freshwater ecosystem as well as the biology and ecology of	
	organisms found in freshwater.	
	3. Develop skills and techniques required to control water pollution	

UNIT-I

Aquatic Biomes: Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.

UNIT-II

Freshwater Biology: Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico-chemical Characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide).

UNIT-III

Nutrient Cycles in Lakes-Nitrogen, Sulphur and Phosphorous. Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes. Marine Biology: Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

UNIT-IV

Management of Aquatic Resources: Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment; Water quality assessment-BOD and COD.

S.No	Title	Author(s)	Publisher
1	Bioresources Ecology 3rd Edition	Anathakrishnan	
2	Limnology, 2nd Edition	Goldman	
3	Fundamentals of Ecology, 5th Edition	Odum and Barrett	
4	Chemical and biological methods for water pollution studies	Trivedi and Goyal	

ZOOLOGY V - C : AQUATIC BIOLOGY PRACTICAL

Semester	V
Course Code	Z00371
Course Title	Zoology V - C : Aquatic Biology Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc Medical II year
Course Objective (CO)	The aim of this course is to enable the students to
	1. To give the training to the students regarding different techniques used
	in determination of various parameters of water and soil, so that we can
	check their quality.
	2. To know about water pollution and its control.
Course Outcomes (CO)	By the end of this course, students will be able to
	1. Gain information about phytoplanktons, zooplanktons and other
	microscopic organisms.
	2. Analyse and evaluate abiotic and biotic conditions in aquatic systems
	account for structure and dynamics in biogeochemical cycles.
	3. Carry out basic sampling and analyses in freshwater field/laboratory
	systems.

LIST OF EXPERIMENTS

- 1. Determine the area of a lake using graphimetric and gravimetric method.
- 2. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
- 3. Determine the amount of Turbidity/transparency, Dissolved Oxygen, Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake/ water body.
- 4. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.
- 5. A Project Report on a visit to a Sewage treatment plant/Marine bioreserve/ Fisheries Institutes.

S.No	Title	Author(s)	Publisher
1	Bioresources Ecology 3rd Edition	Anathakrishnan	
2	Limnology, 2nd Edition	Goldman	





ZOOLOGY VI - A: IMMUNOLOGY AND BIOSTATICS

Semester	VI	
Course Code	ZOO362	
Course Title	Zoology VI - A: Immunology and Biostatics	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc Medical II year	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Get aware about the immunology and immunological reaction taking	
	place in your body.	
	2. Use the best data analysis methods in research projects.	
Copurse Outcomes (CO)	By the end of this course, students will be able to	
	By the end of this course, students will be able to	
	1.Imparts in depth knowledge of tissues, cells and molecules involved in	
	host defense mechanisms	
(0)	2. Interactions of antigens, antibodies, complements and other immune	
	components.	
	3. Gain knowledge about biostatistical methods like measures of central	
	tendencies, probability and learn the problem-solving methods.	

UNIT I

Overview of the Immune System: Introduction to basic concepts in immunology, components of immune system, principles of innate and adaptive immune system, Cells and Organs of the Immune System Haematopoiesis, Cells of immune system and organs (primary and secondary lymphoid organs) of the immune system

UNIT-II

Antigens: Basic properties of antigens, B and T cell epitopes, haptens and adjuvants. Antibodies: Structure, classes and function of antibodies, monoclonal antibodies, antigen antibody interactions as tools for research and diagnosis

UNIT-III

Working of the immune system: Structure and functions of MHC, exogenous and endogenous pathways of antigen presentation and processing, basic properties and functions of cytokines, Classical pathway of Complement system.

UNIT-IV

Immune system in health and Vaccines: General introduction to vaccines, various types of vaccines, various types of hypersensitivities, Introduction to concepts of autoimmunity and immunodeficiency,

S.No	Title	Author	Publisher
1.	Immunology, VI Edition	Kindt, T. J., Goldsby, R.A.,	W.H. Freeman and Company
		Osborne, B. A. and Kuby, J (2666)	
2.	Immunology, VII Edition	David, M., Jonathan, B., David, R.	Mosby, Elsevier Publication
		B. and Ivan R. (2666)	
3.	Text book ofImmunology	Dr. P. MadhaveeLatha	S. Chand publications
4.	Cellular and Molecular	Abbas, K. Abul and Lechtman H.	Saunders Publication.
	Immunology. V Edition	Andrew (2663.)	
5.	Biostatistics	P. Ramakrishnan	Saras Publications

ZOOLOGY VI - A: IMMUNOLOGY AND BIOSTATICS PRACTICAL

Semester	VI
Course Code	Z00364
Course Title	Zoology VI - A: Immunology and Biostatics Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc Medical II year
Course Objective (CO)	The aim of this course is to enable the students to
	1. Study the histology of immune system and physiology of immunological
	reactions.
	2. Use the best data analysis methods in research projects.
Course Outcomes (CO)	By the end of this course, students will be able to
	1. Know about immune system and allows the student to create insight as how
	to improve their immune system and good health.
	2. Use of Math in science for study of different data.
	3. Perform routine blood analysis.

LIST OF EXPERIMENTS

- 1. Demonstration of lymphoid organs
- 2. Histological study of spleen, thymus and lymph nodes through slides/ photographs
- 3. Preparation of stained blood film to study various types of blood cells.
- 4. ABO blood group determination.
- 5. Demonstration of Immunoelectrophoresis
- 6. Demonstration of ELISA
- 7. Chromatography (Paper and TLC).

S. no.	Title	Author	Publisher
1	Imm <mark>un</mark> ology	Kindt, T. J., Goldsby, R.A., Osborne,	W.H. Freeman and Company
		B. A. and Kuby, J	
2	Immunology	David, M., Jonathan, B., David, R. B.	Elsevier Publication
		and Ivan R	
3	Cellular and Molecular	Abbas, K. Abul and Lechtman H.	Saunders Publication
	Immunology	Andrew	



ZOOLOGY VI - B: REPRODUCTIVE BIOLOGY

Semester	VI
Course Code	ZOO366
Course Title	Zoology VI - B : Reproductive Biology
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc Medical II year
Course Objective (CO)	The aim of this course is to enable the students to
	1. Aware about the organs of reproduction and their hormonal secretions and the
	role played by each hormone for the development of reproductive organs in humans.
	2. Get aware about the reproductive health and the modern techniques used in
	reproductive processes.
Course Outcomes (CO)	By the end of this course, students will be able to
	1. Learn the biological processes of reproduction, including the endocrinology and
	physiology of male and female reproduction, puberty and lactation.
	2. Gain an understanding of the determinants of fertility and infertility.
	3. Know about social and ethical implications of reproductive technologies.

UNIT-I

Reproductive Endocrinology: Gonadal hormones and mechanism of hormone action, steroids, glycoprotein hormones, and prostaglandins, hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female; Reproductive System: Development and differentiation of gonads, genital ducts, external genitalia, mechanism of sex differentiation.

UNIT-II

Functional anatomy of male reproduction: Outline and histological of male reproductive system in rat and human; Testis: Cellular functions, germ cell, system cell renewal; Spermatogenesis: kinetics and hormonal regulation; Androgen synthesis and metabolism; Epididymal function and sperm maturation; Accessory glands functions; Sperm transportation in male tract

UNIT-III

Functional anatomy of female reproduction: Outline and histological of female reproductive system in rat and human; Ovary:folliculogenesis, ovulation, corpus luteum formation and regression; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (rat and human) and their regulation, changes in the female tract; Ovum transport in the fallopian tubes; Sperm transport in the female tract, fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto – maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation

UNIT-IV

Reproductive Health Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT,IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning.

S. no.	Title	Author	Publisher
1	Reproduction in Mammals	Austin, C.R. and Short, R.V	Cambridge University Press
2	Endocrinology	Degroot, L.J. and Jameson, J.L.	W.B. Saunders and Company
3	The Physiology of Reproduction	Knobil, E	Raven Press Ltd

ZOOLOGY VI - B: REPRODUCTIVE BIOLOGY PRACTICAL

Semester	VI
Course Code	ZOO368
Course Title	Zoology VI - B : Reproductive Biology Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc Medical II year
Course Objective (CO) The aim of this course is to enable the students to	
	1. Aware about the different techniques used in studying various types of cells
	involved in formation of reproductive organs.
	2. Familarize with various contraceptive technologies and surgical techniques.
Course Outcomes (CO)	BBy the end of this course, students will be able to
	1. Gain knowledge about histological and biological processes of reproduction
	and learn about the reproductive health.
2	2. Examine vaginal smear and determination of cell count.
	3. Understand various contraceptive methods

LIST OF EXPERIMENTS

- 1. Study of animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.
- 2. Examination of vaginal smear rats from live animals.
- 3. Surgical techniques: principles of surgery in endocrinology. Ovarectomy, hysterectorny, castration and vasectomy in rats.
- 4. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.
- 5. Human vaginal exfoliate cytology.
- 6. Sperm count and sperm motility in rat.
- 7. Study of modern contraceptive devices.

S. no.	Title	Author	Publisher
1	Reproduction in Mammals	Austin, C.R. and Short, R.V	Cambridge University
	To the state of th		Press
2	Endocrinology	Degroot, L.J. and Jameson,	W.B. Saunders and
	LEA, DIST	J.L. I. ANDHAR	Company
3	The Physiology of Reproduction	Knobil, E	Raven Press Ltd

ZOOLOGY VI - C: INSECT, VECTOR AND DISEASES

Semester	VI
Course Code	ZOO370
Course Title	Zoology VI - C : Insect, Vector and Diseases
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc Medical II year
Course Objective (CO)	The aim of this course is to enable the students to
	1. Aware students about the role of insects in spreading the various
	diseases.
	2. Gain knowledge about the concepts or overview of Entomology.
Course Outcomes (CO)	By the end of this course, students will be able to
	1. Understand insect vector host interactions of many diseases like
	Malaria, Filaria, Dengue, etc.
	2. Undertand the general organisation of insect body.
	3. Gain knowledge about physiology and reproduction of insect vectors
	and their control measures.

UNIT-I

Introduction to Insects: General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits

Concept of Vectors: Brief introduction of Carrier and Vectors (mechanical and biological vector), Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity

Unit II

Insects as Vectors: Classification of insects up to orders, detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera

Dipteran as Disease Vectors: Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies; Study of mosquito-borne diseases - Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis; Control of mosquitoes Study of sand fly-borne diseases – Visceral Leishmaniasis, Cutaneous Leishmaniasis, Phlebotomus fever; Control of Sand fly. Study of house fly as important mechanical vector, Myiasis, Control of house fly

UNIT-III

Siphonaptera as Disease Vectors: Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases-Plague, Typhus fever; Control of fleas

Siphunculata as Disease Vectors: Human louse (Head, Body and Pubic louse) as important insect vectors; Study of louse-borne diseases – Typhus fever, Relapsing fever, Trench fever, Vagabond's disease, Phthiriasis; Control of human louse

Hempitera as Disease Vectors: Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures. DISTT. JALANDHAR (PUNJA

S. no.	Title	Author	Publisher
1	A General Text Book of Entomology	Imms, A.D	Chapman & Hall
2	The Insects: Structure and Function	Chapman, R.F	Cambridge University Press
3	Entomology and Pest Management	PedigoL.P	Prentice Hall Publication
4	Integrated Vector Management	Mathews, G.	Wiley-Blackwell

ZOOLOGY VI - C: INSECT VECTORS AND DISEASES PRACTICAL

Semester	VI	
Course Code	ZOO372	
Course Title	Zoology VI - C : Insect, Vector and Diseases Practical	
Type of course	Practical	
LTP	0 0 4	
Credits	2	
Course prerequisite	B.Sc Medical II year	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Give hands on training about the different types of insects and their	
	body parts which are involved in spreading disease.	
	2. Create skills for scientific study of insects.	
Course Outcomes (CO)	By the end of this course, students will be able to	
	1. Undertand the different kinds of mouth parts of insects.	
	2. Gain knowledge about physiology, biochemistry and reproduction of	
	insect vectors and their control measures.	
	3. Understand the diseases spread by insects.	

LIST OF EXPERIMENTS

- 1. Study of different kinds of mouth parts of insects.
- 2. Study of following insect vectors through permanent slides/ photographs:

 Aedes, Culex, Anopheles, Pediculus humanus capitis, Pediculus humanus corporis, Phithirus pubis, Xenopsyllacheopis, Cimexlectularius, Phlebotomusargentipes, Musca domestica, through permanent slides/Photographs.
- 3.Study of different diseases transmitted by above insect vectors
- 4. Submission of a project report on any one of the insect vectors and disease transmitted.

S. no.	Title	Author	Publisher
1	A General Text Book of	Imms, A.D	Chapman <mark>& H</mark> all
	Entomology		
2	The Insects: Structure and	Chapman, R.F	Camb <mark>ridg</mark> e
	Function	MA CONTROLL	University Press
3	Entomology and Pest	PedigoL.P	Prentice Hall Publication
	Management		
4	Integrated Vector Management	Mathews, G.	Wiley-Blackwell





ZOOLOGY VII - A: BIOSYSTEMATICS, TAXONOMY & EVOLUTION

Semester	VII	
Course Code	ZOO461	
Course Title	Zoology VII - A: Biosystematics, Taxonomy & Evolution	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc Medical III year	
Course Objective (CO)	·	
	1. To provide knowledge of biosystematics, evolution and International code of Zoological nomenclature (ICZN).	
	2. Understand the patterns and processes of evolution above the species level.	
Course Outcomes (CO)	By the end of this course, students will be able to	
	1. Learn the basic concepts of biosystematics and taxonomy.	
	2. Study the taxonomic collections, preservation, curetting, process of	
	identification in biology.	
	3. Understand the molecular basis of evolution.	

UNIT-I

Definition and basic concepts of biosystematics and taxonomy; Trends in biosystematics: Chemotaxonomy, cytotaxonomy and molecular taxonomy; Species concept: Different species concepts; Theories of biological classification; Taxonomic categories & Hierarchy of categories

IINIT-II

Taxonomic characters: Different kinds, origin of reproductive isolation, biological mechanism of genetic incompatibility; Taxonomic procedures: Taxonomic collections, preservation, curetting, process of identification; **Taxonomic keys:** Different kinds of keys, their merits and demerits; International code of Zoological nomenclature (ICZN); Concepts of evolution and theories of organic evolution

UNIT-III

Neo-Darwinism and population genetics: Hardy-Weinberg Law of genetic equilibrium; Destabilizing forces, natural selection, mutation, genetic drift, migration & meiotic drive; Ecological significance of molecular variations (genetic polymorphism); Patterns and mechanisms of reproductive isolation; Modes of speciation (allopatry& sympatry); Zoo-geological time scale

.UNIT-IV

Trends in evolution; **Molecular evolution:** Gene evolution & Evolution of gene families; **Molecular** phylogenetics: Construction of phylogenetic trees, Amino acid sequences and phylogeny; DNA-DNA hybridization, restriction enzyme sites

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

ZOOLOGY VII - B: POPULATIONS ECOLOGY & ENVIRONMENTAL PHYSIOLOGY

Semester	VII
Course Code	ZOO463
Course Title	Zoology VII - B : Populations Ecology & Environmental Physiology
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc Medical III year
Course Objective (CO)	The aim of this course is to enable the students to
	1. Aware about the role and need of conservation of our biodiversity.
	2. Correlate physiological adaptations to environment; pollution and its control
	measures.
Course Outcomes (CO)	By the end of this course, students will be able to
	1. Understand the basic principles of ecology and ecosystem.
	2. Describe the characteristics of the major biomes and biogeographical regions
	of the Earth.
	3. Evaluate environmental issues and management practices.

UNIT-I

Biodiversity Conservation and Status; Biodiversity laws, significance and management approaches; **Population ecology:** Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); **Concept of metapopulation**: demes and dispersal, interdemic extinctions, age structured populations.

UNIT-II

Adaptation: Levels of adaptation, mechanisms and significance of body size; Biogeography: Major terrestrial biomes; biogeographical zones of India; Aquatic environments: Freshwater, marine and estuarine environments; Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

UNIT-III

Eco-physiological adaptations to terrestrial, fresh water and marine water environments; Ecological succession: Types; mechanisms; changes involved in succession; concept of climax; Environmental limiting factors; Concept of homeostasis.

UNIT-IV

Inter and intra specific relationship competition; Predatory-prey relationship, predator dynamics, optimal foraging theory; Mutualism, evolution of plant-pollinator interaction; Environmental pollution; global Environmental change; Environmental impact assessment; Sustainable development.

S.No.	Name/Ti <mark>t</mark> le	Author	Publisher	
1	Ecological Concepts	Cherrett, J.M.	Blackwell Science Publication	
2	Ecology	Krebs, C.J	Harper & Row, New York	
3	Fundamentals of Ecology	Eugene P. Odum	Cengage publications	
4	Animal Physiology:	Eckert, R	W.H. Freeman and Co., New York.	
	Mechanisms and Adaptation			
5	Physiological Animal Ecology	Louw, G.N.	Longman Harloss, UK	
6.	Ecology and Environment	P.D. Sharma	Rastogi Publications	

ZOOLOGY VII - C: TOOLS AND TECHNIQUES FOR BIOLOGY

Semester	VII
Course Code	ZOO465
Course Title	Zoology VII - C : Tools and Techniques for Biology
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite B.Sc Medical III year	
Course Objective (CO)	The aim of this course is to enable the students to 1. Get knowledge about the different instruments used in biological sciences and prepare them for research work. 2. Demonstrate microbiological, cytobiological, histobiological and molecular biological techniques
By the end of this course, students will be able to 1. Learn the principle, and application of microscopic techniques. 2. Learn the principle, and application of photometry. 3. Understand the working principle of separation techniques in biology chromatography, electrophoresis, etc. 4. Familiarize with molecular biology techniques.	

UNIT-I

Microscopy, principle & applications of: Light microscope, phase contrast microscope and Fluorescence microscope; General principle and applications of Electron microscope (TEM & SEM); Principle and applications of confocal microscopy; Cryotechniques: Cryopreservation of cells, tissues, organs and organisms, Freeze fracture & freeze drying.

UNIT-II

Principles and applications of photometry: Beer & Lambert's law, Absorption spectrum & absorption maxima; Colorimeter & spectrophotometer; Flame photometer; Atomic absorption spectrophotometer

UNIT-III

Separation techniques: Chromatography, principle, types and applications; Electrophoresis, principle, types & applications; PAGE and agarose gel electrophoresis; Radioisotopes in biology: Units of radioactivity, Radioactive counters, Autoradiography

UNIT-IV

Histological techniques: Principles of tissue fixation, Microtomy, cryotomy; Immunological techniques: Immunodiffusion and Imunoelectrophoresis; Molecular cytological techniques: In situ hybridization (radiolabelled mon-radiolabelled methods), FISH, and Restriction banding; Molecular biology techniques: Southern hybridization and Northern hybridization; DNA sequencing; Polymerase chain reaction (PCR).

S.No.	Name/Title	Author	P ublisher
1	Handbook of Microscopy	Locquin and	Butterwaths
		Langeron	
2	Modern Experimental Biochemistry	Boyer	Benjamin
3	Practical Biochemistry	Wilson and Walker	Cambridge
4	Introduction to Instrumental analysis	Robert Braun	McGraw Hill Int.
5	Experimental Biochemistry	Clark & Switzer	Freeman Publ.

ZOOLOGY VII - D : STRUCTURE AND FUNCTION OF INVERTEBRATES

Semester	VII	
Course Code	ZOO467	
Course Title	Zoology VII - D : Structure and Function of Invertebrates	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc Medical III year	
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

		DOUNG WILLIAMS	
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	Barrington	Thomas Nelson and Sons Ltd.,
	Function	E.J.W	London

ZOOLOGY VII - E: STRUCTURE AND FUNCTION OF CHORDATES

Semester	VII	
Course Code	ZOO469	
Course Title	Zoology VII - E : Structure and function of Chordates	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	ite B.Sc Medical III year	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Get the comparative knowledge about different groups of chordates regarding	
	their physiology and anatomy.	
	2. Understand the origin and evolutionary relationship in different sub-phylum of	
	chordates.	
Course Outcomes (CO) By the end of this course, students will be able to		
. ,	1. Understand the classification of various classes of phylum Chordata	
	i.e.Pisces, Reptiles, Aves and Mammals.	
	2. Study the various physiological processes of chordates.	
	3. Understand the adaptations in chordates.	

UNIT - I

Protochordates and Cyclostomates: Characteristic feature and affinities; Origin of the following: Fishes, Amphibians, Reptiles, Birds and Mammals

SBBSIT

UNIT-II

Comparative anatomy of Integumentary System and Skeletal System: Comparative anatomy Digestive System

UNIT-III

Respiratory System: Characters of respiratory tissue; Internal and external respiratory organs; Circulatory system: Evolution of heart; Evolution of aortic arches; Comparative account of jaw suspensorium and vertebralcolumn

IINIT-IV

Comparative account of limbs and girdles; Urogenital system: Evolution; Sense organs: Comparative account of Organs of olfaction and taste; Nervous system: Comparative account of brain and spinal cord; Comparative account of nervous system

S.No.	Name/Title	Author	Publish <mark>er</mark>
1	Text book of Zoology	Parker and Hashwell	Macmillan
2	Analysis of Vertebrate structure	Hildebrand	John Willey
3	Chordate Zoology	Verma J. & Agrawal	S. Chand Publications
4	Modern Text Book of Vertebrates	R.L. Kotpal	Rastogi Publications
5	Text Book of Zoology (Chordates)	Dhami and Dhami	Pradeep Publications

ZOOLOGY VII - A : ECOLOGY, ENVIRONMENTAL PHYSIOLOGY, SYSTEMATICS, TAXONOMY AND EVOLUTION PRACTICAL

Semester	VII	
Course Code	ZOO471	
Course Title	Zoology VII - A : Ecology, Environmental Physiology, Systematics, Taxonomy and Evolution Practical	
Type of course	Practical	
LTP	0 0 4	
Credits	2	
Course prerequisite	B.Sc Medical III year	
Course Objective (CO)	The aim of this course is to enable the students to 1. Gain knowledge about components of environment, and evolutionary processes. 2. Learn about collection and preservation of animals.	
Course Outcomes (CO)	By the end of this course, students will be able to 1. Understand the Animal association and communities. 2. Acquire knowledge of various eco-physiological adaptations in animals. 3. Learn the process of evolution and population genetics.	

List of Experiments

- 1. To study external morphological features of various animal groups (beaks & claws, scales of fishes).
- 2. Composition and classification of soil, gravel, coarse and fine sands, clay, sand, loam, chalky and peaty
- 3. To study the concept of Ecological niche
- 4. To study the types of animal association and communities
- 5. Techniques of collection and preservation, mounting & display, indexing
- 6. Structural adaptations of ecological significance
- 7. Study of evolutionary trends through Photographs/models, Homology, Analogy, Parallel trends, Living fossils, polyphyletic origin, Anagenesis, Regressivetrends.
- 8. Problem related to evolution, population genetics etc. (natural selection, adaptation, trends of evolution, genetic polymorphismetc.)
- 9. Preparation of phylogenetic tree using molecular data
- 10. Toxicity tests: LC₅₆/LD₅₆

S.No.	Name/Ti <mark>t</mark> le	Author	Publisher
1	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications
2	A Manual of Practical Zoology	P.S. Verma	S. Chand Publications
	Invertebrates		
3	Lab Manual of Blood Analysis	Prakash G	S. Chand Publications
	and Medical Diagnostics		
4	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications

ZOOLOGY VII - B: STRUCTURE AND FUNCTIONS OF ANIMALS PRACTICAL

Semester	VII
Course Code	ZOO473
Course Title	Zoology VII - B : Structure and Functions of Animals Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc Medical III year
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)	 Learn the classification and external morphology of Protozoa, Cnidaria, Arthropoda, Mollusca Observe the physiological systems of insects. Distinguish poisonous & non-poisonous snakes and their biting apparatus.

List of Experiments

1. 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.

- **2.** Dissections: Alimentary canal of cockroach/grasshopper; Arthopoda: Salivary gland of cockroach, Nervous system of Prawn; Mollusca: Nervous system of *Mytilus* and *Aplysia/Sepia*.
- 3. Study of museumspecimens:Porifera, Cnidaria, Annelida, Arthopoda, Mollusca, Echinodermata, Amphibians, Reptiles and Pisces
- a. Study of external morphology of honey bee and dissection of sting apparatus
- **b.** Dissection and display of accessory respiratory organs of *Clariasbatrrachus/Channa*sp.
- c. Study of important characters of poisonous & non-poisonous snakes and their biting apparatus.
- 4. Study of permanent slides of:Protochordates: Whole mount of Doliolum, Pyrosoma, Salpa and Oikopleura;

Fishes: T.S. of gill, accessory respiratory organs, swim bladder.

5. Study of Adaptive features of following: Amphibians, Reptiles, Birds, mammals

Text and Reference Books: LA, DISTT, JALANDHAR (PUNIAB)

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



ZOOLOGY VIII - A: BASIC ENDOCRINOLOGY

Semester	VIII
Course Code	ZOO462
Course Title	Zoology VIII - A : Basic Endocrinology
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc Medical III year
Course Objective (CO)	The aim of this course is to enable the students to
	1. Understand endocrinology as an important branch of Animal Physiology.
	2. Examine and describe various endocrine glands and their hormonal impact.
Course Outcomes (CO)	By the end of this course, students will be able to
	1. Study the classification, modes and phylogeny of endocrine system
	2. Study the endocrine control of various physiological mechanisms in nemerteans,
	annelids, mollusks, arthropods (Insects and crustaceans) and echinodermates.
	3. Study the comparative morphology, anatomy, functions of various endocrine
	glands present in a human body. Also study the deficiency diseases caused, and
	chemical structure of hormones secreted from the glands

UNIT-I

Concept of endocrinology: introduction to the endocrine system, classes of hormones, modes of hormone secretion. Phylogeny of endocrine system. Endocrine control of various physiological mechanisms in nemerteans, annelids, mollusks, arthropods (Insects and crustaceans) and echinodermates. Comparative aspects of endocrine physiology in vertebrates.

UNIT-II

Evolution of pituitary gland; Physiological actions of pituitary hormones. Urophysis and action of its hormone(s). Evolution of discrete adrenal gland; Synthesis of corticosteroid, structural diversity of glucocorticoids among vertebrates, role of glucocorticoid in gluconeogenesis; Evolution of renin-angiotensin system, hormonal control of water and electrolyte balance; Catecholamine biosynthesis, its storage and release mechanism, physiological actions of adrenal medullary hormones; Importance of adrenocortical and adrenomedullary interaction.

UNIT-III

A comparative account of parathyroid gland and ultimobranchial body/C cells, synthesis of parathyroid hormone, calcitonin and of vitamin D3; benthic organisms and source of vitamin D; hormonal regulation of calcium and phosphate homeostasis.

UNIT-IV

Steroid hormones of Gonads and Adrenal cortex: Gonads: Comparative Morphology, anatomy, functions, deficiency diseases and chemical structure of hormones released, Biosynthesis and Role of Male and Female sex hormones, Adrenal Gland: Comparative Morphology, anatomy, functions, deficiency diseases and chemical structure of hormones released.

S.No.	Name/Title	Author	Publisher
1	Gardner: Basic and clinical	Francis. S. Greenspan	MC graw Hill Co
	endocrinology	&David G	
2	Review of medical physiology	William F. Ganong, M. C	Graw Hill companies
3	Text book of Medical Physiology	Guyton &Hall	Saunders Pb.
4	Comparative vertebrate Endocrinology	Bantley, P.J. (1970)	Cambridge Univ. Press, U.K
5	Text book of Endocrinology	Williams	W.B. Saunders Company

ZOOLOGY VIII - B: ICHTHYOLOGY

Semester	VIII
Course Code	ZOO464
Course Title	Zoology VIII - B : Ichthyology
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc Medical III year
Course Objective (CO)	The aim of this course is to enable the students to
	1. Provide knowledge on the basic physiological, ecological and behavioural
	adaptations of fishes.
	2. Familiar with fish reproduction and development.
Course Outcomes (CO)	By the end of this course, students will be able to
	1. Study the morphology and classification in fishes.
	2. Study of sense organs and some special features in fishes.
	3. Understand adaptation of fishes to various ecological conditions.

UNIT-I

Morphology and classification: Distinctive characteristics of fishes, Body form and its diversity, Fins: Theories of origin of fins, Structure skeletal support, modification and functions of paired fins, Structure skeletal support, modification and functions of un-paired fins, Outline classification of fishes with special reference to distinctive features, geographical distributions, classification and typical examples of the following subdivisions, Chondrichthyes, Actinopterygi, Crossopterygi and Dipnoi.

UNIT-II

Sense organs and some special features: Scales: types, structure and functions of scales, Coloration: chromatophores, pigments and biological significance of coloration in fishes, Biolumniscence in fishes and its significance, Electric organs: their structure and use in fishes, Venomous and poisonous fishes, Sense organs: Eye, Lateral line, Internal ear.

UNIT-III

Feeding and Respiration: Alimentary canal and its diversity in fishes, Food, feeding habits and feeding adaptations, Respiratory organs: Structure, modifications and functions of gills, Structure and development of air breathing organs in fishes, Structure and function of swim bladder.

UNIT-IV

Reproduction and Development: Reproductive organs and Accessory sex organs, Secondary sexual characters, Oviparity, vivparity (Aplacental and Placental), Nest building and parental Care, Types of eggs, Metamorphosis.

Text and Reference Books: ALA, DISTT JALANDHAR (PUNIAB)

S.No.	Name/Title	Author	Publisher
1	Introduction to the fish physiology	Lynwood, S.	Narendra Publ. House, Delhi
		Smith	
2	Advancers in Aquatic Ecology	Vasanth Kumar.	Daya Publ. House, New Delhi
3	Fish Management and Aquatic	Arvind Kumar and	Daya Publ. House, New Delhi
	Environment	Pushaplata Dubey	
4	Icthyology, 2 nd Ed.	Lagler, Bardock,	John Wiley and Sons, Inc.
		Miller & Possino,	
5	Fish Biology	S.S. Khanna	Rastogi Publications

ZOOLOGY VIII - C : GENERAL AND APPLIED ENTOMOLOGY

Semester	VIII
Course Code	ZOO466
Course Title	Zoology VIII - C : General and Applied Entomology
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc Medical III year
Course Objective (CO)	he aim of this course is to enable the students to
Course Objective (CO)	1. Understand the scope of entomology; get aware about structure of insects and
Course Objective (CO)	
Course Objective (CO)	1. Understand the scope of entomology; get aware about structure of insects and
Course Objective (CO) Course Outcomes (CO)	1. Understand the scope of entomology; get aware about structure of insects and their significance.
•	 Understand the scope of entomology; get aware about structure of insects and their significance. Know about beneficial and harmful insects (and their control).
•	 Understand the scope of entomology; get aware about structure of insects and their significance. Know about beneficial and harmful insects (and their control). By the end of this course, students will be able to
•	 Understand the scope of entomology; get aware about structure of insects and their significance. Know about beneficial and harmful insects (and their control). By the end of this course, students will be able to Know the techniques of insect collection, preservation and identification.

UNIT I

Entomology: Introduction, history and scope; Insect collection: Significance and insect nets and traps; General organization of a typical insect body; Insecta: Salient features, scheme of classification; Classification of Apterygota with distinctive feature, example of various orders and their sub divisions; Classification of Exopterygota upto orders with distinctive features and examples; Classification of Endopterygota upto orders with distinctive features and examples;

UNIT II

Insects as sustainable resource: Apiculture: Classification of honey bees, life history of honey bee, social organization in honeybees; products of apiculture industry and its uses; Lac Culture: life cycle of lac insects, propagation, cultivation, uses;

UNIT III

Sericulture: Types of sericulture; life cycle of silkworm (Bombyx mori), silkworm rearing technology; Role of insect as vectors of human diseases and their control; Live-stock pests and their control; Insects and their role in forensic investigations; Role of insects in plant pollination

UNIT IV

Detailed information and classification of insecticides and their mode of action Biological pest control; Integrated pest management; Account of the following: (a) Catalysts and synergists of insecticides (b) Systemic insecticides (c) Antifeedants (d) Attractants and repellents (e) Aerosols (f) Biopesticides (g) Microbiol insecticides (h) Male sterility techniques (i) IGRs, third & fourth generation pesticides (j) Chitin synthesis inhibitors

S.No.	Name/Title	Author	Publisher
1	Imm's Text book of Entomology	Richards and Davies	Methuen and Co., London
2	Principles of Insect Morphology	Snodgrass, R.E	Tata MaGraw Hill's Bombay
3	Introduction to Comparative Entomology	Fox and Fox	Reinhold Publishing Corporation
4	The Insects – Structure and Function	Chapman, R.F.	ELBS, London
5	General and Applied Entomology	Nayar et al.	Tata MacGraw Hill
6.	A Text book of Entomology	Ross, H.H	John Wiley & Sons

ZOOLOGY VIII - D : WILDLIFE AND ITS CONSERVATION

Semester	VIII
Course Code	ZOO468
Course Title	Zoology VIII - D : Wildlife and its conservation
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc Medical III year
Course Objective (CO)	The aim of this course is to enable the students to
	1. Understand the various aspects of wild life and its conservation for sustainable
	development.
	2. Familiar with wildlife diseases and various control measures.
Course Outcomes (CO)	By the end of this course, students will be able to
	1. Know about the basics and scope in wildlife.
	2. Understand the strategies to conserve wildlife.
	3. Know the government initiative in animal protection.
	4. Know the role of common public in wildlife protection.

Unit 1

Scope of Wildlife Biology: Physiological Basis of; Hibernation, aestivation, Awakening, Migration Circadian rhythms Hypothalamo- Hypophysial Axis and its role Pineal gland and its role Day- length influences on Phenology Seed dormancy and methods of breaking it

Unit 2

Adaptations to Habitats: Animal adaptations to water, temperature, salinity, predation Deep sea & diving adaptations in animals Role of blubber in marine mammals "Superspecialised" animal species (e.g. Ant eater). Animal adaptations to water, temperature, salinity, predation. Association between animals for adaptation, Orientation & navigation in animals

Unit 3

Wild Life diseases: Major diseases and their control Domestic animals & wildlife diseases Governmental role in control of Wildlife diseases Sick animal refuges in protected areas

Unit 4

Wildlife and Human welfare: Biomimetics Ethnobiology& Ecosystem people The Economics of Ecosystem and Biodiversity (TEEB)

Suggested Readings:

- 1. Caughley, G., and A.R.E. Sinclair, editors. 1994. Wildlife Ecology and Management, Blackwell Science.
- 2. Sutherland, W.J. 2000. The Conservation Handbook: Research, Management and Policy. Blackwell Sciences.
- 3. Bookhout, T.A. 1996. Research and Management Techniques for Wildlife and Habitats, 5 th edition. The Wildlife Society, Allen Press.
- 4. Woodroffe R., S. Thirgood and A. Rabinowitz. 2005. People and Wildlife, Conflict or Co-existence? Cambridge University.
- 5. Caughley, G. 1977. Analysis of vertebrate populations. John Wiley and Sons.
- 6. Rangarajan M. 2001. India's Wildlife History. Permanent Black.

ZOOLOGY VIII - E : CELLULAR NEUROBIOLOGY AND NEURON ORGANIZATION

Semester	VIII
Course Code	ZOO470
Course Title	Zoology VIII - E: Cellular neurobiology and neuron organization
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc Medical III year
Course Objective (CO)	y the end of this course, students will be able to
	1. Explain fundamental elements of functional neuroanatomy and neurobiology
	2. Gain advanced knowledge of cell and molecular biology of neurons, glia and other
	neural type cells
Course Outcomes (CO)	AAt the end of this course, students will be able to
	1. Familarize with techniques and research strategies employed in cellular
	neurobiology.
	2. Know about the CNS, ANS and PNS.
	3. Know about the functional operation of auditory, visual and olfactory systems.

Unit 1:

An overview of the nervous system; Neurons: Introduction to neurons, The Neuron Doctrine, The Nissl and Golgi stains, Components of neurons, Classification and types of neurons, Cytology of neurons, Dendrites structure and function, Axons structure and functional aspects, ultrastructure, myelination and synapses.

Unit 2:

Glial cells: Structure and function of glial cells, Different types of glial cells: astrocytes, oligodendrocytes and Schwann cells, Types of astrocytes – type I & II astrocytes, fibrous and protoplasmic astrocytes, Importance of astrocytes in glutamate metabolism and blood brain barrier, Function of other glial cells: oligodendrocyte and microglial cells, Microglial phenotypes, Overview of glial and neuronal relationship in the CNS, Glial -neuronal interplay in the CNS.

Unit 3:

Gross anatomy of the adult brain; organization of the nervous system; Subdivisions of the nervous system; Concept of CNS, ANS & PNS; The scalp, skull and meninges; Cerebrospinal fluid. Cerebellum: Gross anatomy, cerebellar cortex, central nuclei, cerebellar peduncles; Functional anatomy of cerebellum; Cerebral cortex: Histology, general organization, functional localization; Descending motor pathways; Thalamus: Scheme of thalamic organization, nuclei of the thalamus; Basal ganglia: Corpus striatum, subthalamic nucleus, substantia nigra; Ascending sensory pathways.

Unit 4:

Neuronal elements, basic circuit, synaptic action, dendritic properties and functional operation of: Auditory system; Visual system; Olfactory and Limbic system; Autonomic system.

Books Recommended

- 1. Siegel, Basic Neurochemistry (7th Edition) Academic Press, 2006
- 2. Albertes, Molecular Biology of the Cell (5th Edition) Garland Science, 2008
- 3. Kendel, Principles of Neural Science (4th edition), McGraw Hill, 2000
- 4. Verkhratsky, Glial Neurobiology, A Text Book, Wiley, 2007

ZOOLOGY VIII - A: ENDOCRINOLOGY AND ICHTHYOLOGY PRACTICAL

Semester	VIII
Course Code	ZOO472
Course Title	Zoology VIII - A: Endocrinology and Ichthyology Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc Medical III year
Course Objective (CO)	The aim of this course is to enable the students to
Course Objective (CO)	The aim of this course is to enable the students to 1. Inculcate the knowledge of endocrine system of animals and classification of
Course Objective (CO)	
Course Objective (CO)	1. Inculcate the knowledge of endocrine system of animals and classification of
Course Objective (CO) Course Outcomes (CO)	1. Inculcate the knowledge of endocrine system of animals and classification of fishes.
•	 Inculcate the knowledge of endocrine system of animals and classification of fishes. Prepare slides of various scales of fishes.
•	 Inculcate the knowledge of endocrine system of animals and classification of fishes. Prepare slides of various scales of fishes. BBy the end of this course, students will be able to
•	 Inculcate the knowledge of endocrine system of animals and classification of fishes. Prepare slides of various scales of fishes. BBy the end of this course, students will be able to Study the preparation of permanent slides of fish scales, some endocrine glands
•	 Inculcate the knowledge of endocrine system of animals and classification of fishes. Prepare slides of various scales of fishes. BBy the end of this course, students will be able to Study the preparation of permanent slides of fish scales, some endocrine glands and the abnormalities related to hormones.

List of Experiments

- 1 To prepare permanent slides of some endocrine glands by microtomy: Thyroid, Pancreas, Thymus, Spleen, Adrenal gland, Testis & Ovary.
- To study the Process of spermatogenesis, process of oogenesis, Corpus luteum, Structure of sperm, Parathyroid gland, Sickle cell anemia, Mammary gland & Calcified and decalcified bone.
- 3 To demonstrate the abnormalities of growth harmone: Dwarfism, Gigantism and Acromegly etc.
- 4 To demonstrate the abnormalities related to Thyroid Gland: Hyperthyroidism Exophalmos, Goiter and Grave's disease; Hypothyrodism Myxodema, Cretinism.
- 5 To demonstrate the abnormalities of Adrenal Gland: Cushing Syndrome.
- 6 To identify, classify and study morphological characteristics of Chondrichthyes fishes.
- 7 To identify, classify and study morphological characteristics of Osteichthyes fishes
- 8 To prepare permanent slides of Placoid scales.
- 9 To prepare permanent slides of Ctenoid scales.
- 10 To prepare permanent slides of Cycloid scales.
- 11 To prepare permanent slides of Ganoid scales.
- 12 To prepare permanent slides of ampulla of lorenzini.

Text and Reference Books: A Destruction of the Reference Books:				
S.No.	Name/Title	Author	Publisher	
1	Review of medical physiology	William F. Ganong,	Graw Hill companies	
		M. C		
2	Text book of Medical Physiology	Guyton &Hall	Saunders Pb.	
3	Advancers in Aquatic Ecology	Vasanth Kumar.	Daya Publ. House, New Delhi	
4	Fish Management and Aquatic Environment	Arvind Kumar	Daya Publ. House, New Delhi	
		andPushaplata Dubey		

ZOOLOGY VIII - B: GENERAL & APPLIED ENTOMOLOGY PRACTICAL

Semester	VIII	
Course Code	ZOO474	
Course Title	Zoology VIII - B : General & Applied Entomology Practical	
Type of course	Practical	
LTP	0 0 4	
Credits	2	
Course prerequisite B.Sc Medical III year		
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Collect and preserve insects for systematic studies and to know about beneficial	
	and harmful insects	
	2. Know the life histories of some beneficial and harmful insects and the	
	biological control for harmful insects.	
Course Outcomes (CO)	By the end of this course, students will be able to	
	1. Learn the insect collection and preservation for systematic studies.	
	2. Study the life histories of some beneficial and harmful insects.	
	3. Study the beneficial and harmful effects of insects.	
	4. Study the process of biological pest control and insect control appliances.	

List of Experiments

- 1. Insect collection and preservation for systematic studies
- 2. Study of permanent slides of insects, their body parts, organs and histological preparations

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- 3. Life histories of honey bee, silk worm (Bombyx mori), lac insect, housefly (Musca domestica), and mosquito
- 4. Study of beneficial insects, benefits derived from them and useful products
- 5. Study of destructive insects, damage caused by them and damaged products
- 6. Study of biological pest control and insect control appliances

S.No.	Name/Title	Author	Publisher	
1	A Manual of Practical Entomology	M.M. Trigunayat	Scientific Publishers (India),	
			Jodhpur	
2	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications	
3	A Manual of Practical Zoology	P.S. Verma	S. Chand Publications	
	Invertebrates	-		
4	A Manual of Practical Zoology	P.S. Verma	S. Chand Publications	
	Invertebrates			
5	Practical Zoology Vertebrates	S.S. Lal	Rastogi Publications	
KHIALA, DISTT. JALANDHAR (PUNJAB)				

ZOOLOGY VIII - C: WILDLIFE AND CELLULAR NEUROBIOLOGY PRACTICAL

Semester	VIII	
Course Code ZOO476		
Course Title	Zoology VIII - C : Wildlife and Cellular Neurobiology Practical	
Type of course	Practical	
LTP	0 0 4	
Credits	2	
Course prerequisite B.Sc Medical III year		
Course Objective (CO) The aim of this course is to enable the students to		
	1. Identify mammalian fauna, avian fauna, herpeto-fauna and demonstrate the	
	basic equipments needed in wildlife studies	
	2. Study nervous system and olfaction of Drosophila.	
Course Outcomes (CO) By the end of this course, students will be able to		
	1. Understand basics and scope in wildlifeand strategies to conserve wildlife.	
	2. Study neurons and the preparation of nerve cell.	
	3. Familarize with techniques employed in cellular neurobiology	

List of experiments

- 1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna
- 2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance
- 3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.

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- 4. Demonstration of different field techniques for flora and fauna
- 5. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)
- 6. Dissection and study of Drosophila nervous system using GFP reporter.
- 7. Observation and quantitation of Drosophila photoreceptor neurons in healthy and diseased condition.
- 8. Nerve Cell preparation from the spinal cord.
- 9. Study of neurons and/ or myelin by Nissl, Giemsa or Luxol Fast Blue staining.
- 10. Study of olfaction in Drosophila.

Books Recommended

- 1. Bookhout, T.A. 1996. Research and Management Techniques for Wildlife and Habitats, 5 th edition. The Wildlife Society, Allen Press.
- 2. Woodroffe R., S. Thirgood and A. Rabinowitz. 2005. People and Wildlife, Conflict or Co-existence? Cambridge University

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- 3. Albertes, Molecular Biology of the Cell (5th Edition) Garland Science, 2008
- 4. Kendel, Principles of Neural Science (4th edition), McGraw Hill, 2000



SKILL ENHANCEMENT COURSES

(Semester III - VI)

KHIALA, DISTT. JALANDHAR (PUNJAB)

MEDICAL DIAGNOSTICS

Semester	III
Course Code	ZOO265
Course Title	Medical Diagnostics
Type of course	Skill Enhancement Courses
LTP	2 0 0
Credits	2
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. Familiar with various techniques available to diagnose different diseases.
2. Know about the importance of medical diagnostics.	
Course outcome(CO) By the end of this course, students will be able to:	
1. Understand the use of cytology for clinical diagnostics.	
	2. Understand the technologies used for diagnosis of tumours.
	3. Describe molecular diagnostics tools and their relation to precision medicine.

UNIT-I

Introduction to Medical Diagnostics and its Importance

UNIT-II

Diagnostics Methods Used for Analysis of Blood: Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.)

Diagnostic Methods Used for Urine Analysis: Urine Analysis: Physical characteristics; Abnormal constituents.

UNIT-III

Non-infectious Diseases: Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit

UNIT-IV

Infectious Diseases: Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis Tumours: Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).

S. No	Title	Author(s)	Publisher
1	Preventive and Social Medicine	Park K	B.B. Publishers
2	Textbook of Medical Laboratory	Godkar P.B. and Godkar D.P.	Bhalani Publishing House
	Technology, II	I. IALANDHAR (FOX)	
	Edition		
3	A Laboratory Manual for Rural	Cheesbrough M	Churchill Livingstone
	Tropical Hospitals, A Basis for		
	Training Courses		
4	Textbook of Medical Physiology	Guyton A.C. and Hall J.E	Saunders
5	Pathologic Basis of Disease,	Robbins and Cortan	Saunders
	VIIIEdition		

SERICULTURE

Semester	IV	
Course Code	ZOO466	
Course Title	Sericulture	
Type of course	Skill Enhancement Courses	
LTP	2 0 0	
Credits	2	
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)	BBy 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. Pathogenesis 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.

S. No.	Author(s)	Title T. IALANDHAR (PUN	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

APICULTURE

Semester	V		
Course code	ZOO373		
Course title	Apiculture		
Type of course	Skill enhancement Course		
LTP	2 0 0		
Credits	2		
Course prerequisite	Bsc. Ist, IInd 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 honey bees for commercial production of		
	honey.		
	2. Understand about various pests and diseases of honeybees.		
Course outcome (CO)	By the end of this course, students will be able to:		
	1. Gain knowledge about products of Apiculture Industry.		
	2. Gain knowledge about bee keeping equipments and apiary management.		
	3. Start their own business i.e employbility.		

UNIT-I

Biology of Bees: History, Classification and Biology of Honey Bees; Social Organization of Bee Colony.

UNIT-II

Rearing of Bees and Bee Economy: Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth; Bee Keeping Equipment, Methods of Extraction of Honey (Indigenous and Modern), Products of Apiculture Industry (Honey, Bees Wax, Propolis, Pollen etc.) and its uses.

UNIT-III

Pests and Diseases of honey bees: Bee Diseases and Enemies; Control and Preventive measures.

UNIT-IV

Entrepreneurship in Apiculture: Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens.

S. no.	Title	Author	Publisher
1	Apiculture	P J Prost	Oxford and IBH, New Delhi
2	Apiculture	D S Bisht	ICAR Publication
3	Beekeeping in India	S Singh	ICAR Publication

AQUARIUM FISH KEEPING

Semester	VI	
Course Code	Z00374	
Course Title	Aquarium fish keeping	
Type of course	Skill enhancement Course	
LTP	2 0 0	
Credits	2	
Course prerequisite	B.Sc IInd 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)	e 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 Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish

Unit 3: Food and feeding of Aquarium fishes

Use of live fish feed organisms. Preparation and composition of formulated fish feeds

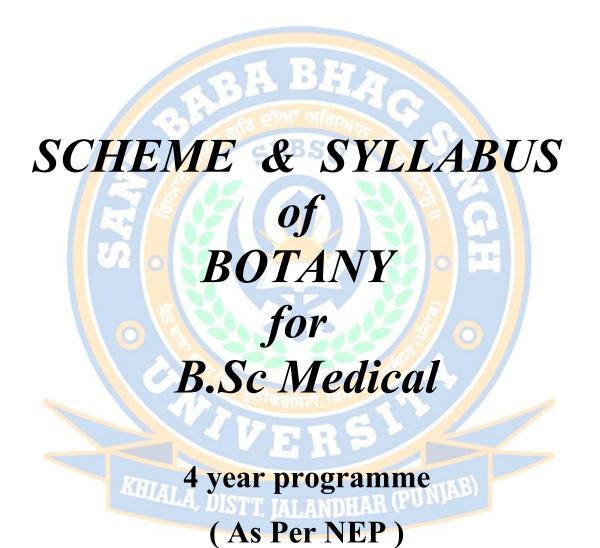
Unit 4: Fish Transportation

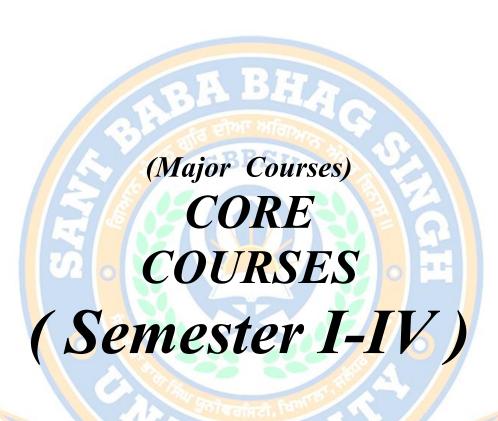
Live fish transport - Fish handling, packing and forwarding techniques.

Unit 5: Maintenance of Aquarium

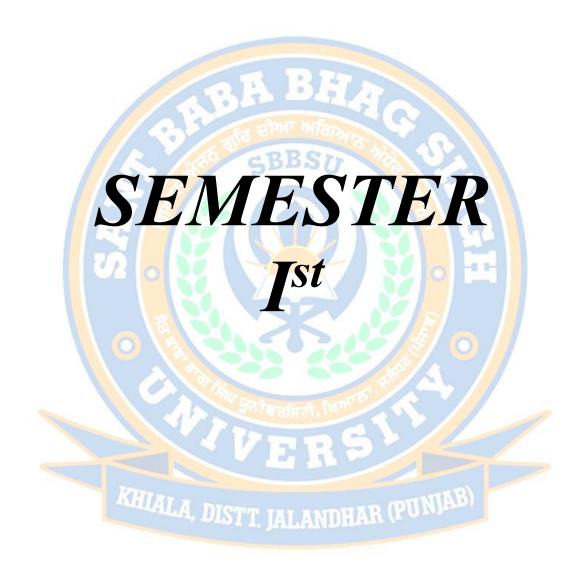
General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry.

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	Surject Publication





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BOTANY I: PLANT BIODIVERSITY

Semester	I	
Course Code	BOT161	
Course Title	Botany I : Plant Biodiversity	
Type of course	Theory	
LTP	$\begin{vmatrix} 4 & 0 & 0 \end{vmatrix}$	
Credits	4	
Course prerequisite	10+2 Medical	
Course Objective	The aim of this course is to enable the students to	
(CO)	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	By the end of this course, students will be able to:	
(CO)	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.	

UNIT-I

Microbes: Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage);Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery,General characteristics and cell structure; Reproduction – vegetative, asexual and recombination(conjugation, transformation and transduction); Economic importance.

Algae: General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Fucus, Polysiphonia. Economic importance of algae

UNIT-II

Fungi: Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium, Alternaria* (Ascomycota), *Puccinia, Agaricus* (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

UNIT-III

Introduction to Archegoniate: Unifying features of archegoniates, Transition to land habit, Alternation of generations.

Bryophytes: General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

UNIT-IV

Pteridophytes:General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.

Gymnosperms: General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance.

Sr 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

BOTANY I: PLANT BIODIVERSITY PRACTICAL

Semester	I	
Course Code	BOT163	
Course Title	Botany I: Plant Biodiversity Practical	
Type of course	Practical	
LTP	0 0 4	
Credits	2	
Course prerequisite	10+2 Medical	
Course Objective	The aim of this course is to enable the students to	
(CO)	1. Aware about biodiversity 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	By the end of this course, students will be able to:	
(CO)	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	
Byryophytes, Ptridophytes and Gymnosperms by watching the specimes of or		
	live or preserved and by section cutting and experiencing the anatomical structure in	
	microscope.	

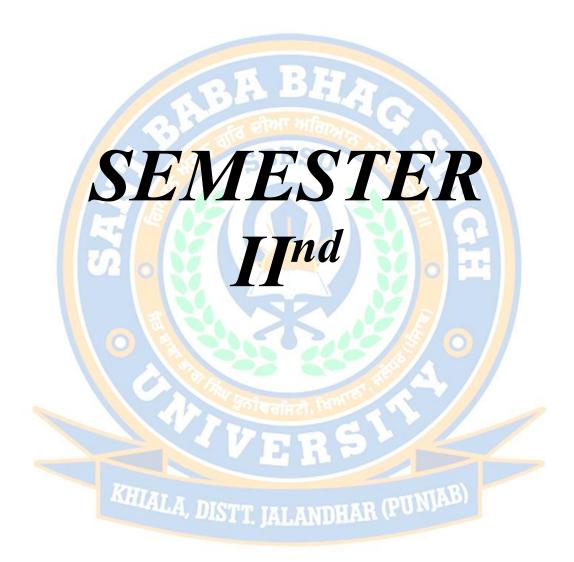
LIST OF EXPERIMENTS

- 1. EMs/Models of viruses T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
- 2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.

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- 3. Gram staining
- 4. Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas* (electron micrographs), *Oedogonium*, *Vaucheria*, *Fucus** and *Polysiphonia*through temporary preparations and permanent slides. (* *Fucus* Specimen and permanent slides)
- 5. Rhizopus and Penicillium: Asexual stage from temporary mounts and sexual structures through permanent slides.
- 6. Alternaria: Specimens; photographs and tease mounts.
- 7. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
- 8. Agaricus: Specimens of button stage and full grown mushroom; Sectioning of gills of Agaricus.
- 9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
- 10. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
- 11. **Marchantia** morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
- 12. **Funaria** morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema. **Selaginella**-morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
- 13. **Equisetum-** morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).
- 14. **Pteris** morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
- 15. *Cycas* morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
- 16. **Pinus** morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s.&r.l.s. stem (permanent slide).

I CAL AI	text and reference books.			
Sr 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	Tata McGraw Hill	
		R Singer		
7	Gymnosperms	SP Bhatnagar and A Moitra	S Chand	



BOTANY II: PLANT ECOLOGY AND TAXONOMY

Semester	П		
Course Code	BOT162		
Course Title	Botany II : Plant Ecology and Taxonomy		
Type of course	Theory		
LTP	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)	By the end of this course, students will be able to:		
	1. Understand he basics of ecology with its ineraction of biotic and abiotic		
	components.		
	2. Learn about the energy flow, trophic system and biogeochemical cycle		
	operating in the ecosystems		
	3. Know about the plant taxonomy, identification keys, herbarium and its		
	function.		
	4. Understand the various principle and rules of ICN, Binomial systems		
	classification of angiosperms and few important families of the plants.		
	John Med		

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 taxonomy: Identification, Classification, Nomenclature. Identification Functions of Herbarium, important herbaria and botanical gardens of the world and India, Documentation: Flora, Keys: single access and multi-access, Taxonomic evidences from palynology, cytology, phytochemistry and molecular data Taxonomic hierarchy: Ranks, categories and taxonomic groups

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. Bentham and Hooker (upto series), Engler and Prantl (upto series). 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. (Brassicaceae, Malvaceae, Fabaceae, RosaceaeUmbelliferae, Rutaceae, Asteraceae, Asclepiadaceae, Solanaceae, Euphorbiaceae, Lamiaceae, Liliaceae, Gramineae)

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	Oliver and
		Heywood, V.H	Boyd, London.



BOTANY II: PLANT ECOLOGY AND TAXONOMY PRACTICAL

Semester	II		
Course Code	BOT164		
Course Title	Botany II: Plant Ecology and Taxonomy Practical		
Type of course	Practical		
LTP	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. 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.		
	By the end of this course, students will be able to:		
Course Outcomes (CO)	1. Understand the principle and use various instruments used in the study of the		
	ecology		
	2. Analyse various physico chemical parameters of soil		
	3. Learn the morphological adaptation of some special plants in different habitat		
	4. Know about the quantitative analysis of plant species diversity by using quadrat		
	methods.		
	5. Learn the classification of angiosperms and some families by observing the		
	common members available for the experiment.		

LIST OF EXPERIMENTS

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.

GBBS1

- 2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
- 3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
- 4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each), (b)Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants)
- 5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
- 6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
- 7. 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):

Brassicaceae -Brassica/Alyssum / Iberis

Asteraceae – Tageteserecta/Ageratum conyzoides

Solanaceae – Solanum tuberosum, Withania

Fabaceae-Pisum sativum/Cassia fistula/Acacia nilotica

Lamiaceae -Salvia, Ocimum

Liliaceae - Asphodelus / Lilium / Allium. l, DISTT, JALANDHAR (PUNJAB)

Gramineae-*Triticum*

Rosaceae-Rosa indica

Malvaceae-Hibiscus Rosa sinensis

Umbelliferae- Coriandrum

Asclepiadaceae- Calotropis

Euphorbiaceae- Euphorbia

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

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	Oliver and
		Heywood, V.H	Boyd, London.



BOTANY III: ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

Semester	III		
Course Code	BOT261		
Course Title	Botany III : Anatomy and Embryology of Angiosperms		
Type of course	Theory		
LTP	4 0 0		
Credits	4		
Course prerequisite	10+2 Medical		
Course Objective	The aim of this course is to enable the students to		
	1. Understand the basic body plan of flowering plant, various tissue systems in higher		
	plants, their structure, development and function.		
	2. Study the structure, development and function of reproductive structures in flowering		
	plants.		
Course Outcomes	By the end of this course, students will be able to:		
(CO)	1. Understand the basic body and its parts of flowering plants		
	2. Learn about the shoot and root apical meristem, cambium and secondary growth and its		
	significance in the plant development.		
	3. Undeerstand the diversity of plants and leaf origin and development		
	4. Know about the various methods of propagation of plant and development of flower		
	and fruits		

UNIT-I

The basic body plan of a flowering plant-modular type of growth.

The Shoot System: The shoot apical meristem and its histological organization; meristematic and permanent tissue, formation of internodes, branching pattern; monopodial and sympodial growth; canopy architecture; cambium and its functions; formation of secondary xylem; a general account of wood structure in relation to conduction of water and minerals; characteristics of growth rings, sapwood and heart wood; role of woody skeleton; secondary phloem-structurefunction relationships; periderm.

UNIT-II

Diversity in plant form in annuals, biennials and perennials; trees-largest and longest-lived. **Leaf**: Origin, development, arrangement and diversity in size and shape; internal structure in relation to photosynthesis and water loss; adaptations to water stress; senescence and abscission.

UNIT-III

The Root System: The root apical meristem; differentiation of primary and secondary tissues and their roles; structural modification for storage, respiration, reproduction and for interaction with microbes. Vegetative Reproduction: Various methods of vegetative propagation. Detailed study and types of grafting and budding, economic aspects.

UNIT-IV

Flower: A modified shoot; structure, development and varieties of flower; functions; structure of anther and pistil; the male and female gametophytes; types of pollination; attractions and reward for pollinators; (sucking and foraging types); pollen-pistil interaction self incompatibility; double fertilization: formation of seed endosperm and embryo: fruit development and maturation. Significance of Seed: Suspended animation; ecological adaptation; unit of genetic recombination with reference to reshuffling of genes and replenishment; dispersal strategies.

Sr No.	Title	Author	Publisher	
1	The Embryology of	S S Bhojwani and S P	Vikas Publishing House, Delhi	
	Angiosperms	Bhatnagar		
2	Plant Propagation: Principles	H E Hartman and D E	Prentice Hall of India Pvt. Ltd., New	
	and Practices	Kestler	Delhi	
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	

BOTANY III: ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS PRACTICAL

Semester	III		
Course Code	BOT263		
Course Title	Botany III: Anatomy and Embryology of Angiosperms Practical		
Type of course	Practical		
LTP	0 0 4		
Credits	2		
Course prerequisite	B.Sc Ist year		
Course Objective (CO)	The aim of this course is to enable the students to		
	1. Understand the morphology and anatomy of various parts of angiosperm		
	plants		
	2. Understand the flower and floral parts and embryology of angiosperm.		
	By the end of this course, students will be able to:		
Course Outcomes (CO)	1. Understand the anatomical features of angiosperm plants and their adaptation.		
	2. Understand the various shapes of leaves and its adaptation.		
	3. Understand the structure of various types of ovules and endosperm		
	development.		
	4. Learn the techniques by performing experiment of vegetative propagation of angiosperm.		

LIST OF EXPERIMENTS

- 1. Study of any commonly occurring dicotyledonous plant (for example *Solanum nigrum* or Kalanchoe) to the body plan, organography and modular type of growth.
- 2. Life forms exhibited by flowering plants (by a visit to a forest or a garden, Study of tree-like habit in cycads, bamboo, banana, traveller's tree (*Revenala madagascariensis*) and yucca and comparison with true trees as exemplified by conifers and dicotyledons.
- 3. L.S. Shoot tip to study the cytohistological zonation and origion of leaf primordia.
- 4. Monopodial and sympodial types of branching in stems (especially rhizomes).
- 5. Anatomy of primary and secondary growth in monocots and dicots using free hand razor technique (Solanum, Boerhavia Helianthus, Mirabilis, Nyctanthus, Draceana, Maize) hand sections (or prepared slides). Structure of secondary phloem and xylem. Growth rings in wood, Microscopic study of wood in T.S., T.L.S. and R.L.S.
- 6. Field study of diversity in leaf shape, size, thickness, surface properties. Internal structure of leaf. Structure and development of stomata (using epidermal peels of leaf.
- 7. Anatomy of the root. Primary and secondary structure.
- 8. Examination of a wide range of flowers available in the locality and methods of their pollination.
- 9. Structure of anther, microsperogenesis (using slides) and pollen grains (using whole mounts). Pollen viability using in vitro pollen germination.
- 10. Structure of ovule and embryo sac development using serial sections) from permanent slides.
- 11. Nuclear and cellular endosperm. Embryo development in monocots and dicots (using permanent slides/dissections).
- 12. Simple experiments to show vegetative propagation (leaf cuttings in Bryophyllum. Sansevieria, Begonia; stem cuttings in rose, salix, money plant, Sugarcane and Bougainvillea).
- 13. Germination of non-dormant and dormant seeds.

Text and reference books: [ALA, DISTT INLAMPIAR (PUNAB)

Sr No.	Title	Author	Publisher
1	The Embryology of	S SBhojwani and S P Bhatnagar	Vikas Publishing House, Delhi
	Angiosperms		
2	Plant Propagation: Principles	H E Hartman and D E Kestler	Prentice Hall of India Pvt. Ltd.,
	and Practices		New Delhi
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	The Principles of Pollination	K Pegeri and Vander Pijl	Pergamon Press, Oxford
	Biology		
6	Biology of Plants	P H Raven, R F Evert and S E	W.H.Freeman and Co., New
		Eichhorn	York.
7	Trees: Their Natural History	P Thomas	Cambridge University Press,
	-		Cambridge



ROTANV IV	PLANT PHYSIO	LOCV AND	METAROLISM
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Semester	IV	
Course Code	BOT262	
Course Title	Botany IV: Plant Physiology and Metabolism	
Type of course	Theory	
LTP	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. 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)	By the end of this course, students will be able to:	
	1. Understand plant water relation and mineral nutrition absorption process	
	2. Know about the translocation of sap and Photosynthesis process in different types of plants	
	3. Understand Carbohydrate and Nitrogen metabolism in Plants	
	4. Learn about enzymes and various phases of plant development such as seed dormancy,	
	germination and plant movement.	
	5. Understand plant response to light and its effect in the devepopment of plants	

UNIT-I

Plant-water relations: Importance of water, physical properties of water, imbibitions, diffusion and osmosis, absorption, transport of water, 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, girdling experiment; Pressure flow model; Phloem loading and unloading.

Photosynthesis: Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reactioncenter, antenna molecules; z-scheme, photophosphorylation, Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.

IINIT-III

Carbohydrate metabolism: Carbohydrates- classification, occurrence, structure of mono, oligo and polysaccharides (starch, cellulose, pectin). Carbohydrate breakdown-Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, electron transport mechanism (chemi-osmotic theory), redox potential, Glyoxylate cycle, Oxidative Pentose Phosphate Pathway.

Nitrogen metabolism: Protein and amino acid structure features and functions. Biology of nitrogen fixation, importance of nitrate reductase and its regulation, ammonium assimilation, structure and function of lipids, fatty acid biosynthesis, β -oxidation, saturated and unsaturated fatty acids, storage and mobilization of fatty acids.

UNIT-IV

Enzymes: Structure and properties; Discovery and nomenclature, characteristics of enzymes, concept of holoenzyme, apoenzyme, coenzymes and cofactors regulation of enzyme activity. Mechanism of enzyme catalysis and enzyme inhibition.

Plant growth development: Definitions, phases of growth and development, kinetics of growth, seed dormancy, seed germination and factors of their regulation, plant movements, physiology of flowering, florigen concept, biological clocks, physiology of senescence, fruit ripening, Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

Plant response to light and temperature: Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), redand far red light responses on photomorphogenesis; Vernalization.

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	Fundamentals of Plant Physiology	V K Jain	S. Chand Publishing
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	Experiments in Plant Physiology- A Laboratory Manual.	D Bajracharya	Narosa Publishing House

BOTANY IV: PLANT PHYSIOLOGY AND METABOLISM PRACTICAL

Semester	IV	
Course Code	BOT264	
Course Title	Botany IV: Plant Physiology and Metabolism Practical	
Type of course	Practical	
LTP	0 0 4	
Credits	2	
Course prerequisite	10+2 Medical	
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)	By the end of this course, students will be able to:	
	1. Understand various plants physiological processes with the help of	
	experiments.	
	2. Study and calculate stomatal index.	
	3. Learn about impact of light on chlorophyll and phytochrome pigment	
	4. Demonstrate various physiological processes to understand properly.	

LIST OF EXPERIMENTS

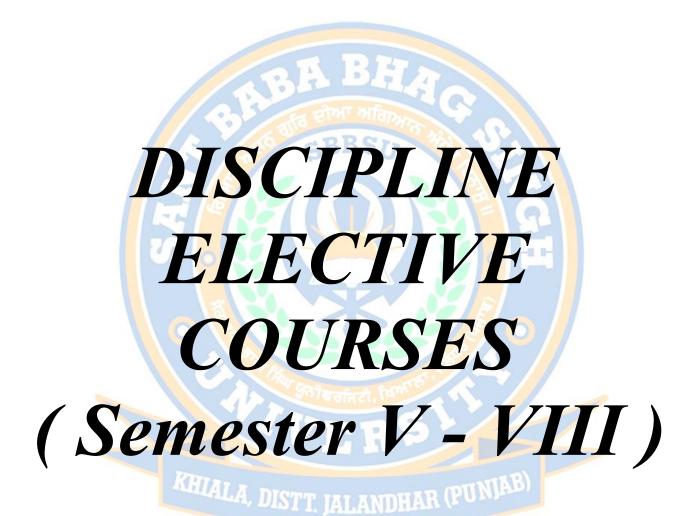
- 1. Determination of osmotic potential of plant cell sap by plasmolytic method.
- 2. To study the rate of transpiration from foliar surfaces.
- 3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
- 4. Demonstration of Hill reaction.
- 5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
- 6. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.
- 7. Comparison of the rate of respiration in any two parts of a plant.
- 8. To obtain the action spectrum of chlorophyll pigment.
- 9. Separation of amino acids by paper chromatography.

Demonstration experiments (any two)

- 1. Bolting.
- 2. Effect of auxins on rooting.
- 3. Suction due to transpiration.
- 4. R.Q.

S. No.	Title	Author	Publisher
1	Plant Physiology	H N Srivastava	Pradeep Publishers
2	A Textbook of Plant Physiology,	Dr S K Verma and Mohit Verma	S. Chand Publishing
	Biochemistry and Biotechnology		







BOTANY V - A: Cell and Molecular Biology

Semester	V	
Course Code	BOT361	
Course Title	Botany V -A: Cell and Molecular Biology	
Type of course	Discipline Elective Courses (Theory)	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc. Medical II year	
Course Objective	The aim of this course is to enable the students to	
	1. Impart the knowledge about details of cell structure, cell organelles and	
	their functions	
	2. Impart knowledge DNA and functional details of genetic material.	
	By the end of this course, students will be able to understand:	
Course Outcomes (CO)	1. Various types of equipment's, their principles and application for	
	studying plants development, physiology and functions	
	2.Basic structure of plant cell, cell wall and organelles	
	3.Structure of chloroplast, golgi bodies, ER, mitochondria and nucleus	
	4. Cell cycle, Structure of DNA, DNA replication, translation and	
	transcription	
	5. Regulation of gene expression.	

UNIT-I

Techniques in Biology: Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis.

UNIT-II

Cell as a unit of Life: The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components.

Cell Membrane and Cell Wall; The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall. Cell Organelles: Mitochondria: Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA

UNIT-III

Cell Organelles: Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA. ER, Golgi body & Lysosomes: Structures and roles. Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants and biogenesis.

Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecularorganization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).

UNIT-IV

Cell Cycle: Overview of Cell cycle, Mitosis and Meiosis; Molecular controls. Genetic material: DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material.

DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi-conservative, semi discontinuous RNA priming, \acute{O} (theta) mode of replication, replication of linear, ds-DNA, replicating the 5 end of linear chromosome including replication enzymes.

Transcription (Prokaryotes and Eukaryotes)

Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation (Prokaryotes and eukaryotes), genetic code.

Regulation of gene expression: Prokaryotes (Lac operon and Tryptophan operon) and in Eukaryotes.

S.No	Title	Author(s)	Publisher
1	Genetics- A Molecular Approach, 3rd	Russell, P. J.	Benjamin
	edition		Cummings.
2	Introduction to Genetic Analysis, 9th	Griffiths, A.J.F., Wessler, S.R.,	W. H. Freeman and Co.
	edition	Lewontin, R.C. and Carroll, S.B.	
3	Evolution, 3 rd edition	Ridley, M.	Blackwell Publishing
4	Evolutionary Biology	Douglas, J. Futuyma	Sinauer Associates.

BOTANY V - A: CELL AND MOLECULAR BIOLOGY PRACTICAL

Semester	V
Course Code	BOT363
Course Title	Botany V - A : Cell and Molecular Biology Practical
Type of course	Discipline Elective Courses (Practical)
LTP	0 0 4
Credits	2
Course prerequisite	B. Sc Medical II year
Course Objective	The aim of this course is to enable the students to 1. Imparts practical knowledge about details of cell structure, cell organelles and their functions 2. Imparting the knowledge of molecular techniques, structural and functional details of genetic material
Course Outcomes (CO)	By the end of this course, students will be able to understand: 1. Structure of bacteria, virus, prokaryotic and eukaryotic cells through various types microscopy 2. Structure of plant cells by preparing temporary mounts 3. Study of mitosis and meiosis through preparation of temporary slides 4. Study of various physiological processes through experiments 5. Measurement of cell size with the help of micrometry

LIST OF EXPERIMENTS

- GBBSU 1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
- 2. Study of the photomicrographs of cell organelles
- 3. To study the structure of plant cell through temporary mounts.
- 4. To study the structure of animal cells by temporary mounts-squamous epithelial cell and nerve cell.
- 5. Preparation of temporary mounts of striated muscle fiber
- 6. To prepare temporary stained preparation of mitochondria from striated muscle cells /cheek epithelial cells using vital stain Janus green.
- 7. Study of mitosis and meiosis (temporary mounts and permanent slides).
- 8. Study the effect of temperature, organic solvent on semi permeable membrane.
- 9. Demonstration of dialysis of starch and simple sugar.
- 16. Study of plasmolysis and deplasmolysis on Rhoeo leaf.
- 11. Measure the cell size (either length or breadth/diameter) by micrometry.
- 12. Study the structure of nuclear pore complex by photograph (from Gerald Karp)
- 13. Study of special chromosomes (polytene &lampbrush) either by slides or photographs.
- 14. Study DNA packaging by micrographs.

S.No	Title	Author(s)	Publisher
1	Genetics- A Molecular Approach,	Russell, P. J.	Benjamin
	3 rd edition		Cummings.
2	Introduction to Genetic Analysis,	Griffiths, A.J.F., Wessler, S.R.,	W. H. Freeman and Co.
	9 th edition	Lewontin, R.C. and Carroll, S.B.	
3	Evolution, 3 rd edition	Ridley, M.	Blackwell Publishing
4	Evolutionary Biology	Douglas, J. Futuyma	Sinauer Associates.

BOTANY V - B: ANALYTICAL TECHNIQUES IN PLANT SCIENCES

Semester	V	
Course Code	BOT365	
Course Title	Botany V - B : Analytical Techniques in Plant Sciences	
Type of course	Discipline Elective Courses (Theory)	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc Medical II year	
Course Objective	The aim of this course is to enable the students to	
	1. Acquaint the students about different principle and working of	
	instruments used in plant sciences	
	2. Acquaint the students about various techniques and methods used in plant	
	sciences	
Course Outcomes	By the end of this course, students will be able to understand:	
	1. Principle and functions of various types of microscopes	
	2. Principle and functions of centrifuge and spectroscopy	
	3. Concept and use of radioisotopes in biological studies	
	4. Characterization of proteins and nucleic acids	
	5. Use of biostatics in plant sciences	

UNIT-I

Imaging and related techniques: Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

UNIT-II

Cell fractionation: Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl2, gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Radioisotopes: Use in biological research, auto-radiography, pulse chase experiment. Spectrophotometry: Principle and its application in biological research.

UNIT-III

Chromatography: Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.

Characterization of proteins and nucleic acids: Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

UNIT-IV

Biostatistics: Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.

S.No	Title	Author(s)	Publisher
1	An Introduction to	Plummer, D.T.	Tata McGraw-Hill
	Practical Biochemistry		Publishing Co. Ltd
2	Plant Microtechnique	Ruzin, S.E.	Oxford University
	and Microscopy		Press, New York
3	Short Protocols in	Ausubel, F., Brent, R., Kingston, R. E.,	John Wiley & Sons
	Molecular Biology	Moore, D.D., Seidman, J.G., Smith	
4	Biostatistical Analysis.	Zar, J.H	Pearson Publication

BOTANY V - B: ANALYTICAL TECHNIQUES IN PLANT SCIENCES PRACTICAL

Semester	V	
Course Code	BOT367	
Course Title	Botany V - B : Analytical Techniques in Plant Sciences Practical	
Type of course	Discipline Elective Courses (Practical)	
LTP	0 0 4	
Credits	2	
Course prerequisite	B.Sc. Medical II year	
Course Objective	The aim of this course is to enable the students to	
	1. Demonstration and use of various instrument used in plant sciences	
	2. Demonstration of various methods used in plant sciences	
Course Outcomes	By the end of this course, students will be able to:	
	1. Understand different types of chromatography used to study plant's	
	structure and functions by performing experiments	
	2.Understand the use of blotting techniques to transfer DNA, RNA and	
	Proteins	
	3. Understand the use of centrifuge in the separation of biomolecules in	
	plants	
	4.Understand the use of different microscopic techniques to study plant	
	structure.	

LIST OF EXPERIMENTS

- 1.Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
- 2. Demonstration of ELISA.
- 3. To separate nitrogenous bases by paper chromatography.
- 4. To separate sugars by thin layer chromatography.
- 5. Isolation of chloroplasts by differential centrifugation.
- 6. To separate chloroplast pigments by column chromatography.
- 7. To estimate protein concentration through Lowry's methods.
- 8. To separate proteins using PAGE.
- 9. To separate DNA (marker) using AGE.
- 10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
- 11. Preparation of permanent slides (double staining).

S.No	Title	Author(s)	Pub <mark>lish</mark> er
1	An Introduction to Practical	Plummer, D.T.	Tata McGraw-Hill
	Biochemistry		Publishing Co. Ltd
2	Plant Microtechnique and	Ruzin, S.E.	Oxford University
	Microscopy		Press, New York
3	Short Protocols in	Ausubel, F., Brent, R., Kingston, R.	John Wiley & Sons
	Molecular Biology	E., Moore, D.D., Seidman, J.G., Smith	VIAD)
4	Biostatistical Analysis.	Zar, J.H	Pearson Publication

BOTANY V - C: MYCOLOGY AND PHYTOPATHOLOGY

Semester	V
Course Code	ВОТ369
Course Title	Botany V - C : Mycology and phytopathology
Type of course	Theory
LTP	4:0:0
Credits	4:0:0
Course prerequisite	10+2 (Medical)
Course Objective	By the end of this course, students will be able to:
	1. Know about the diversity of Fungi and its classification
	2. Learn about the symptoms, diseases and plant fungi interactions
Course Outcome	By the end of this course, students will be able to understand:
	1. The diversity and life cycles of fungi
	2. The Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance
	3. The cultivation of mushroom
	4. The phytopathology and diseases in plants caused by fungus
	5. About the commercial and industrial application of fungi.

UNIT I:

Introduction to true fungi: General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification.

Chytridiomycota and Zygomycota: Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to Synchytrium, Rhizopus.

UNIT II:

Ascomycota: General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; Life cycle and classification with reference to Saccharomyces, Aspergillus, Penicillium, Alternaria, Neurospora and Peziza.

Basidiomycota: General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat *Puccinia* (Physiological Specialization), loose and covered smut (symptoms only), *Agaricus*; Bioluminescence, Fairy Rings and Mushroom Cultivation.

UNIT III:

Allied Fungi: General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.

Oomycota: General characteristics; Ecology; Life cycle and classification with reference to *Phytophthora*, *Albugo*. Symbiotic associations: Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance.

UNIT IV:

Applied Mycology: Role of fungi in biotechnology; Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Myconematicides); Medical mycology.

Phytopathology: Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine.

Bacterial diseases – Citrus canker and angular leaf spot of cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers.

S. No.	Name/Title	Author	Publisher
1	Introduction to Fungi, 3rd edition	Webster, J. and Weber, R. (2007).	Cambridge University Press,
			Cambridge.
2	Text book of Fungi and Their Allies	Sethi, I.K. and Walia, S.K. (2011).	Macmillan Publishers
			India Ltd.
3	Plant Pathology	Sharma, P.D. (2011).	Rastogi Publication, Meerut,
			India.
4	Plant Pathology, 4th edition,	Agrios, G.N. (1997)	Academic Press, U.K.
5	Introductory Mycology	Alexopoulos, C.J., Mims, C.W.,	John Wiley &
		Blackwell, M. (1996)	Sons (Asia) Singapore. 4th edition

BOTANY V - C: MYCOLOGY AND PHYTOPATHOLOGY PRACTICAL

Semester	V
Course Code	BOT371
Course Title	Botany V - C: Mycology and phytopathology practical
Type of course	Practical
LTP	0:0:4
Credits	0:0:2
Course prerequisite	10+2 (Medical)
Course Objective	 The aim of this course is to enable the students to Acquaint students about the diversity of Fungi by observing the wet specimens and slides in the laboratory Understand the symptoms of the diseases of plants and the life cycle of the fungus
Course Outcome	by observing the spores in the slides By the end of this course, students will be able to: 1. Learn about the diversity and life cycles of fungi
	 Learn about the phytopathology and diseases in plants caused by fungus Learn about the commercial and industrial application of fungi. Learn about the diversity of Lichens and their ecological importance Learn about the Mycorrhiza interaction with plants and its role

LIST OF EXPERIMENTS

- 1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps).
- 2. *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides.
- 3. Aspergillus and Penicillium: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.
- 4. *Peziza*: sectioning through ascocarp.
- 5. Alternaria: Specimens/photographs and temporary mounts.
- 6. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
- 7. Agaricus: Specimens of button stage and full grown mushroom; sectioning of gills of Agaricus, fairy rings and bioluminescent mushrooms to be shown.
- 8. Study of phaneroplasmodium from actual specimens and /or photograph. Study of Stemonitis sporangia.
- 9. *Albugo*: Study of symptoms of plants infected with *Albugo*; asexual phase study through section/ temporary mounts and sexual structures through permanent slides.
- 10. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs)
- 11. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers.

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S. No.	Name/Title	Author	Publisher
1	Introduction to Fungi, 3rd edition	Webster, J. and Weber, R.	Cambridge University Press,
		(2007).	Cambridge.
2	Text book of Fungi and Their Allies	Sethi, I.K. and Walia, S.K.	Macmillan Publishers
		(2011).	India Ltd.
3	Plant Pathology	Sharma, P.D. (2011).	Rastogi Publication, Meerut,
			India.
4	Plant Pathology, 4th edition,	Agrios, G.N. (1997)	Academic Press, U.K.
5	Introductory Mycology	Alexopoulos, C.J., Mims, C.W.,	John Wiley &
		Blackwell, M. (1996)	Sons (Asia) Singapore. 4th
			edition



BOTANY VI - A: ECONOMIC BOTANY AND BIOTECHNOLOGY

Semester	VI	
Course Code	BOT362	
Course Title	Botany VI - A: Economic Botany and Biotechnology	
Type of course	Theory	
LTP	4 O 0	
Credits	4	
Course prerequisite	B.Sc Medical II year	
Course Objective	The aim of this course is to enable the students to	
	1. Study economically important plants	
	2. Study the tissue culture and recombinant DNA techniques.	
Course Outcomes (CO)	urse Outcomes (CO) By the end of this course, students will be able to understand:	
	1. Core concepts of Economic Botany and relate with environment,	
	populations, communities, and ecosystems	
	2. The various types of cereal, pulses, spices, oil, brewage, fiber crops, their	
	origin, cultivation and uses	
	3. Micro propagation techniques and tissue culture	
	4. Recombinant DNA Techniques	

UNIT-I

Origin of Cultivated Plants: Concept of centers of origin, their importance with reference to Vavilov's work

Cereals: Wheat, Rice, Maize – Origin, morphology, uses

Legumes: General account with special reference to Gram, Pea, Soybean,

UNIT-I

Spices: General account with special reference to clove and black pepper (Botanical name, family, part used morphology and uses)

Beverages: Tea, Coffee (morphology, processing, uses)

UNIT-III

Oils and Fats: General description with special reference to groundnut

Fiber Yielding Plants: General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

Plant tissue culture: Micropropagation; haploid production through androgenesis and gynogenesis; brief account of embryo& endosperm culture with their applications

UNIT-IV

Recombinant DNA Techniques: Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immuno detection. Molecular diagnosis of human disease, Human gene Therapy.

S. no.	Title	Author	Pub <mark>lish</mark> er
1	Economic Botany in the Tropics	Kochhar, S.L.	MacMillan Publishers India
2	Plant Tissue Culture: Theory and	Bhojwani, S.S. and Razdan,	Elsevier Science
	Practice	M.K	
3	Molecular Biotechnology- Principles	Glick, B.R., Pasternak, J.J.	ASM Press
	and Applications of recombinant DNA		

BOTANY VI - A: ECONOMIC BOTANY AND BIOTECHNOLOGY PRACTICAL

Semester	VI
Course Code	BOT364
Course Title	Botany VI - A: Economic Botany and Biotechnology Practical
Type of course	Practical
LTP	0 0 4
Credits	2
Course prerequisite	B.Sc. Medical II year
Course Objective	The aim of this course is to enable the students to
	1. Impart the practical knowledge about economically important plants
	2. Tissue culture and recombinant DNA techniques.
Course Outcomes (CO)	By the end of this course, students will be able to understand:
	1. The economic important plants such as Wheat, Gram, Soybean, Black
	pepper, Clove
	2. Tea, Cotton, Groundnut through specimens, sections and
	microchemical test.
	3. Tissue culture through photographs: Anther culture, somatic
	embryogenesis, endosperm and embryo culture; micropropagation
	4. Molecular techniques: PCR, Blotting techniques, AGE and PAGE by
	performing experiments

LIST OF EXPERIMENTS

- 1. Study of economically important plants: Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests
- 2. Familiarization with basic equipments in tissue culture.
- 3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
- 4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

S. no.	Title	Author	Publisher
1	Economic Botany in the Tropics	Kochhar, S.L.	MacMillan Publishers
			India
2	Plant Tissue Culture: Theory and	Bhojwani, S.S. and Razdan,	Elsevier Science
	Practice	M.K	
3	Molecular Biotechnology- Principles	Glick, B.R., Pasternak, J.J.	ASM Press
	and Applications of recombinant DNA	- a first	



BOTANY VI -B: BIOINFORMATICS

Semester	VI
Course Code	BOT366
Course Title	Botany VI - B : Bioinformatics
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	B.Sc Medical II year
Course Objective	The aim of this course is to enable the students to
	1. Gain knowledge about creation and usefulness of plant databases and
	software's related to it.
	2. Gain the knowledge about analysis and storage of databases with the
	help of these software.
Course Outcomes	By the end of this course, students will be able to understand:
	1. Aim, scope and application of bioinformatics
	2. Biological databases and their classification
	3. National center for biotechnology information (NCBI), Tools used in
	bioinformatics such as BLAST, various types of databases
	4. DNA DDBJ, PIR. MSA, PAM, Blosum

UNIT-I

Introduction to Bioinformatics: Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics.

Databases in Bioinformatics: Introduction, Biological Databases, Classification format of Biological Databases, Biological Databases Retrieval System.

UNIT-II

Biological Sequence Databases: National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database.

EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools.

UNIT-III

DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ. Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR

Swiss-Prot: Introduction and Salient Features Sequence Alignments: Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

UNIT-IV

Molecular Phylogeny: Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction.

Applications of Bioinformatics: Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement.

S. no.	Title	Author	Publisher
1	Bioinformatics: Principles and	Ghosh Z. and Bibekanand M	Oxford University Press
	Applications		
2	Bioinformatics and Functional	Pevsner J	Wiley-Blackwell
	Genomics		-
3	Discovering Genomics, Proteomics and	Campbell A. M., Heyer L. J	Benjamin Cummings
	Bioinformatics		

BOTANY VI - B: BIOINFORMATICS PRACTICAL

Semester	VI	
Course Code	BOT368	
Course Title	Botany VI - B : Bioinformatics Practical	
Type of course	Practical	
LTP	0 0 4	
Credits	2	
Course prerequisite	B.Sc Medical II year	
Course Objective	The aim of this course is to enable the students to	
	1. Give practical knowledge about creation and usefulness of plant	
	databases and softwares related to it.	
	2. Give the practical knowledge of various databases and their analysis	
Course Outcomes	By the end of this course, students will be able to understand:	
	1. How to use nucleic and protein databases?	
	2. How to retrieve the sequences from the databases?	
	3. Sequence homology and Gene annotation	
	4. Construction of phylogenetic tree using various software	

LIST OF EXPERIMENTS

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

Text and reference books:

S. no.	Title	Author	Publisher
1	Bioinformatics: Principles and	Ghosh Z. and Bibekanand M	Oxford University Press
	Applications		
2	Bioinformatics and Functional	Pevsner J	Wiley-Blackwell
	Genomics		
3	Discovering Genomics, Proteomics and	Campbell A. M., Heyer L. J	Benjamin Cummings
	Bioinformatics		

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BOTANY VI - C : ARCHEGONIATE

Semester	VI	
Course Code	BOT370	
Course Title	Botany VI - C : Archegoniate	
Type of course	Theory	
LTP	4:0:0	
Credits	4:0:0	
Course prerequisite	10+2 (Medical)	
Course Objective	The aim of this course is to enable the students to	
-	1. Acquaint about basic knowledge bryophytes, pteridophytes and gymnosperms	
	2. Acquaint about the fossil plants of archegoniate and its evolution, adaptation	
	with the changing climate	
Course Outcome	By the end of this course, students will be able to understand:	
	1. The evolution of fossil plants and its adaptation in land.	
	2. About the diversity, habitat and life cycle of bryophytes	
	3. About the diversity, habitat and life cycle of Pteridophytes	
	4. About the diversity, habitat and life cycle of Gymnosperm	

UNIT I:

Introduction

Unifying features of archegoniates; Transition to land habit; Alternation of generations.

Bryophytes

General characteristics; Adaptations to land habit; Classification; Range of thallus organization.

UNIT II

Type Studies-

Bryophytes Classification (up to family), morphology, anatomy and reproduction of Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum and Funaria; Reproduction and evolutionary trends in Riccia, Marchantia, Anthoceros and Funaria (developmental stages not included). Ecological and economic importance of bryophytes with special reference to Sphagnum.

UNIT III:

Pteridophytes

General characteristics; Classification; Early land plants (Cooksonia and Rhynia).

Type Studies- Pteridophytes

Classification (up to family), morphology, anatomy and reproduction of Psilotum, Selaginella, Equisetum and Pteris (Developmental details not to be included). Apogamy, and apospory, heterospory and seed habit, telome theory, stelar evolution; Ecological and economic importance.

UNIT IV:

Gymnosperms

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

Text and Reference books:			
S. No.	Name/Title	Author	Publisher
1	An introduction to Embryophyta: Vol. I.	Parihar, N.S. (1991).	Central Book Depot.
	Bryophyta.		Allahabad.
2	Introduction to Bryophytes	Vanderpoorten, A. &	Cambridge University
		Goffinet, B. (2009)	Press.
3	Biology.	Raven, P.H., Johnson, G.B.,	Tata McGraw Hill, Delhi
		Losos, J.B., Singer, S.R.	
		(2005)	
4	Pteridophyta	Vashistha, P.C., Sinha,	S. Chand. Delhi, India.
		A.K., Kumar, A. (2010).	
5	Gymnosperms	Bhatnagar, S.P. & Moitra,	New Age International (P) Ltd
		A. (1996)	Publishers,
			New Delhi, India.

BOTANY VI - C : ARCHEGONIATE PRACTICAL

Semester	VI	
Course Code	BOT372	
Course Title	Botany VI - C : Archegoniate practical	
Type of course	Practical	
LTP	0:0:4	
Credits	0:0:2	
Course prerequisite	10+2 (Medical)	
Course Objective	The aim of this course is to enable the students to	
	1. About the fossil plants early adaptation of land plants by observing	
	photographs and fossil structure.	
	2. Acquaint about bryophytes, pteridophytes and gymnosperm	
Course Outcome	By the end of this course, students will be able to understand:	
	1. The evolution of land plants and their adaptation	
	2. About the diversity, habitat and life cycle of bryophytes	
	3. About the diversity, habitat and life cycle of Pteridophytes	
	4. About the diversity, habitat and life cycle of Gymnosperm	

LIST OF EXPERIMENTS

- 1. *Riccia* Morphology of thallus.
- 2. *Marchantia* Morphology of thallus, whole mount of rhizoids & Scales, vertical section of thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides).
- 3. *Anthoceros* Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).
- 4. Pellia, Porella- Permanent slides.
- 5. **Sphagnum** Morphology of plant, whole mount of leaf (permanent slide only).
- 6. *Funaria* Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal section of capsule and protonema.
- 7. **Psilotum** Study of specimen, transverse section of synangium (permanent slide).
- 8. **Selaginella-** Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide).
- 9. *Equisetum* Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).
- 10. *Pteris* Morphology, transverse section of rachis, vertical section of sporophyll, wholemount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).
- 11. *Cycas* Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide).
- 12. **Pinus-** Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of Needle, transverse section of stem, longitudinal section of / transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), longitudinal section of female cone, tangential longitudinal section & radial longitudinal sections stem (permanent slide).
- 13. *Gnetum* Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide)
- 14. Botanical excursion.

S. No.	Name/Title	Author	Publisher
1	An introduction to Embryophyta:	Parihar, N.S. (1991).	Central Book Depot.
	Vol. I. Bryophyta.		Allahabad.
2	Introduction to Bryophytes	Vanderpoorten, A. & Goffinet, B. (2009)	Cambridge University Press.
3	Biology.	Raven, P.H., Johnson, G.B., Losos, J.B.,	Tata McGraw Hill, Delhi
		Singer, S.R. (2005)	
4	Pteridophyta	Vashistha, P.C., Sinha, A.K., Kumar, A.	S. Chand. Delhi, India.
		(2010).	
5	Gymnosperms	Bhatnagar, S.P. & Moitra, A. (1996)	New Age International (P) Ltd
			Publishers,
			New Delhi, India.



BOTANY VII - A: WATER RELATIONSHIP, GROWTH AND DEVELOPMENT

Semester	VII	
Course Code	BOT461	
Course Title	Botany VII - A: Water relationship, growth and development	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	10+2 with biology	
Course Objective	The aim of this course is to enable the students to	
	1. Study concept of water relations in plants, photosynthesis and growth	
	2. Study the growth and morphogenesis of plants by hormones and other	
	physiological processes.	
Course Outcome	By the end of this course, students will be able to understand:	
	1. About different physiological processes occur in the plants.	
	2. The physical processes like transpiration help the plants to translocate the water	
	from roots to aerial parts of the plant even in tall trees.	
	3. The different aspects of light and dark reaction in photosynthesis and different	
	modification of plants	
	4. About the regulation of growth in plants by hormones	
	5. About the various physiological processes in the regulation of plant growth	

UNIT: I

Water relationships in plants: Unique physio-chemical properties of water, Chemical potential, water potential, Apparent free space, bulk movement of water, soil plant atmosphere continuum (SPAC), Stomatal regulation of transpiration, hormonal and energy dependent hypothesis.

Inorganic nutrition, physicochemical aspects of solute transport, diffusion and facilitated diffusion, passive and active transport.

Nernst equation and Donnan's potential. Role of ATPase as a carrier, Co-transport (Symport) and counter transport (antiport), Ion channels, role of calmodulin, Importance of foliar nutrition and use of chelates.

UNIT: II

Photosynthesis: Energy pathway in photosynthesis, chloroplast as an energy transducing organelle. Composition and characterization of photo systems I and II, electron flow through cyclic, non cyclic and pseudo cyclic photophosphorylation. Pathways of CO2 fixation, Difference between C3 and C4 fixation and different kinds of C4 pathways

UNIT: III

CAM pathway: Occurrence, biological events and adaptive advantage

Photorespiration: Mechanism and regulation of photorespiration

Enzymes: Classification, mode of action, km value, Industrial application, immobilized enzymes, their preparation and application, Enzyme regulation: Competitive and non-competitive, allosteric enzymes

UNIT: IV

Chemical control of growth and morphogenesis

Hormonal effect on growth and development

Bioassay of plant growth regulators and mode of action with reference to auxins, Gibberellins, cytokinins, abscisic acid and ethylene

Phytochrome: Chemistry and photo morphogenetic effects and role in flowering

Dormancy: Seed and bud dormancy; hormonal regulation

S.No.	Name/Title	Author	Publisher
1	Biochemistry and Molecular Biology of	Buchanan, B.B.,	American Society of
	Plants.	Gruissem, W., and Jones,	Plant Physiologists,
		R.L. (2666).	Maryland.
2	Plant Physiology.	Taiz, L., and Zeiger, E.	Sinauer Associates, Inc.,
		(1998).	Publishers,
			Massachusetts.
3	Plant Physiology,	Salisbury, F.B., and Ross,	Wadsworth Publishing
		C.W. (1992).	Co., California.
4	Plant Physiology	Mukherji, S & Ghosh,	New Central Book
		A.K.	Agency (P) Limited,
			2669-

BOTANY VII - B: PLANT BIOCHEMISTRY AND METABOLISM

Semester	VII
Course Code	BOT463
Course Title	Botany VII - B: Plant biochemistry and metabolism
Type of course	Theory
LTP	4 0 0
Credits	4
Course prerequisite	10+2 with biology
Course Objective	The aim of this course is to enable the students to
	1. Study the classification, occurrence and structure of biomolecules and their
	metabolism.
	2. Study the general concept of nitrogen fixation and its role in plant growth and
	development.
Course Outcome	By the end of this course, students will be able to understand:
	1. The structure, function and biosynthetic pathways of essential biochemical
	molecules (carbohydrates, protein) including their key chemical and physical
	properties.
	2. The Biochemistry cycles in plants such as Gluconeogenesis vs glycolysis,
	Degradation of fatty acids and role of krebs cycle
	3. The knowledge about amino acid structures and relate their chemical properties to
	the synthesis and function of proteins.
	4. The concept of free energy and entropy, high energy compounds, Gibb's free energy
	will help him to understand the basics of biochemistry and metabolism.

UNIT: I

Carbohydrates: Classification, occurrence and structure of monosaccharides, oligosaccharides and polysaccharides (Starch, cellulose and pectin

Proteins: Amino acids, structure and characteristics, peptides and protein structure, functions of proteins, Conjugate proteins, Accounts of lactins and their function

UNIT: II

Lipids: Classification, occurrence, structure and importance of acryl lipids and phosphates

Concept of free enengy and entropy, high energy compounds, Gibb's free enengy concept in biochemical reaction

Synthesis of ATP through oxidative electron transport chain, Chemiosmotic regeneration of ATP

UNIT: III

Gluconeogenesis vs glycolysis Biosynthesis of fatty acids Degradation of fatty acids Lipid as high energy molecule Role of Kreb's cycle

UNIT: IV

Nitrogen fixation by free living and symbiotic organisms, mechanism of nitrogen fixation, Soil nitrogen sources, nitrogen uptake by plants and assimilation

Nitrate reductase system, substrate controlled induction, interrelation between photosynthesis and nitrogen metabolism

Brief account of amino acid synthesis by reductive amination, GS-GOGAT system, transamination Basic structure of important phenolics and alkaloids: a general view of their synthesis

S.No.	Name/Title	Author	Publisher
1	Biochemistry and Molecular Biology of	Buchanan, B.B., Gruissem, W., and	American Society of Plant
1	Plants.	Jones, R.L. (2666).	Physiologists, Maryland.
2	Lehninger Principles of Biochemistry: 6th Edition	Nelson, D. L., Cox, M.M	Macmillan Learning, 2612
3	Plant Physiology,	Salisbury, F.B., and Ross, C.W. (1992).	Wadsworth Publishing Co., California.
4	Plant Physiology	Mukherji, S & Ghosh, A.K.	New Central Book Agency (P) Limited, 2669-
5	Plant Physiology.	Taiz, L., and Zeiger, E. (1998).	Sinauer Associates, Inc., Publishers, Massachusetts.

BOTANY VII - C: EVOLUTION

Semester	VII	
Course Code	BOT465	
Course Title	Botany VII - C : Evolution	
Type of course	Theory Course	
LTP	3 0 0	
Credits	3	
Course prerequisite	10+2 with biology	
Course Objective	The aim of this course is to enable the students to 1. Learn about the evolutionary processes taken place and development of the plant species in relation to the todays biodiversity 2. Evolution of various photosynthetic pathways and multicellularity, animal behavior and plant body formation	
Course Outcome	By the end of this course, students will be able to understand: 1. The different evolutionary processes among the different species 2. The similarity and dissimilarity among the nearest species and their evolution 3. The scientific understanding about the existence of species. 4. The evolution of various photosynthetic pathways and complexity of plants physiological system	

UNIT: 1

Historical prospective of evolutionary biology, fundamental concepts of cosmology and geology

Origin and Evolution of Cells: First cell, evolution of metabolism, Present day Prokaryotes, Eukaryotic Cells, Development of multicellular organisms.

Pre-Darwinian and Darwinian theories of organic evolution, Concept of Oparin and Haldane; Experiment of Miller (1953), phylogenetic tress, taxonomic and biological concept of species, dating methods

UNIT: II

Ancient environment and earliest form of plant life, Evolution of photosynthesis, evolutionary trend: algae to land plants, evolutionary trend in land plants: vascular to nonvascular, influence of land dwelling plants on the earth system. Evolution of C4 and CAM photosynthetic pathways.

Origins of multicellularity in the plant kingdom, development and genetics in the evolution of land plant body plans, the evolution of plant development: past, present and future, innovations in the origin of vascular plants

UNIT: III

Altruism, Kin selection, Biological clocks; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.

Allopatric speciation, genetic models, peripetric speciation, disjunct distributions, the theory of island biogeography, Sympatric speciation, the role of genetic drift and gene flow in Evolution, Models Of Genetic Drift, Evolutionary Development Of Plant Speciation, macroevolution and the biological diversity of plants, Concepts of neutral evolution, molecular divergence and molecular clocks

UNIT: IV

Paleontology, geological time scale, eras, periods and epochs, major evolutionary events in the geological time scale, fossil evidence for plant terrestrialization, examples of earliest land plants in the fossil record.

Mass extinction events in plants: evidence in the geological record, evidence for persistence in the plant fossil record, Pleistocene glaciations.

Molecular tools in phylogeny, classification and identification; origin of new genes and proteins; Gene duplication and divergence

S.No.	Name/Title	Author	Publisher
1	Evolutionary Biology	Douglas, J. Futuyma. Sinauer Publications	
2	Evolutionary Genetics.	Smith, J.M. Oxford University Press.	
3	Evolutionary Biology	Minkoff, J.C. 1983.	Addison Wesley
			Publishing Company
4	The Evolution of Plants,	Kathy Willis, Jennifer	Oxford University
		McElwain 2616.	Press.2616.
5	The origin and early evolution of plants on	Kenrick, Paul, and Peter	Nature 389.6646 (1997):
	land.	R. Crane.	33-39

BOTANY VII - D : REMOTE SENSING AND ECOLOGICAL MODELLING

Semester	VII	
Course Code	BOT467	
Course Title	Botany VII - D: Remote sensing and ecological modelling	
Type of course	Theory Course	
LTP	4 0 0	
Credits	4	
Course prerequisite	10+2 (Medical)	
Course Objective	The aim of this course is to enable the students to	
_	1. Learn about the basic knowledge of remote sensing GIS and application	
	2. Learn the various models of ecology	
Course Outcome By the end of this course, students will be able to understand:		
	1. About the role of satellite and monitoring importance	
	2. The the formation of maps	
	3. The different software used in the remote sensing.	
	4. About different models of ecology and their interpretation	

UNIT 1:

Remote sensing: Definition and data acquisition techniques. Application of remote sensing in vegetation classification, understanding the key environmental issues and ecosystem management.

Geoinformatics and geographic information sciences, components of geoinformatics, applications of geoinformatics, approach to the study of geoinformatics, legal implications, geoinformatics and environmental modelling, GIS data collection, concept and techniques of geoinformatics.

Surveying Technology: Introduction, surveyors, datum and reference systems, survey operations classification of surveys, principles of surveying, methods of surveying, stages in surveying, modern trends in surveying and mapping.

UNIT: II

Introduction, GPS elements, GPS satellite constellation and signals, GPS measurements, GPS instrumentation, earth resources satellites, meteorological satellites, satellite carrying microwave sensors, OCEANSAT- 1(IRS-P4) and Ikonos satellite series. Introduction, roots of GIS, overview of information system, the four Ms, GIS architecture, theoretical models of GIS, theoretical frame work for GIS, GIS softwares, GIS applications and GIS operations. Role of remote sensing in Forest resource management, watershed Management, natural disaster management, and urban planning management.

UNIT: III

Exponential Population Growth: Finite rate of increase, population doubling time, life tables, life expectancy, net reproduction rate, generation time, intrinsic rate of natural increase, stable age distribution.

Leslies matrix model for population growth in unlimited environment, finite rate of increase with stable age distribution.

UNIT: IV

Logistic Population Growth: Differential and matrix models for population growth in limited environment. Dispersal: Empirical models, random walk model. Interaction Between Two Species: Competition – Differential equations, Leslie-Gower Model, Lotka-Volterra model for predator – prey interaction, Leslie model, deterministic STI JALANDHAR (P)

models for simple and general epidemics.

S.No.	Name/Title	Author	Publisher
1	Principles of Remote Sensing	Curran, P.J. (1988)	Longman Scientific and Technical, Harlow.
2	Remote Sensing for Natural Resource Management and Environmental Monitoring	<u>Ustin, S.L. (Ed.) (2004).</u>	John Wiley & Sons, U.S.A.
3	Environmental Hazards	Smith, K.	Routledge Publishers, London
4	Ecology.	Begon, M., Harper, J.L. and Townsend, C.R. (1996)	Blackwell Science, Cambridge
5	Ecology: Principles and Applications	Chapman, J.L. and Reiss, M.J. (1988)	Cambridge University Press, Cambridge.
6	Ecological Diversity and its Measurement.	Magurran, A.E. (1988).	Chapman & Hall, London.
7	Aims and Methods of Vegetation Ecology,	Muller-Dombois, D. and Ellenberg, H. (1974).	Wiley, New York.

BOTANY VII - E: FORESTRY

Semester	VII
Course Code	BOT469
Course Title	Botany VII - E : Forestry
Type of course	Theory Course
LTP	4 0 0
Credits	4
Course prerequisite	10+2 (Medical)
Course Objective	The aim of this course is to enable the students to 1. Learn about the various types of forest in India, their contribution and various protection policies and rules 2. Learn about the techniques to regenerate the forest and types, social forestry and Agroforestry
Course Outcome	By the end of this course, students will be able to understand: 1. About the practices of silviculture 2. The various forest policies and different types of forest in India 3. About the joint forest management and agroforestry 4. About the effect of forest on climate, control of floods and water regeneration

UNIT 1:

Introduction – definitions of basic terms related to forestry, objectives of silviculture, forest classification. Forest regeneration, tending, thinning, pruning and harvesting. Various interactions within forest communities, disturbances and succession, Gap dynamics

UNIT: II

Salient features of Indian Forest Policies, S, alient features of the Indian Forest Act 1972 (preliminary, reserved forests, protected forests), different methods employed for conservation of forests. **Ecosystem Services:** Definition, General account; Different types; Significance.

UNIT: III

Forest regeneration, Natural regeneration - natural regeneration from seed and vegetative parts, coppicing, pollarding, root suckers; Artificial regeneration – objectives, choice between natural and artificial regeneration, essential preliminary considerations. Climate of India, different climatic regions of India; Central characters and distribution of the different forest types of India. Forest Effects: General effects of forests on climate, control of runoff, effects on snow, soil erosion, wild life, pollution control, nutrient cycling, social values and ecotourism, economic values, floods, green belts and control of temperature.

UNIT: IV

Social Forestry: Social forestry- social land allocation programmes (Taungya system), Economic benefits of social forestry.

Agroforestry: Role in-soil conservation, soil restoration, conservation of biodiversity.

Watershed management, Climate change and Forestry: Definition of climate change, impact of climate change on forests, adaptation of trees to climate change -A, DISTT. JALANDHAR (PUNJA

S.No.	Name/Title	Author	Publisher
1	A Manual of Indian Forest Botany	Bore, N.L	International Book Dist. New Delhi
2	A Text Book of Silviculture	Diwivedi, A.P	International Book Distributor
3	Forestry Principles and Applications	Antony Joseph Raj and S B Lal	Scientific Publisher
4	Introduction to Forestry and Natural Resources	Donald L. Grebner, Peter Bettinger and Jacek P. Siry	Elsevier

BOTANY VII - A: PRACTICAL COURSE ON WATER RELATIONSHIP, GROWTH AND **DEVELOPMENT, PLANT BIOCHEMISTRY AND METABOLISM**

Semester	VII		
Course Code	BOT471		
Course Title	Practical course on water relationship, growth and development, plant		
	biochemistry and metabolism		
Type of course	Laboratory Course		
LTP	0 0 4		
Credits	2		
Course prerequisite	rse prerequisite 10+2 with biology		
Course Objective	The aim of this course is to enable the students to		
	 Learn the basic instrumentation used in plant physiology and biochemistry and different quantitative as well quantitative methods for determination of biomolecules and activity of enzymes. Understand the various physiological processes by performing the experiments in Lab 		
Course Outcome	By the end of this course, students will be able to understand:		
	1. The use subject knowledge about water potential and photosynthesis		
	2. The various techniques such as colorimeter and spectrophotometry		
	3. The quantification of biomolecules like protein, amino acids and chl		
	4. The role of nodules in N fixation		

SBBSI

LIST OF EXPERIMENTS

- 1. Determination of water potential in different tissues
- 2. Estimation of the Hill reaction activity
- 3. Study of photosynthetic efficiency in plants.
- 4. Observation of plants in which C3, C4 and CAM pathways take place.
- 4. Principle of colorimetry, spectrophotometry and fluorimetry
- 5. Determination of chlorophyll a and chlorophyll b, total chlorophyll (Arnon;s method)
- 6. Effect of Growth hormone in plants
- 7. Estimation of seed germination as affected by red and infrared radiation
- 8. Photo morphogenetic effects on plants and its role in flowering
- 9. Extraction and Estimation of starch
- 10. Determination of reducing sugars in fruits
- 11. Estimation of amino acids by ninhydrin
- 12. Estimation of protein by Biuret and Lowry's method
- 13. Separation and identification of sugars by paper chromatography 14. Separation of soluble protein by gel electrophoresis
- 15. Extraction of phenolics and alkaloids
- 16. Study of nodules in leguminous plants

S. No.	Name/Title	Author	Publisher
1	Practical in Plant Physiology and	Sunita Gupta, N.K. Gupta &	Scientific Publishers.
	Biochemistry	M.K. Sangha Manju Bala	
2	A Practical Manual for Plant Physiology	Shriram Mirajkar, Prashant	Lambert Academic
	and Biochemistry	Kale, Prashant Shingote	Publishing
3	Practical in Plant Physiology and	Sunita Gupta, N.K. Gupta &	Scientific Publishers.
	Biochemistry	M.K. Sangha Manju Bala	
4	A Practical Manual for Plant Physiology	ShriramMirajkar, Prashant	Lambert Academic
	and Biochemistry	Kale, Prashant Shingote	Publishing

BOTANY VII - B : PRACTICAL COURSE ON REMOTE SENSING, ECOLOGICAL MODELLING AND FORESTRY

Semester	VII		
Course Code	BOT473		
Course Title	Botany VII - B: Practical course on remote sensing, ecological modelling and		
	forestry		
Type of course	Laboratory Course		
LTP	0 0 4		
Credits	2		
Course prerequisite	10+2 (Medical)		
Course Objective	The aim of this course is to enable the students to		
	1. Learn the basic software used in remote sensing		
	2. Learn the techniques and methods used in ecological modelling and forest		
	management		
Course Outcome	By the end of this course, students will be able to understand:		
	1. The different software used in remote sensing		
	2. Various techniques and methods used in forestry		
	3. How to grow and maintain nursery of forest tree		
	4. How to perform the models used in ecology		
	2717 177		

SBBSU

LIST OF EXPERIMENTS

- 1. Introduction To Digital Image Processing Software Envi
- 2. Importing Satellite Data And Familiarization With Basic Functions Of Envi
- 3. Rectification And Image Geo Referencing
- 4. Subsetting And Masking To Get Required Image From Whole Image
- 5. Image Classification And Post Classification Processing
- 6. Dispersal random walk model
- 7. Lotka-Volterra model for predator prey interaction
- 8. Instruments used in forest mensuration: visual observation, sketches and utilities
- 9. Estimation of stand diameter
- 10. Height measurement of tree Abney's level, Clinometer,
- 11. Volume estimation of felled trees
- 12. Preparation of Nursery for tree planting

S. No.	Name/Title	Author	Publisher
1	Principles of Remote Sensing	Curran, P.J. (1988)	Longman Scientific and Technical, Harlow.
2	Remote Sensing for Natural Resource Management and Environmental Monitoring	Ustin, S.L. (Ed.) (2004).	John Wiley & Sons, U.S.A.
3	Environmental Hazards	Smith, K.	Routledge Publishers, London
4	Aims and Methods of Vegetation Ecology,	Muller-Dombois, D. and Ellenberg, H. (1974).	Wiley, New York.
5	A Manual of Indian Forest Botany	Bore, N.L	International Book Dist. New Delhi
6	A Text Book of Silviculture	Diwivedi, A.P	International Book Distributor
7	Forestry Principles and Applications	Antony Joseph Raj and S B Lal	Scientific Publisher



BOTANY VIII - A : REPRODUCTIVE AND DEVELOPMENTAL BIOLOGY OF ANGIOSPERMS

Semester	VIII		
Course Code	BOT462		
Course Title	Botany VIII - A: Reproductive and Developmental biology of Angiosperms		
Type of course	Theory		
LTP	4 0 0		
Credits	4		
Course prerequisite	10+2 with biology		
Course Objective	The aim of this course is to enable the students to		
_	1. Learn the concepts of reproductive and developmental biology of angiosperms		
	2. Learn about the development of flower, root, shoot and leaf		
Course Outcome	By the end of this course, students will be able to understand:		
	1. The development of flower and floral organ		
	2. The development of roots, shoot and leaf		
	3. The pollination, pistil pollen interaction and fertilization		
	4. The pattern of senescence and programmed cell death (PCD), polyembryony and		
	apomixes, dynamics of fruit growth,		
IINIT• I	ABA DAA		

UNIT: I

Flower development: floral evocation, floral organ formation, flowering in perennials, seasonal flowering, polycarpy and biennial bearing. Male and female gametophyte: structure of anther, role of tapetum, microsporogenesis and development of pollen, regulation of asymmetric first pollen mitosis, control of second pollen mitosis and sperm cell differentiation, female gametophyte development: initiation, patterning, cell fate specification and maintenance of cell identities of female gametophyte. Co-evolution of flower vis a vis Pollinators

UNIT: II

Pollination, pollen-pistil interactions and fertilization: pollination mechanisms, pollination syndromes, structure of pistil, pollen germination and compatible pollenstigma interactions, sporophytic and gametophytic self-incompatibility, pollen tube growth and guidance, double fertilization Seed development, fruit growth and dormancy: endosperm development, embryogenesis- landmarks of embryo pattern formation, polyembryony and apomixes, dynamics of fruit growth, importance and types of dormancy, seed dormancy, overcoming seed dormancy, bud dormancy.

UNIT: III

Root development: organization of root apical meristem (RAM); vascular tissue differentiation; lateral roots, root hairs. Root microbe interaction. Leaf growth and differentiation: determination; phyllotaxy; control of leaf form; differentiation of epidermis with special reference to stomata, trichomes, and mesophyll Senescence and programmed cell death (PCD): concept, types of cell death, mechanism of PCD. PCD in the life cycle of plants, metabolic changes associated with senescence significance of Pteridospermales, Cycadeoidales, Cordiatales

UNIT: IV

Patterns in plant development: growth, differentiation and development, genetic control and hormonal regulation of development, physiology of hormones in plant development.

Shoot development: organization of the shoot apical meristem (SAM); cytological and molecular analysis of SAM; mechanisms of cell division and cell to cell communication; tissue differentiation with reference to xylem and phloem; secretary structures and laticifers Wood development in relation to environmental factors, Genetics of Flower Development in *Antirrhinum* and *Arabidopsis*.

S.No.	Name/Title	Author	Publisher
1	The Embryology of Angiosperms.	Bhojwani, S.S. and	Vikas Publishing House,
		Bhatnagar, S.P. 1975.	Delhi.
2	Seeds: Physiology of Development and	Bewley, J.D. and Black,	Plenum Press, New York.
	Germination,	M. 1994.	
3	Morphology of the Angilosperms.	Eames, A.J. 1961.	Tata McGraw Hill
			Publishing Co., Bombay.
4	An Introduction to the Embryology of	Maheshwari, P. 1956.	Tata McGraw Hill
	Angiosperms.		Publishing Co. Bombay –
			New Delhi.

BOTANY VIII - B: METABOLIC INTEGRATION

Semester	VIII	
Course Code	BOT464	
Course Title	Botany VIII - B : Metabolic integration	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	10+2 with biology	
Course Objective	The aim of this course is to enable the students to	
_	1. Learn about the transportation system of the plants and uptake of nitrogen and	
	sulphur	
	2. Learn the concepts of metabolism of biomolecules, signal transduction and	
	Senescence in plants	
Course Outcome	By the end of this course, students will be able to understand:	
	1. The different pathways of biomolecules synthesis and regulation in plants.	
	2. The pathways of signal transduction which can later be used to carry out research	
	and innovation by the students.	
	3. The concepts of metabolism of biomolecules, signal transduction and Senescence	
	in plants	
	4. The concept of environmental influences on senescence	

UNIT: I

Long distance transport: Introduction, Overview of diffusive and active transport in plants, Importance of channel dimensions in defining the transport properties of the apoplast and symplasm. Comparison of xylem and phloem transport. Transpirational water movement in the xylem, Symplasmtic transport via plasmodesmata, Phloem transport, Intercellular transport of endogenous macromolecules, Secondary Metabolites: types, biosynthesisand their role in plants.

UNIT: II

Nitrogen and sulphur: Introduction, Overview of nitrogen in the biosphere and in plants, Overview of nitrogen fixation, Enzymology of nitrogen fixation, Symbiotic nitrogen fixation, Ammonia uptake and transport, Overview of nitrate uptake and reduction, Nitrate reduction, Nitrate reduction, Interaction between nitrate assimilation and carbon metabolism, Overview of sulfate assimilation, Sulfur chemistry and function, Sulfur uptake and transport, The reductive sulfate assimilation pathway, Synthesis and function of glutathione and its derivatives.

UNIT: III

Signal perception and transduction: Introduction, Overview of signal transduction, receptors, specific examples of plant receptors, G-proteins and phospholipid signaling, Cyclic nucleotides, Calcium, Protein kinases: primary elements in signal transduction, Particulars pathways of signal transduction associated with plant growth regulators, The future of plant cell signal transduction research.

UNIT: IV

Senescence and Programmed Cell Death: Types of cell deaths observed in animals and plants, PCD in the life cycle of plants, Overview of senescence, Pigment metabolism during senescence, Protein metabolism in senescence, Impact of senescence of photosynthesis, Impact of senescence on oxidative metabolism, Degradation of nucleic acids during senescence, Regulation of metabolic activity in senescing cells, Endogenous plant growth regulators and senescence, Environmental influences on senescence, Examples of developmental PCD in plants, Examples of PCD as a plant response to stress, Further questions and future directions for PCD research.

S. No.	Name/Title	Author	Publisher
1	Biochemistry and Molecular Biology of Plants.	Buchanan, B.B., Gruissem, W., and Jones, R.L. (2666).	American Society of Plant Physiologists, Maryland.
2	Lehninger Principles of Biochemistry: 6th Edition	Nelson, D. L., Cox, M.M	Macmillan Learning, 2612
3	Galston, A.W. (1989).	Life Processes in Plants.	Scientific American Library, Springer-Verlag, New York.
4	Plant Physiology.	Taiz, L., and Zeiger, E. (1998).	Sinauer Associates, Inc., Publishers, Massachusetts.
5	Salisbury, F.B., and Ross, C.W. (1992).	Plant Physiology,	Wadsworth Publishing Co., California.
6	Plant Physiology	Taiz and Zeinger	Sinauer Associates

BOTANY VIII - C : PLANT NATURAL RESOURCES, CONSERVATION AND SUSTAINABLE DEVELOPMENT

Semester	VIII	
Course Code	BOT466	
Course Title	Botany VIII - C: Plant natural resources, conservation and sustainable	
	development	
Type of course	Theory Course	
LTP	4 0 0	
Credits	3	
Course prerequisite	10+2 with biology	
Course Objective	The aim of this course is to enable the students to	
	1. Learn about the different plant natural resources their conservation and sustainable development	
	2. Learn about the various role of organizations and programmes, treaties in the conservation and sustainable use of biodiversity and resources	
Course Outcome	By the end of this course, students will be able to understand:	
	1. About the different types of natural resources available	
	2. The sustainable use of these energy processes	
	3. About the economic, social and environmental impact of utilization of natural	
	resources	
	4. The various organizations programmes and treaties working for the conservation	
	and sustainable use of resources from nature	

UNIT 1:

Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues. Ecological, social and economic dimension of resource management.

UNIT: II

Different types of resources, their production, management and sustainability; Forest resources, Land resources, Water resources, Energy resources, Food resources, Fish and other marine resources, Mineral resources, Resource Management Paradigms.

Management of Common International Resources: Ocean, climate, International fisheries and management commissions; Antarctica: the evolution of an international resource management regime

UNIT: III

Global and local governance, challenges of good governance. Ostrom design principles and basic frameworks, organizational structure and stakeholders in NRM and livelihood. Natural Resource Governance in rapidly changing world. Local utilization and institutions: Joint Forest Management Committees (JFMCs), watershed committees, irrigation committees, Forest Rights Act (FRA) committees, Biodiversity Management Committees (BMCs), etc.

International and National efforts: CITES and other international treaties and conventions, roles of international organizations and NGOS with special reference to UN and specialized agencies, institutional regulatory bodies and authorities: direct intervention by the state, green business and green ethics, stakeholder analysis, understanding and managing governance issue, governance tactics and tools, CSR (Corporate Social Responsibility) as a tool for sustainable NRM based business.

UNIT: IV

Concept of Economic value, relevance of environmental economics, ecosystems services, direct and indirect economic benefit from – forest ecosystems, mountain ecosystems, mineral and water resources, ecotourism.

Conservation and management, cost / benefit analysis, methods of costing, cost criteria, evaluating alternative projects, operational vs. total costs, determining benefiting vs. comprehensive stakeholders Application of resource accounting Methods of pricing resources- example forest and mineral resources.

Role of national and international organizations in the promotion of sustainable natural resource use and management.

S.No	Name/Title	Author	Publisher
1	Ecology of Natural Resources	Francois Ramade 1984.	John Wiley & Sons Ltd
2	Nature and the Marketplace: Capturing The Value	Heal, Geoffrey. 2666.	Island Press
	Of Ecosystem Services		
3	A New Century for Natural Resources Management.	Knight, Richard L., editor, et al. 1995	Island Press
4	Introduction to Forestry and Natural Resources	Donald L. Grebner, Peter Bettinger and Jacek P	Elsevier
5	Environmental and Natural Resource Economics: A	Harris, J.M. 2666	Houghton Mifflin
	Contemporary Approach, 2nd edition.		
6	Economics: Natural Resources Scarcity and	Barber, E. 1989.	Earthscan
	Development		

BOTANY VIII - D: ADVANCED INDUSTRIAL BOTANY

Semester	VIII	
Course Code	BOT468	
Course Title	Botany VIII - D : Advanced industrial botany	
Type of course	Theory Course	
LTP	4 0 0	
Credits	4	
Course prerequisite	10+2 (Medical)	
Course Objective	The aim of this course is to enable the students to	
	1. Learn about the various industrial application of the plant product and their	
	extraction	
	2. Learn about the various plant based resources used in the manufacturing of	
	products	
Course Outcome	By the end of this course, students will be able to understand:	
	1. The different types of plants and their parts used for industrial application	
	2. The different processes take place to produce the product from the raw material	
	3. The different types of industries and products based on plant and their parts	
	4. The various parts of plants used as ingredient for the preparation of medicines	

UNIT 1:

Physical characteristics of Indian woods: Methods of seasoning and chemical treatment of specialized use, fire proofing of the wood. Industrial manufacturing of packing material and plywood and the classifications of plywoods according to their use. Some important commercial woods: Dalbergia spp., Shorea robusta, Tectona grandis, Cedrus deodara, Bamboo-the 'green gold' of India.

Manufacturing of paper and board from raw plant material: Manufacturing of crude and high quality paper, recycled paper.

UNIT: II

Extraction of sugar from sugar cane. Flow diagram of the process with a critical study of the steps involved, problems faced by the sugar industry in India. Bye-products of sugar industry, distillation of alcohol and other products with special reference to distilleries in Punjab.

Agro industries in India with particular reference to Punjab. The manufacturing and packing of milk and milk products, pickles, jams, jellies, juices, pastes, sauces etc. Problems of storage and marketing.

UNIT: III

Sources of natural dyes in India and their extraction methods, merits and limitations of plant based dyes. Sources and methods of extractions of vegetable oils and fats and their utilization

UNIT: IV

An introduction to pharmaceutical industry in India, extraction of antibiotics from microorganisms. Medicines extracted from higher plants, Industrial manufacturing of quinine, the concept of nutraceuticals, their availability, uses & problems.

Essential oil yielding plants of India, their use in perfumery and extraction, Sources of gums and resins and their classifications according to their chemical nature. Extraction of the raw resin and down the line processing for turpentine and other products. A, DISTT. JALANDHAR (PUNJAB)

S.No.	Name/Title	Author	Publisher
1	Economic Botany in the Tropics.	Kochhar S. L. (1998).	MacMillan India limited,
			Delhi.
2	Economic Botany (3 rd Ed.)	Pandey B P (1984).	S. Chand & Company
			Ltd.New Delhi
3	The Common Commercial Timbers of India And	Trotter H (1982).	The Controller of
	TheirUses.		Publications, Delhi.
4	The Useful Plants of India. (3 rd Ed.)	Ambasta S P (1994).	Publications & Information
			Directorate, New Delhi.

BOTANY VIII - E: ETHNOBOTANY AND PHARMACOGNOSY

Semester	VIII		
Course Code	BOT470		
Course Title	Botany VIII - E: Ethnobotany and pharmacognosy		
Type of course	Theory Course		
LTP	4 0 0		
Credits	4		
Course prerequisite	10+2 (Medical).		
Course Objective	The aim of this course is to enable the students to		
	1. Learn the traditional ethnobotanical wisdom from the tribal people and its role		
	in development of modern medicine		
	2. Learn about the various important plants used as ingredients in the traditional		
	medicinal system of Indian tribe		
Course Outcome	Students will understand		
	1. The use of different plants and its parts in traditional by many ethnic people		
	2. The medicinal use of plants		
	3. The different types of methodologies used by local people to cure many diseases		
	and their pharamacognosy		
	4. The role of tribes in conservation of plant genetic resource		

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

Traditional Systems of Medicine: Brief history of use of medicinal herbs; Introduction to indigenous systems of medicines- Ayurveda, Unani and Siddha system of medicine.

Plants Used by the Tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous usesd Sacred plants. 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, Taxus wallichiana, Trichopus zeylanicus, Artemisia, Withania

UNIT: III

Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management). 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.

UNIT: IV

Pharmacognosy and pharmacopial standards of Adhatoada vasica, Arctium lapa, Terminalia belerica, Bidens tripartite, Sida rhombifolia, Symplocos racemose, Syzygium aromaticum, Tectona grandis.

Text and Reference books:				
S.No.	Name/Title	Author	Publisher	
1	Traditional Systems of Medicine	Abdin, M.Z. and Y.P. Abrol, Y.P. 2006.	Narosa Publishing House, New Delhi.	
2	Plants, People and Culture: The Science of Ethnobotany.	Balick, M.J. and Cox, P.A. 1996.	The Science of Ethnobotany. Scientific American Library	
3	Ethnobotany: Principles and Applications	Colton C.M. 1997.	John Wiley and Sons.	
4	Wealth of India (Vol 1-13)		CSIR New Delhi	

BOTANY VIII - A: PRACTICAL COURSE ON REPRODUCTIVE BIOLOGY OF ANGIOSPERM

Semester	VIII	
Course Code	BOT472	
Course Title	Botany VIII - A : Practical course on reproductive biology of angiosperm	
Type of course	Laboratory Course	
LTP	0 0 4	
Credits	2	
Course prerequisite	10+2 with biology	
Course Objective	The aim of this course is to enable the students to	
	1. Study of comparative morphology and anatomy of vegetative and	
	reproductive stages of angiosperm	
	2. Understand different developmental stages of plant embryology.	
Course Outcome	y the end of this course, students will be able to understand:	
	1. The different specimens of hydrophytes and study their adaptation by	
	observing.	
	2. The cytological zonation in the shoot apical meristem and study the detail of	
	monocot and dicot shoot and root system.	
	3. The different types of stomata in the plants. Students will prepare their own	
	slides of stomata and count the stomata in the various plants.	
	4. Different types of ovules, embryo sacs through examination of permanent	
	slides	

LIST OF EXPERIMENTS

- 1. Study of living shoot apex of Hydrilla and other hydrophytes
- 2. Study of cytological zonation in the shoot apical meristem in double stained permanent slides of any suitable plant.
- 3. Study of different leaf arrangements
- 4. Study of epidermal peels of leaves of appropriate to study various stomata types
- 5. Study of anatomy of dicot and monocot roots and stems using appropriate materials
- 6. Study of microsporogenesis and gametogenesis in appropriate materials
- 7. Study of different types of ovules, embryo sacs through examination of permanent slides
- 8. Study of pollens of different angiosperm
- 9. Study of phyllotaxy in plants
- 10. Study of different types of seeds in monocots and their anatomy
- 11. Study of different methods of nitrogen fixation by plants in nature.

Text and Reference books:

S. No.	Name/Title Name/Title	Author	Publi <mark>she</mark> r
1	Plant Physiology	Salisbury, F.B., and Ross, C.W. (1992).	Wadsworth Publishing Co., California.
2	Plant Physiology, Development and Metabolism	Satish C Bhatla · Manju A. Lal	Springer
3	An Introduction to the Embryology of Angiosperms.	Maheshwari, P. 1950.	Tata McGraw Hill Publishing Co. Bombay – New Delhi.
4	Plant Physiology.	Taiz, L., and Zeiger, E. (1998).	Sinauer Associates, Inc., Publishers, Massachusetts.

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BOTANY VIII - B: PRACTICAL COURSE ON METABOLIC INTEGRATION

Semester	VIII		
Course Code	BOT474		
Course Title	Botany VIII - B: Practical course on metabolic integration		
Type of course	Laboratory Course		
LTP	0 0 4		
Credits	2		
Course prerequisite	10+2 with biology		
Course Objective	The aim of this course is to enable the students to		
	1. Study the concepts of metabolism of biomolecules, signal transduction and		
	senescence in plants		
	2. The transportation of water, mineral and sap through xylem and phloem		
Course Outcome	By the end of this course, students will be able to understand:		
	1. The transportation of water, mineral and sap through xylem and phloem by		
	performing experiments in lab.		
	2. Senescence of plants by experimentation		
	3. Sensitivity and movements of certain plants with experimentation		
	4. Drought stress by observing the experimentation		

LIST OF EXPERIMENTS

- 1. Study of water and mineral transport by observing water moving through plants.
- 2. Study of sap transport through phloem in plants.
- 3. Determination of transpiration ratio or water use efficiency.
- 4. Determination of senescence in plants.
- 5. Growing plants in nutrient solution without soil (Hydroponics)
- 6. Determination of genotype from the data provided
- 7. Study of plants and its sensitivity Mimosa pudica and Cassia fasciculata from Leguminosae and Biophytum sensitivum from Oxalidaceae
- 8. Experimentation in plants on Programmed Cell Death
- 9. To grow plants under salt and drought stress and demonstration of different stress enzymes like catalase, superoxide dismutase, peroxidase

S. No.	Name/Title	Author	Publisher
1	Plant Physiology	Salisbury, F.B., and Ross, C.W. (1992).	Wadsworth Publishing Co., California.
2	Plant Physiology, Development and Metabolism		Springer
3	An Introduction to the Embryology of Angiosperms.	Maheshwari, P. 1950.	Tata McGraw Hill Publishing Co. Bombay – New Delhi.
4	Plant Physiology.	Taiz, L., and Zeiger, E. (1998).	Sinauer Associates, Inc., Publishers, Massachusetts.



BOTANY VIII - C: PRACTICAL COURSE ON ADVANCED INDUSTRIAL BOTANY

Semester	VIII		
Course Code	BOT476		
Course Title	Botany VIII - C : Practical course on advanced industrial botany		
Type of course	Laboratory Course		
LTP	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 the concepts of different plant material used as commercial and industrial		
	products		
	2. Learn the various methods to process the raw material of plants into products in		
	the lab		
Course Outcome	By the end of this course, students will be able to understand:		
	1. The various plants parts used in commercial and industrial products .		
	2. The different manufacturing process and packages made from plants and plants		
	part.		
	3. The extraction of medicine, perfume, gum and resins from different plants and		
	their parts.		
	4. Manufacturing of milk and milk products.		

LIST OF EXPERIMENTS

1. Collection and sampling of different types of woods from the campus and study its uses.

SBBSU

- 2. Extraction of sugar from sugarcane or visit to sugar mill
- 3. Process of manufacturing of Juice, jelly, pastes and sauces and their packaging.
- 4. Manufacturing of Milk and its products or visit to milk plant.
- 5. Extraction dyes from the plants
- 6. Extraction of oil and perfume from the plants
- 7. Study of medicinal plants from the campus and use of plants and its parts in making products
- 8. Extraction of raw gums and resins from the plants and their parts.

S.No.	Name/Title	Author	Publ <mark>ish</mark> er	
1	Economic Botany in the Tropics.	Kochhar S. L. (1998).	MacMillan India limited,	
	90 E	Tell Tell	Delhi.	
2	Economic Botany (3 rd Ed.)	Pandey B P (1984).	S. Chand & Company	
			Ltd.New Delhi	
3	The Common Commercial Timbers of India And	Trotter H (1982).	The Controller of	
	TheirUses.		Publications, Delhi.	
4	The Useful Plants of India. (3 rd Ed.)	Ambasta S P (1994).	Publications & Information	
	KHTZ		Directorate, New Delhi.	
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SKILL ENHANCEMENT COURSES

(Semester III - VI)

KHIALA, DISTT. JALANDHAR (PUNJAB)

MEDICINAL BOTANY

Semester	III	
Course Code	BOT 265	
Course Title	Medicinal Botany	
Type of course	Skill Enhancement Courses	
LTP	2 0 0	
Credits	2	
Course prerequisite	B.Sc. Medical II year	
Course Objective The aim of this course is to enable the students to		
	1. Understand medicinal plant with references to Botany.	
	2. Understand the concept of Ayurveda, Siddha, Unani and Ethnobotany	
Course Outcome	By the end of this course, students will be able to understand:	
	1. The scope and importance of medicinal plants and traditional medical	
	systems in India	
	2. The conservation of endangered and endemic plants their use in ethnobotany	
	3. The propagation of medicinal plants, objective of nursery	
	4. The use of Ethno botany and folk medicine in India and application of	
	natural products for curing some diseases	

Unit 1: History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope-Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations. (16 Lectures)

Unit 2: Conservation of endangered and endemic medicinal plants. Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding. (16 Lectures)

Unit 3: Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases. (16 Lectures)

S.No	Title	Author(s)	Publisher
1	Medicinal Plants: Ethnobotanical	Trivedi P C,	Tata McGraw-Hill
	Approach, Agrobios, India.		Publishing Co. Ltd
2	Medicinal Plant Cultivation: A	Purohit and Vyas	Oxford University
	Scientific Approach, 2nd edn.		Press, New York
	Agrobios, India.		-TATTAB)
JALA, DISTT. JALANDHAR (PUNJA)			

FLORICULTURE

Semester	IV	
Course Code	BOT266	
Course Title	Floriculture	
Type of course	Theory	
LTP	$\begin{vmatrix} 2 & 0 & 0 \end{vmatrix}$	
Credits	2	
Course prerequisite	B.Sc IInd 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.

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

ETHNOBOTANY

Semester	IV	
Course Code	BOT268	
Course Title	Ethnobotany	
Type of course	Theory	
LTP	0 0 4	
Credits	2	
Course prerequisite	10+2 Medical	
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. (6 Lectures)

Unit 2: Methodology of Ethnobotanical studies

a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places. (6 Lectures)

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). (16 Lectures)

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. (8 Lectures)

S. No.	Title	Author	Publisher
1	Manual of Ethnobotany,	S.K. Jain	Scientific Publishers, Jodhpur, 1995
2	Glimpses of Indian. Ethnobotny	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

MUSHROOM CULTURE TECHNOLOGY

Semester	V	
Course Code	BOT374	
Course Title Mushroom Culture Technology		
Type of course Theory		
LTP	2 0 0	
Credits	2	
Course prerequisite	B.Sc IInd year	
Course Objective	The aim of this course is to enable the students to	
	1. Study about commercial aspect of mushroom cultivation in India which may	
	motivate students to take up it as professional occupation	
	2. Learn about various types of food and products developed from mushroom	
Course Outcome	By the end of this course, students will be able to understand:	
	1. Various types of edible and poisonous mushrooms available in India	
	2. Cultivation of mushroom and preparation of low cost composting material	
	for mushroom cultivation	
	3. Storage of mushroom and their post harvesting till marketing	
	4. Mushroom research centers, and their marketing	

UNIT-I

Introduction, history: Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - Volvariella volvacea, Pleurotus citrinopileatus, Agaricus bisporus. UNIT-II

Cultivation Technology: Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production.

UNIT-III

Storage and nutrition: Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.

UNIT-IV

Food Preparation: Types of foods prepared from mushroom. Research Centres -National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

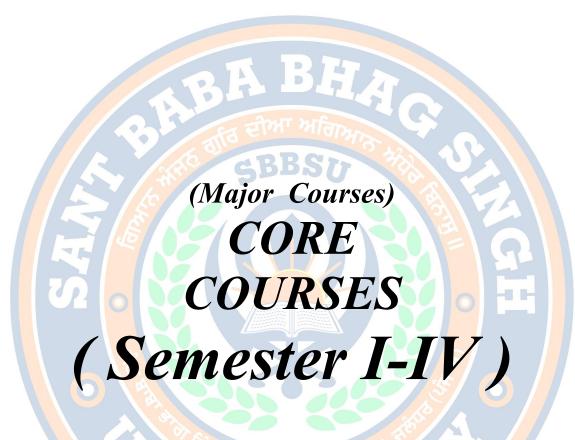
S. No.	Title	Author	Publisher
1	Mushroom Cultivation	S C Tewari and Pankaj Kapoor	Mittal Publications
2	Mushroom Production and Processing Technology	V N Pathak	Agrobios India
3	Mushroom Cultivation and Uses Suman and B C Sharma Agrobios India		Agrobios India
4	Food and Nutrition	M Swaminathan	Bangalore Printing and Publishing Co.



4 year programme

(As Per NEP)

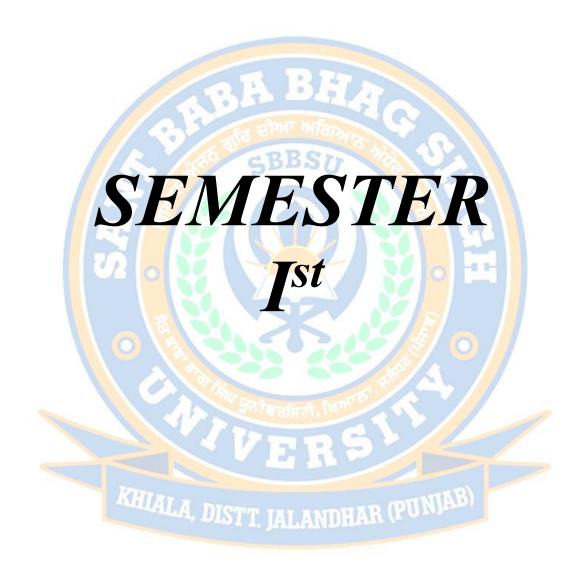
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CHEMISTRY-I: ATOMIC STRUCTURES, BONDING, GENERAL ORGANIC CHEMISTRY AND ALIPHATIC HYDROCARBONS

Semester	I	
Course Code	CHM161	
Course Title	Chemistry-I: Atomic Structures , Bonding , General Organic Chemistry and Aliphatic	
	Hydrocarbons	
Type of course	CORE (Theory)	
LTP	400	
Credits	4	
Course prerequisite	10+2 with chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Enhance knowledge in Chemical bonding atomic / molecular structure.	
	2. Impart knowledge about basic concepts of organic chemistry.	
	3. Visualizing the organic molecules in a three-dimensional space.	
Course Outcome (CO)	me (CO) By the end of the course, the students will be able to:	
1. Solve the conceptual questions using the knowledge gained from quantum me		
	model of the atom, quantum numbers, electronic configuration, radial and angu	
	distribution curves, shapes of s, p, and d orbitals, and periodicity in atomic radii, ionic radii,	
	ionization energy, and electron affinity of elements.	
	2. Draw the plausible structures and geometries of molecules using Radius Ratio Rule	
100	VSEPR theory and MO diagrams.	
	3. Able to explains significance of quantum numbers, de-Broglie's dual behaviour of matte	
	and Heisenberg's uncertainty principle and solve numerical problems.	
	4. Understand and explain the different nature and behavior of organic compounds and able	
	to analyse and evaluate fundamental concepts of stereochemistry	

Unit-I

Atomic Structure: Review of: Bohr's theory and its limitations, dual behavior of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic 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, orbital angular momentum and quantum numbers ml and ms . Shapes of s, p and d atomic 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.

Unit-II

Chemical Bonding and Molecular Structure Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO⁺. Comparison of VB and MO approach

Unit-III

Fundamentals of Organic Chemistry: Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyper-conjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

Stereochemistry: Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Unit-IV

Aliphatic Hydrocarbons Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO₄) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidatioN

Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC₂ and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4

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	Joh <mark>n W</mark> iley
5	Stereochemistry	P.S. Kalsi	New age International
6	Organic reaction mechanism	Singh and Mukharie	New age International



CHEMISTRY-I: ATOMIC STRUCTURES , BONDING , GENERAL ORGANIC AND CHEMISTRY AND ALIPHATIC HYDROCARBONS PRACTICAL

Semester	I	
Course Code	CHM163	
Course Title	Chemistry-I: Atomic Structures, Bonding, General Organic and Chemistry and	
	Aliphatic Hydrocarbons Practical	
Type of course	CORE (Practical)	
LTP	0:0:4	
Credits	2	
Course prerequisite	10+2 with chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Impart practical knowledge about the separation of organic molecules.	
	2. Study estimation of inorganic salt and metal ions.	
Course Outcome (CO)	By the end of the course, students will be able to:	
	1. Estimate and identify the various ions in stock solutions.	
	2. Detection of elements (N, S and halogens) in organic compounds, Detection of	
	functional groups	
	3. Identify amino acid & sugars through chromatographic methods	

Volumetric Analysis

Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.

Estimation of oxalic acid by titrating it with KMnO4.

Estimation of water of crystallization in Mohr's salt by titrating with KMnO4.

Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator.

Estimation of Cu (II) ions iodometrically using Na2S2O3.

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, glutamic acid, tyrosine or any other amino acid) by paper chromatography

Identify and separate the sugars present in the given mixture by paper chromatography.

Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC).

S. No	Name	Author(S)	Publisher
1	Vogel's Qualitative Inorganic Analysis (7th Ed.)	G Svehla	Prentice Hall
2	Laboratory Manual in Organic Chemistry	R.K. Bansal,	Wiley Eastern
3	Advanced Experimental Chemistry. Vol. I	Physical, 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	J. Basseff, R.C. Dennery, G.H.	ELBS
	Analysis (revised),	Jeffery and J. Mendham	

^{*}Perform any four experiments from each section



Semester	II	
Course Code	CHM 162	
Course Title	Chemistry-II: Chemical Energetic, Equilibrium and Functional Group Organic – I	
Type of course	CORE (Theory)	
LTP	4:0:0	
Credits	4	
Course prerequisite	10+2 with chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to 1. Enhance the knowledge regarding Physical concepts of chemistry like Chemical Energetic, Chemical Equilibrium. 2. Impart knowledge of general organic chemistry of aromatic systems and functional groups.	
Course Outcome (CO)	By the end of the course, students will be able to: 1. Acquire the knowledge of thermodynamic property of any system, Chemical & Ionic equilibria of various systems. 2. Apply the concepts of concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt, pH and electrolytes. 3. Understand preparation, properties and reactions of haloalkanes, haloarenes and oxygen containing functional groups. 4. Use the synthetic chemistry for functional group transformations & to propose plausible mechanisms for any relevant reaction.	

Unit-I

Chemical Energetics: Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermo-chemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Unit-II

Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between G and G° , Le Chatelier's principle. Relationships between Kp, Kc and Kx for reactions involving ideal gases.

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. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions.

Unit-III

Aromatic hydrocarbons Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Alkyl and Aryl Halides, Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution (SN1, SN2 and SNi) reactions Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH₂/NH₃ (or NaNH₂/NH₃).Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Unit-IV

Alcohols, Phenols and Ethers (Up to 5 Carbons)

Alcohols: Preparation: Preparation of 1°, 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with

PCC, alk.KMnO₄, acidic dichromate, conc. HNO₃). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben-Hoesch Condensation, Schotten-Baumann Reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetandehyde) Preparation: from acid chlorides and from nitriles. Reactions – Reaction with HCN, ROH, NaHSO3, NH2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.

S. No	Name	Author(S)	Publisher
1	Organic reaction mechanism, 3 rd ed.	V. K. Ahluwalia	Narosa publishing house, New
	Latest edition		Dehli
2	Organic Chemistry	Morrison and Boyd	Prentice Hall
3	Fundamentals of Organic Chemistry	Solomons	John Wiley
4	The Elements of Physical Chemistry	P.w. Aikins	Oxford
5	Physical Chemistry	R.A. Alberty	Wiley Eastern Ltd



CHEMISTRY-II: CHEMICAL ENERGETIC, CHEMICAL EQUILIBRIUM AND FUNCTIONAL GROUP **ORGANIC-I**

Semester	II	
Course Code	CHM 164	
Course Title	Chemistry-II: Chemical energetic, Chemical Equilibrium and Functional Group organic-I	
Type of course	Core (Practical)	
LTP	0:0:4	
Credits	2	
Course prerequisite	10+2 with chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Get provide practical knowledge about the preparation of organic compounds.	
	2. Study basis of thermo-chemistry and Ionic equilibrium.	
Course Outcome (CO)	By the end of the course, students will be able to:	
	1. Acquire basic concepts of thermochemistry, Analyse thermodynamic parameters of solutions	
	and salt mixtures.	
	2. Find out the acidity, Basicity and pKa Value on pH meter.	
	3. Accurately evaluate separation, purifications techniques, of organic compounds.	

Section A: Physical Chemistry

Thermochemistry

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

Ionic equilibria

- Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps using pH-meter.
- Preparation of buffer solutions: Sodium acetate-acetic acid; Ammonium chloride-ammonium hydroxide

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3. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry

- Purification of organic compounds by crystallization (from water and alcohol) and distillation.
- 2. Criteria of Purity: Determination of melting and boiling points.
- Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.

Bromination of Phenol/Aniline; Benzoylation of amines/phenols

Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone; Acetylation of amines/phenols

S. No	Name	Author(S)	Publisher
1	Electrochemical methods, Fundamentals and Methods	A.J. Bard, L.R. Faulkner	Wiley, 1980.
2	Experimental Physical Chemistry	C. Das, B. Behera	McGraw Hill

^{*}Perform any four experiments from each section LA, DISTT. JALANDHAR (PUNJAB)



CHEMISTRY-III: SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY AND FUNCTIONAL GROUP ORGANIC-II

Semester	III		
Course Code	CHM 261		
Course Title	Chemistry-III: Solutions , Phase Equilibrium, conductance, electrochemistry and		
	functional group organic-II		
Type of course	Core (Theory)		
LTP	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 enable the students to		
	1. Impart knowledge about basic of solution chemistry, phase equilibia.		
	2. Impart knowledge of Electrochemistry.		
	3. Aquint students about organic chemistry and natural polymers.		
Course Outcome (CO)	By the end of the course, students will be able to:		
	1. Acquire coherent knowledge of solutions, phase equilibrium and conductance		
	2. Learn the working of electrochemical cells, EMF & pH determination.		
	3. Understand structure and bonding in carboxylic acids and amine derivatives & Use the		
	synthetic chemistry for functional group transformations.		
	4. Identify & Analyse structural components, configuration of amino acids, proteins and		
	Carbohydrates		

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 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

Phase Equilibrium: Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase 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).

Unit-II

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.

Unit-III

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Carboxylic acids and their derivatives

Carboxylic acids (aliphatic and aromatic) Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell – Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons) Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

Amines and Diazonium Salts Amines (Aliphatic and Aromatic): (Upto 5 carbons)Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO₂, Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

Unit-IV

Amino Acids, Peptides and Proteins: Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitterion, Isoelectric point and Electrophoresis Reactions of Amino acids: ester of –COOH group, acetylation of –NH2 group, complexation with Cu²⁺ ions, ninhydrin test.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C-terminal (thiohydantoin and with carboxypeptidase enzyme).

Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in mono-saccharides.

S. No	Name	Author(S)	Publisher
1	Natural Products: Chemistry and Biological	Mann, J.; Davidson, R.S.; Hobbs,	Longman, Esse
	Significance,	J.B.;Banthrope,D.V.;Harborne, J.B.	
2	Organic reaction mechanism, 3 rd ed. Latest	V. K. Ahluwalia	Narosa publishing
	edition		house, New Dehli
3	Organic Chemistry	Morrison and Boyd	Prentice Hall
40	Fundamentals of Organic Chemistry	Solomons	John Wiley
5	The Elements of Physical Chemistry	P.w. Aikins	Oxford
6	Physical Chemistry	R.A. Alberty	Wiley Eastern Ltd
7	Physical Electrochemistry- Fundamentals,	Eliezer Gileadi,	Wiley-VCH
	Techniques and Applications		



CHEMISTRY-III: SOLUTIONS, PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY AND FUNCTIONAL ORGANIC-II (PRACTICAL)

Semester	III
Course Code	CHM 263
Course Title	Chemistry-III: Solutions, Phase equilibrium, Conductance, Electrochemistry and Functional Organic-II (Practical)
Type of course	Core (Practical)
LTP	0:0:4
Credits	2
Course prerequisite	B.Sc. 1st with chemistry as core subject
Course Objective (CO)	The aim of this course is to enable the students to
	1. Gain practical knowledge about conductometry.
	2. Perform potentiometric analysis and qualitative organic analysis.
Course outcome (CO)	By the end of the course, students will be able to:
	1. Demonstrate and calculate various parameters of distribution & phase equilibria
	2. Calculate molar and normal solution of various concentrations.
	3. Perform and evaluate outcomes of conductometric & potentiometric titrations.
	4. Study 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. $I2(aq) + I^{-}(aq)$ $I3^{-}(aq)Cu^{2+}(aq) + xNH2(aq)$ $[Cu(NH3)x]^{2+}$
- 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 possessing monofunctional 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

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

^{*}Perform any four experiments from each section



CHEMISTRY-IV: TRANSITION METAL & COORDINATION CHEMISTRY, STATES OF MATTER AND CHEMICAL KINETICS

Semester	IV
Course Code	CHM 262
Course Title	Chemistry-IV: Transition Metal & Coordination Chemistry, States of Matter and
	Chemical Kinetics
Type of course	CORE (Theory)
LTP	4:0:0
Credits	4
Course prerequisite	BSc. 1st with chemistry as core subject
Course Objective (CO)	The aim of this course is to enable the students to
	1. Impart knowledge about basic of transition elements.
	2. Impart basic knowledge of bonding of transition elements,
	3. Study states of matter and chemical kinetics.
Course Outcome (CO)	By the end of the course, the students will be able to:
	1. Understand the terms, ligand, denticity of ligands, chelate, coordination number and
	use standard rules to name coordination compounds.
	2. 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
	3. Derive mathematical expressions for different properties of gas, liquid and solids and
	understand their physical significance.
	4. 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).

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



CHEMISTRY-IV: TRANSITION METAL & COORDINATION CHEMISTRY, STATES OF MATTER AND CHEMICAL KINETICS (PRACTICAL)

Semester	IV
Course Code	CHM 264
Course Title	Chemistry-IV: Transition Metal & Coordination Chemistry, States of Matter and Chemical Kinetics (Practical)
Type of course	Core (Practical)
LTP	0:0:4
Credits	2
Course prerequisite	BSc. 1st with chemistry as core subject
Course Objective (CO)	The aim of this course is to enable the students to
	1. Impart practical knowledge to the students about semi micro qualitative analysis.
	2. Study practically physical properties of solutions.
Course Outcome (CO)	By the end of the course, students will be able to:
	1. Analyse and estimate Qualitative analysis of inorganic cations & anions.
	2. Calculate viscosity and surface tension of different liquids and solutions.
	3. Understand and apply gravimetric analysis and complexometric titrations.
	4. Derive mathematical expressions of chemical kinetics methods.

Section A: Inorganic Chemistry

1. **Semi-micro qualitative analysis** (using H₂S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:

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- 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^-} , $S_2^{0^2}$, $S_2O_3^{2^-}$, NO_3^- , CH_3COO^- , CI^- , 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) Mg²⁺ or (ii) Zn²⁺ 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:

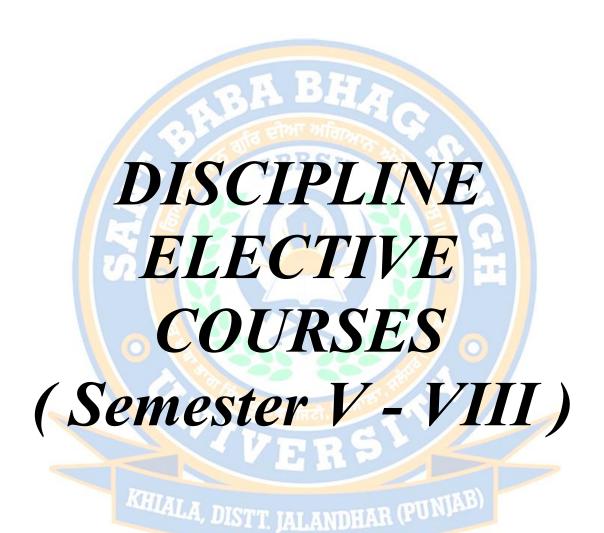
Acid hydrolysis of methyl acetate with hydrochloric acid.

Saponification of ethyl acetate.

Compare the strengths of HCl and H₂SO₄ by studying kinetics of hydrolysis of methyl acetate

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,

^{*}Perform any four experiments from each section





CHEMISTRY-V: MOLECULES OF LIFE

Semester	V
Course Code	CHM 361
Course Title	Chemistry-V: Molecules of Life
Type of course	Discipline Elective course (Theory)
LTP	4:0:0
Credits	4
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as one core subject
Course Objective (CO) The aim of this course is to enable the students to	
	1. Impart coherent knowledge to the students about organometallic chemistry.
	2. Impart knowledge of polynuclear hydrocarbons and organic spectroscopy.
Course Outcome (CO)	By the end of this course, students will be able to
	1. Understand and demonstrate how structure of biomolecules determines their
	reactivity and biological functions.
	2. Gain insight into concepts of heredity through the study of genetic code,
	replication, transcription and translation.
	3. Demonstrate understanding of metabolic pathways, their inter-relationship,
	regulation and energy production from biochemical processes.

UNIT I

Carbohydrates Classification of carbohydrates, reducing and non-reducing sugars, General properties of glucose and fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose. Linkage between monosachharides, structure of disacharrides (sucrose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.

Amino Acids, Peptides and Proteins Classification of Amino Acids, Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins.

Determination of primary structure of peptides, determination of N-terminal amino acid (by DNFB and Edman method) and C-terminal amino acid (by thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid phase synthesis.

UNIT-II

Enzymes and correlation with drug action

Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition(Competitive and Non- competitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure –activity relationships of drug molecules, binding role of –OH group, NH2 group, double bond and aromatic ring,

UNIT - III

Nucleic Acids Components of nucleic acids: Adenine, guanine, thymine and Cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (**nomenclature**), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (**types of RNA**), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

Lipids Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

UNIT IV

Concept of Energy in Biosystems Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.

S. No	Name	Author(S)	Publisher
1.	Lehninger's Principles of Biochemistry 7th Ed.,	Nelson, D. L. & Cox, M. M.	W. H. Freeman.
2.	Biochemistry, 2002	Berg, J.M., Tymoczko, J.L. & Stryer, L.	W.H. Freeman,
3.	Bioinorganic Chemistry	Bertini, H. B. Grey, S. J. Lippard and J. S. Valentine	Viva Books Pvt. Ltd., New Delhi (1998
4.	Biological Inorganic Chemistry: An Introduction	Robert Crichton	.Elsevier Science (2008)
5.	Organic Chemistry (Vol. I & II),	I.L. Finar	E.L.B.S.
6.	Inorganic Chemistry	G.L. Miessler & Donald A. Tarr	Pearson Publication.
7.	Organic Chemistry	R.T. Morrison & R.N. Boyd	Prentice Hall.
8.	A Guide Book to Mechanism in Organic Chemistry	Peter Sykes:	Orient Longman.



CHEMISTRY-V: MOLECULE OF LIFE (PRACTICAL)

Semester	V	
Course Code	CHM 363	
Course Title	Chemistry-V: Molecule of life (Practical)	
Type of course	Discipline elective(Practical)	
LTP	0:0:4	
Credits	2	
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as one core subject	
Course Objective (CO) The aim of this course is to enable the students to		
	1. Impart practical knowledge about the biochemical analysis.	
	2. Study extraction and purification of organic biomolecules.	
Course Outcome (CO)	By the end of the course, the students will be able to:	
	1. Identify and carry out qualitative & quantitative analysis of biomolecules in stock	
	solutions.	
	2. Analyze biochemical analysis of proteins, amino acids and carbohydrates.	
	3. Familiar with paper chromatography.	

- 1. Separation of amino acids by paper chromatography
- 2. To determine the concentration of glycine solution by formylation method.
- 3. Estimation of glucose by Fehling's solution.
- 4. Estimation of proteins by Lowry's method.
- 5. Determination of the isoelectric pH of a protein.
- 6. Study of titration curve of glycine
- 7. Action of salivary amylase on starch
- 8. Effect of temperature on the action of salivary amylase on starch.
- 9. To determine the saponification value of an oil/fat.
- 10. To determine the iodine value of an oil/fat
- 11. Differentiate between a reducing/ non reducing sugar.
- 12. Extraction of DNA from onion/cauliflower
- 13. To synthesise aspirin by acetylation of salicylic acid and compare it with theingredient of an aspirin tablet by TLC.

S. No	Name	Author(S)	Publisher
1	Vogel's Textbook of Practical Organic Chemistry	Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R.	ELBS.
2	Comprehensive Practical Organic Chemistry	Ahluwalia, V.K. & Aggarwal, R.	Universities Press.
3	Textbook of Practical Organic Chemistry, 5th edition, 1996.	Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G	Prentice-Hall
4	(2012), Biochemical Tests: Principles and Protocols.	Kumar, A.; Garg, S.; Garg, N.	Viva Books.

CHEMISTRY-V: ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY

Semester	V		
Course Code	CHM 365		
Course Title	Chemistry-V: Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR spectroscopy		
Type of course	Discipline Elective course (theory)		
LTP	4:0:0		
Credits	4		
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as one core subject		
Course Objective (CO)	The aim of this course is to enable the students to 1. Impart coherent knowledge about organometallic chemistry. 2. Impart basic knowledge of polynuclear hydrocarbons and organic spectroscopy.		
Course Outcome (CO)	By the end of the course, the students will be able to: 1. Apply 18-electron rule to rationalize the stability of organomettalic compounds 2. Identify important structural features of the of Zeise's salt, metal alkyls tetrameric methyl lithium and dimeric trialkyl aluminium and explain the concept of multicenter bonding in these compounds 3. Diagrammatically explain the working of the sodium-potassium pump in organisms and sources and consequences of excess and deficiency of trace elements 4. Analyse and elaborate structure & properties of polynuclear hydrocarbons 5. Gain insight into the basic principles of UV, IR spectroscopic techniques & Use spectroscopic techniques to determine structure and stereochemistry of known and unknown compounds.		

UNIT I

Chemistry of 3d metals: Oxidation states displayed by Cr, Fe, Co, Ni and Co.

A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, K₂Cr₂O₇, KMnO₄, [Fe(CN)₆], Sodium nitroprusside, [Co(NH₃)₆]Cl₃, Na₃[Co(NO₂)₆].

HNIT -H

Organometallic Compounds: Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).

UNIT – III

Bio-Inorganic Chemistry: A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na +,K+,Mg2+ ions, Na/K pump; Role of Mg2+ions in energy production and chlorophyll. Role of Ca2+in blood clotting, stabilization of protein structures and structural role (bones).

Polynuclear and heteronuclear aromatic compounds: Properties of the following compounds with reference to electrophilic and Nucleophilic substitution: Naphthalene, Anthracene, Furan, Pyrrole, Thiophene, and Pyridine.

Active methylene compounds: Preparation: Claisen ester condensation. Keto-enol tautomerism. Reactions: Synthetic uses of ethylacetoacetate (preparation of non-hetero molecules)

UNIT IV

Application of Spectroscopy to Simple Organic Molecules: Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λ max& ϵ max , chromophore, auxochrome, bathochromic and hypsochromic shifts, Solvent Effect in UV and IR Spectroscopy. Application of electronic spectroscopy and Woodward rules for calculating 1 max of conjugated dienes and $\alpha,\beta-$ unsaturated compounds.

Infrared radiation and types of molecular vibrations, functional group and fingerprint region.

IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions.

S. No	Name	Author(S)	Publisher
1	Concise Inorganic Chemistry	1.D. Lee	ELBS
2	Inorganic Chemistry: Principles of Structure and Reactivity	James E. Huheey, Ellen Keiter & Richard Keiter	Pearson Publication.
3	Bioinorganic Chemistry	Bertini, H. B. Grey, S. J. Lippard and J. S. Valentine	Viva Books Pvt. Ltd., New Delhi (1998
4	Biological Inorganic Chemistry: An Introduction	Robert Crichton	.Elsevier Science (2008)
5	Biological Inorganic Chemistry: Structure and Reactivity	Harry B. Gray, Edward I. Stiefel et al.,	University Science Books.
6	Inorganic Chemistry	G.L. Miessler & Donald A. Tarr	Pearson Publication
7	Basic Inorganic Chemistry	F.A. Cotton & G. Wilkinson	John Wiley & Sons
8	Shriver & Atkin's Inorganic Chemistry (5 th Edition)	P Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong, M. Hagerman	Oxford University Press,
9	Organic Chemistry (Vol. I & II)	I.L. Finar	E.L.B.S.
10	Applications of Absorption Spectroscopy of Organic Compounds	John R. Dyer:	Prentice Hall.
11	Spectroscopic Identification of Organic Compounds	R.M. Silverstein, G.C. Bassler & T.C. Morrill	John Wiley & Sons
12	Organic Chemistry	R.T. Morrison & R.N. Boyd	Prentice Hall
13	A Guide Book to Mechanism in Organic Chemistry	Peter Sykes	Orient Longman



CHEMISTRY-V: ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY (PRACTICAL)

Semester	V		
Course Code	CHM 367		
Course Title	Chemistry-V: Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy (Practical)		
Type of course	Discipline elective(Practical)		
LTP	0:0:4		
Credits	2		
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as one core subject		
Course Objective (CO)	The aim of this course is to enable the students to 1. Impart practical knowledge about organometallic chemistry.		
Course Outcome (CO)	2. Perform organic qualitative analysis. By the end of this course, students will be able to 1. Interpret the structures of various complexes and understand their properties. 2. Impart knowledge about handling the spectrophotometer and carry out qualitative &quantitative analysis 3. Employ spectroscopy for characterization of metal complexes and organic compounds		

Section A: Inorganic Chemistry

1. Separation of mixtures by chromatography: Measure the Rf value in each case. (Combination of two ions to be given)

Paper chromatographic separation of Fe³⁺, A1³⁺ and Cr³⁺ Paper chromatographic separation of Ni²⁺, Co²⁺, Mn²⁺ and Zn²⁺.

- 2. Preparation of any two of the following complexes and measurement of their conductivity:
- (i) tetraamminecarbonatocobalt (III) nitrate
- (ii) tetraamminecopper (II) sulphate
- potassium trioxala toferrate (III) trihydrate

Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl₂ and LiCl₃

Section B: Organic Chemistry

Verification of Lambert-Beer's law and determination of concentration of a coloured species (CuSO4, KMnO4, CoCl2, CoSO4)

Identification of simple organic compounds by IR spectroscopy(Spectra to be provided).

Determination of a mixture of cobalt and nickel (UV-visible spectroscopy).

S. No	Name	Author(S)	Publisher
1	Vogel's Qualitative Inorganic Analysis (7th Edition).	A.I. Vogel, G Svehla	Prentice Hall
2	Vogel's Quantitative Chemical Analysis (6 th Edition),	A.I. Vogel, J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas	Prentice Hall
3	Advanced Practical Inorganic Chemistry	Ayodha Singh	Campus Books 2002
4	Textbook of Practical Organic Chemistry, 5th edition, 1996.	Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G	Prentice-Hall
5	Practical Organic Chemistry	Mann, F.G. & Saunders, B.C.	Orient-Longman,

CHEMISTRY-V: INDUSTRIAL CHEMICAL AND ENVIRONMENT

Semester	V
Course Code	CHM 369
Course Title	Chemistry-V: Industrial Chemical and Environment
Type of course	Discipline elective(Theory)
LTP	4:0:0
Credits	4
Course prerequisite	B.Sc. Ist, IInd year with Chemistry as core subject
Course Objective (CO)	 The aim of this course is to enable the students to Get familiar with the concepts of different gases and their industrial production, uses, storage and hazards. Study manufacturing, applications, analysis and hazards of the Inorganic Chemicals. Study Air and Water pollution, control measures for Air and Water Pollutants, Catalyst and Biocatalyst, Energy and Environment.
Course outcome (CO)	By the end of this course students will be able to 1. Understand the vital role played by chemistry in industry. 2. Give solution based on chemical knowledge in the field of various industries such as manufacturing processes, handling and storage of inorganic chemicals & hazardous effects of the inorganic chemicals. 3. Composition of air, various air pollutants, effects and control measures of air pollutants. 4. Different sources of water, water quality parameters, impacts of water pollution, water treatment. 5. Different industrial effluents and their treatment methods. 6. Different sources of energy & generation of nuclear waste and its disposal.

UNIT I

Industrial Gases and Inorganic Chemicals

Industrial Gases: Large scale production, uses, storage and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide and phosgene. Inorganic Chemicals: Manufacture, application, analysis and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate and potassium permanganate.

UNIT II

Industrial Metallurgy Preparation of metals (ferrous and nonferrous) and ultrapure metals for semiconductor technology. Environment and its segments Ecosystems. Biogeochemical cycles of carbon, nitrogen and sulphur.

Air Pollution: Major regions of atmosphere. Chemical and photochemical reactions in atmosphere. Air pollutants: types, sources, particle size and chemical nature; Photochemical smog: its constituents and photochemistry. Environmental effects of ozone, Major sources of air pollution. Pollution by SO₂, CO₂, CO, NOx, H₂S and other foul smelling gases. Methods of estimation of CO, NOx, SOx and control procedures. Effects of air pollution on living organisms and vegetation. Greenhouse effect and Global warming, Ozone depletion by oxides of nitrogen, chlorofluorocarbons and Halogens, removal of sulphur from coal. Control of particulates.

UNIT III

Water Pollution: Hydrological cycle, water resources, aquatic ecosystems, Sources and nature of water pollutants, Techniques for measuring water pollution, Impacts of water pollution on hydrological and ecosystems. Water purification methods, Effluent treatment plants (primary, secondary and tertiary treatment).

Industrial effluents from the following industries and their treatment: electroplating, textile, tannery, dairy, petroleum and petrochemicals, agro, fertilizer, etc. Sludge disposal. Industrial waste management, incineration of waste. Water treatment and purification (reverse osmosis, electro dialysis, ion exchange). Water quality parameters for waste water, industrial water and domestic water.

UNIT IV

Energy & Environment: Sources of energy: Coal, petrol and natural gas. Nuclear Fusion / Fission, Solar energy, Hydrogen, geothermal, Tidal and Hydel, etc. Nuclear Pollution: Disposal of nuclear waste, nuclear disaster and its management.

Biocatalysis Introduction to biocatalysis: Importance in "Green Chemistry" and Chemical Industry.

S. No	Name	Author(S)	Publisher
1	Standard methods for the examination of water and waste water- 19th Edn. 1995.	Andrew D. Eaton, Lenore, S. Clesceri and A. E. Greenberg,	EPS group, INC Roman,
2	Environmental Chemistry, , 2nd edition, 1990.	A. K. DE	Wiley Eastern Ltd
3	(2010), Environmental Pollution Analysis,	Khopkar, S.M.,	New Age International Publisher.
4	2003),Industrial Inorganic Chemistry	Buchel, K.H.; Moretto, H.H.; Woditsch, P.	Wiley-VCH.
5	Waste water treatment disposal and release-, INC second Edn., 1990.	Metcalf and eddy	Tata Mc Graw Hill
6	Environmental pollution control and engineering, 1995.	C. S. Rao	Wiley Eastern Ltd.
7	Chemical and Biological methods for water pollution studies, 1986.	R. K. Trivedy, and P. K. Goel,	Environmental publications
8	Environmental Chemistry, 1994.	B. K. Sharma & H. Kaur	Goel publishing House,
9	Principles of Instrumental Methods of analysis	D. A. Skoog and D.M.West	Saunder's College Publ. Latest edition.



CHEMISTRY-V: INDUSTRIAL CHEMICAL AND ENVIRONMENT (PRACTICAL)

Semester	V
Course Code	CHM 371
Course Title	Chemistry-V: Industrial chemical and environment (Practical)
Type of course	Discipline elective (practical)
LTP	0:0:4
Credits	2
Course prerequisite	Bsc. Ist, IInd year with Chemistry as one core subject
Course Objective (CO)	The aim of this course is to enable the students to
	1. Impart practical knowledge to the students in Industrial processes.
	2. Study and analyse various pollutantsthrough different analytical methods
Course Outcome (CO)	By the end of this course students will be able to:
	1. Identify and analyse various water quality parameters.
	2. Analyse quantitively air, water pollutants.
	3. Estimate bioindicators of pollution through titrimetrically and spectrophotometrically.

- 1. Determination of dissolved oxygen in water.
- 2. Determination of Chemical Oxygen Demand (COD)
- 3. Determination of Biological Oxygen Demand (BOD)
- 4. Percentage of available chlorine in bleaching powder.
- 5. Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO3 and potassium chromate).
- 6. Estimation of total alkalinity of water samples (CO3²-, HCO3⁻) using double titration method.
- 7. Measurement of dissolved CO₂.
- 8. Study of some of the common bio-indicators of pollution.
- 9. Estimation of SPM in air samples.
- 10. Preparation of borax/boric acid.

S. No	Name	Author(S)	Publisher
1	(2008),A Laboratory Manual fo	r Gopalan, R.; Anand, A.;	I. K. International.
	Environmental Chemistry,	Sugumar R.W.	
2	(2010), Environmental Pollution	Khopkar, S.M.,	New Age International
	Analysis,	90 Territorial Frank	Publisher.
3	(1980), Experiments in Environmenta	l Vowles, P.D.; Connell,	Pergamon Series in
	Chemistry: A Laboratory	D.W.	Environmental Science.
	Manual, Vol.4,		
4	Waste water treatment disposal an	d Metcalf and eddy	Tata Mc Graw Hill
	release-, INC second Edn., 1990.		
5	Environmental pollution control an	d C. S. Rao	Wiley Eastern
	engineering, 1 <mark>99</mark> 5.	"' TAT ANDHAR (F	Ltd.
6	Principles of Instrumental Methods of	f D. A. Skoog and	Saunder's College Publ. Latest
	analysis	D.M.West	edition.



CHEMISTRY-VI-	CHEMISTRY OF MAIN O	GROUP ELEMENT.	THEORIES OF ACIDS	AND RASES

Semester	VI	
Course Code	CHM 362	
Course Title	Chemistry-VI: Chemistry of Main Group Element, Theories of Acids and Bases	
Type of course	Discipline Elective Course(Theory)	
LTP	4:0:0	
Credits	4	
Course prerequisite	Bsc. Ist, IInd year with Chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to 1. Impart detailed knowledge of Main group elements. 2. Study industrial important processes based upon Chemistry VII A: Main Group Chemistry.	
Course Outcome (CO)	By the end of the course, the students will be able to: 1. Learn the fundamental principles of metallurgy and understand the importance of recovery of byproducts during extraction. 2. Understand the periodicity in atomic and ionic radii, electronegativity, ionization energy, electron affinity of elements of the periodic table. 3. Understand structure & properties, role of inorganic polymers. 4. Elaborate different acid and base reactions & covalent and ionic bonding using Lewis dot structure.	

UNIT I

Acids and Bases Brönsted-Lowry concept, conjugate acids and bases, relative strengths of acids and bases, effects of substituent and solvent, differentiating and levelling solvents. Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept. Hard and soft acids and bases (HSAB concept), applications of HSAB process

General Principles of Metallurgy: Chief modes of occurrence of metals based on standard electrode potentials, Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agents. Hydrometallurgy with reference to cyanide process for gold and silver. Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn, Au): electrolytic refining, zone refining, van Arkel-de Boer process, Parting Process, Mond's process and Kroll Process.

UNIT II

s- and p-Block Elements Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electron gain enthalpy, electronegativity (Pauling scale). General characteristics of s-block metals like density, melting and boiling points, flame colour and reducing nature. Oxidation states of s- and p-block elements, inert-pair effect, diagonal relationships and anomalous behaviour of first member of each group. Allotropy in C, P and S. Complex forming tendency of s block elements and a preliminary idea of crown ethers and cryptates, structures of basic beryllium acetate, salicylaldehyde/ acetylacetonato complexes of Group 1 metals. Solutions of alkali metals in liquid ammonia and their properties. Common features, such as ease of formation, solubility and stability of oxides, peroxides, superoxides, sulphates and carbonates of s-block metals.

UNIT III

Structure, bonding and properties (acidic/ basic nature, oxidizing/ reducing nature and hydrolysis of the following compounds and their applications in industrial and environmental chemistry wherever applicable: Diborane and concept of multicentre bonding, hydrides of Groups 13 (EH3), 14, 15, 16 and 17.0xides

Noble gases: Rationalization of inertness of noble gases, catharses, preparation and properties of XeF2, XeF4 and XeF6, bonding in these compounds using VBT and shapes of noble gas compounds using VSEPR Theory.

UNIT IV

Inorganic Polymers Types of inorganic polymers and comparison with organic polymers, structural features, classification and important applications of silicates. Synthesis, structural features and applications of silicones. Borazines and cyclophosphazenes – preparation, properties and reactions. Bonding in (NPCl₂)₃. of N and P, Ox acids of P, S and Cl. Halides and ox halides of P and S (PCl₃, PCl₅, SOCl₂ and SO₂Cl₂). Interhalogen compounds. A brief idea of pseudo halides.

S. No	Name	Author(S)	Publisher
1	Concise Inorganic Chemistry	1.D. Lee	ELBS
2	Inorganic Chemistry	A.G. Sharpe	ELBS
3	Inorganic Chemistry Principles of	J.E. Huheey	Harper Inter science
	Structure and Reactivity		
4	Principles of Inorganic Chemistry	Puri, Sharma and Kalia	Vishal publishers
5	Synthesis and Technique in Inorganic	G. S.Girlomi; R.J. Angleci	Latest edition, University
	chemistry		Science Books.
6	Physical Chemistry	R.A. Alberty	Wiley Eastern Ltd
7	Shriver & Atkin's Inorganic Chemistry	P Atkins, T. Overton, J.	Oxford University Press,
	(5 th Edition),	Rourke, M. Weller, F.	
		Armstrong, M. Hagerman	
8	(2014), Inorganic Chemistry, 5th	Miessler, G.L.; Fischer P.J.;	Pearson.
	Edition,	Tarr, D. A.	



CHEMISTRY-VI: CHEMISTRY OF MAIN GROUP ELEMENT, THEORIES OF ACIDS AND BASES (PRACTICAL)

Semester	VI		
Course Code	CHM 364		
Course Title	Chemistry-VI: Chemistry of Main Group Element, Theories of Acids and Bases		
	(Practical)		
Type of course	Discipline Elective Course (Practical)		
LTP	0:0:4		
Credits	2		
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject		
Course Objective (CO)	The aim of this course is to enable the students to		
	1. Impart practical knowledge of iodometric, complexometric.		
	2. Perform gravimetric titration used for analysis of Main group elements.		
Course Outcome (CO)	By the end of the course, the students will be able to:		
	1. Carry out iodometric/iodimetric analysis.		
	2. Perform and estimate constituent ions through complexometric titrations &		
	gravimetrically		
	3. Handle and prepare some industrially significant complex salt		

(A) Iodo / Iodimetric Titrations

- 1. Iodometric estimation of potassium dichromate and copper sulphate
- 2. Iodimetric estimation of antimony in tartaremetic
- 3. Estimation of amount of available chlorine in bleaching powder and household bleaches.
- 4. Iodimetric estimation of ascorbic acid in fruit juices.
- 5. Estimation of iodine in iodized salts.

(B) Complexometric titrations using disodium salt of EDTA

- (i) Estimation of Mg2+,Zn2+
- (ii) Estimation of Ca2+ by substitution method

(C) Gravimetric Analysis

- 1. Gravimetric estimation of sulphate as barium sulphate.
- 2. Gravimetric estimation of aluminium as oximato complex

(D) Inorganic preparations

- 1. Preparation of the following:
- (i) Cuprous Chloride, Cu2Cl2
- (ii) Aluminium potassium sulphate KAl(SO4)2.12H2O (potash alum) or Chromium potassium sulphate KCr(SO4)2.12H2O (chrome alum).
- (iii)tetraamminecopper(II) sulphate monohydrate, potassium trioxalatoferrate(III) (any two, including one double salt and one complex).

S. No	Name Name	Author(S)	Publisher
1	Advanced Practical Inorganic Chemistry	Ayodha Singh	Campus Books 2002
2	Vogel's Quantitative Chemical Analysis (6 th	J. Mendham, R.C. Denney,	Prentice Hall
	Edition, 7 th Edition),	J.D. Barnes, M.J.K.	
	·	Thomas	

CHEMISTRY-VI: ANALYTICAL METHOD IN CHEMISTRY

Semester	VI		
Course Code	CHM 366		
Course Title	Chemistry-VI: Analytical Method in Chemistry		
Type of course	Discipline Elective Course(theory)		
LTP	4:0:0		
Credits	4		
Course prerequisite	Bsc. Ist, IInd year with Chemistry as core subject		
Course Objective (CO)	The aim of this course is to enable the students to 1. Get familiar with concepts of analytical Chemistry various spectrophotometric, electroanalytical and themal methods of analysis. 2. Exposed to important separation methods like solvent extraction and chromatography.		
Course Outcome (CO)	By the end of this course, students will be able to: 1. Understand basic principle of instrument of various spectrophotometric, electroanalytical and themal methods of analysis 2. Develop experience and knowledge to operate and use effectively the analytical tools and instruments available in laboratory. 3. Understand the significance, quality and limitations of the results produced by various separation techniques. 4. Develop methods of analysis for different samples independently.		

UNIT I

Qualitative and quantitative aspects of analysis: Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

Optical methods of analysis: Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers. Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.

UNIT II

Infrared Spectrometry: Basic principles of instrumentation (choice of source, NM monochromatic & detector) for single and double beam instrument; sampling techniques. Structural illustration through interpretation of data, Effect and importance of isotope substitution.

Flame Atomic Absorption and Emission Spectrometry: Basic principles of instrumentation (choice of source, monochromatic, detector, choice of flame and Burner designs. Techniques of atomization and sample introduction; Method of background correction, sources of chemical interferences and their method of removal. Techniques for the quantitative estimation of trace level of metal ions from water samples.

UNIT III

Thermal methods of analysis: Theory of thermogravimetry (TG), basic principle of instrument Techniques for quantitative estimation of Ca and Mg from their mixture.

Electro-analytical methods: Classification of electro analytical methods, basic principle of pH metric, potentiometric and conduct metric titrations. Techniques used for the determination of equivalence points. Techniques used for the determination of pKa values.

UNIT IV

Separation techniques: Solvent extraction: Classification, principle and efficiency of the technique. Mechanism of extraction: extraction by solvation and chelation. Technique of extraction: batch, continuous and counter current extractions. Qualitative and quantitative aspects of solvent extraction: extraction of metal ions from aqueous solution, extraction of organic species from the aqueous and non-aqueous media.

Chromatography: Classification, principle and efficiency of the technique. Mechanism of separation: adsorption, partition & ion exchange. Development of chromatograms: frontal, elution and displacement methods. Qualitative and quantitative aspects of chromatographic methods of analysis: IC, GLC, GPC, TLC and HPLC.

S. No	Name	Author(S)	Publisher
1	Electrochemical methods, Fundamentals and Methods	A.J. Bard, L.R. Faulkner,	Wiley, 1980.
2	Inorganic Chemistry	A.G. Sharpe	ELBS
3	Principles of Instrumental Methods of analysis	D. A. Skoog and D.M.West	Saunder's College Publ. Latest edition.
4	Vogel's Qualitative Inorganic Analysis (7 th Edition).	G Svehla	Prentice Hall
5	Vogel's Quantitative Chemical Analysis (6 th Edition),	J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas	Prentice Hall
6	Instrumental Analysis	G.D. Christian and J.E.G. Reily	Allegn Becon, Latest edition
7	Instrumental Methods of Chemical	G.W.Ewing,	McGraw Hill Pub, 1975.



CHEMISTRY-VI: ANALYTICAL METHOD IN CHEMISTRY (PRACTICAL)

Semester	VI	
Course Code	CHM 368	
Course Title	Chemistry-VI: Analytical Method in Chemistry (Practical)	
Type of course	Discipline Elective (Practical)	
LTP	0:0:4	
Credits	2	
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject	
Course Objective (CO)	The aim of this course is to enable the students to 1. Impart practical knowledge of analytical methods of chemical analysis . 2. Expose to latest instrumentation and they learn to detect analytes in a mixture.	
Course Outcome (CO)	By the end of this course, students will be able to: 1. Perform experiment with accuracy and precision. 2. Perform various types of titrations i.e redox, colorimetric, complexometric and acid-base titration. 3. Determine composition of soil, water analysis, Estimation of macronutrients using Flame Photometery 4. Learn separation of analytes by chromatography.	

I. Separation Techniques

Chromatography:

- 1. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the Rf values.
- 2. Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their Rf values.
- 3. Chromatographic separation of the active ingredients of plants, flowers and juices by TLC
- 4. Separation of compounds using column chromatography.

II. Solvent Extractions:

- 1. To separate a mixture of Ni²⁺ & Fe²⁺ by complexation with DMG and extracting the Ni²⁺- DMG complex in chloroform, and determine its concentration by spectrophotometry.
- 2. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.
- 3. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric techniques.

III Analysis of soil and water:

- 1. Determination of pH of soil.
- 2. Total soluble salt
- 3. Estimation of calcium, magnesium, phosphate, nitrate
- 4. Determination of physical and chemical parameters of water.
- 5. Determination of dissolved oxygen in water.
- 6. Determination of chemical oxygen demand (COD).
- 7. Determination of Biological oxygen demand (BOD).

IV Ion exchange:

- (i) Determination of exchange capacity of cation exchange resins and anion exchange resins.
- (ii) Separation of metal ions from their binary mixture.
- (iii) Separation of amino acids from organic acids by ion exchange chromatography.

V Spectro-photometry

- 1. Verification of Lambert-Beer's law and determination of concentration of a coloured species (CuSO4, KMnO4, CoCl2, CoSO4)
- 2. Determination of pKa values of indicator using spectrophotometry.
- 3. Structural characterization of compounds by infrared spectroscopy.

S. No	Name	Author(S)	Publisher
1	Electrochemical methods,	A.J. Bard, L.R. Faulkner,	Wiley, 1980.
	Fundamentals and Methods		-
2	Inorganic Chemistry	A.G. Sharpe	ELBS
3	Principles of Instrumental	D. A. Skoog and D.M.West	Saunder's College Publ. Latest
	Methods of analysis		edition.
4	Vogel's Qualitative Inorganic	G Svehla	Prentice Hall
	Analysis (7 th Edition).		
5	Vogel's Quantitative Chemical	J. Mendham, R.C. Denney, J.D.	Prentice Hall
	Analysis (6 th Edition),	Barnes, M.J.K. Thomas	
6	Instrumental Analysis	G.D. Christian and J.E.G. Reily	Allegn Becon, Latest edition
7	Instrumental Methods of Chemical	G.W.Ewing,	McGraw Hill Pub, 1975.
	Analysis		



CHEMISTRY-VI: INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

Semester	VI	
Course Code	CHM370	
Course Title	Chemistry-VI: Inorganic Materials of Industrial Importance	
Type of course	DSE	
LTP	4:0:0	
Credits	4	
Course prerequisite	B.Sc I and B.Sc II year with as Chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to 1. Learn diverse roles of inorganic materials in the industry. It gives an insight into how these raw materials are converted into products used in day to day life. 2. Learn about silicates, fertilizers, surface coatings, batteries, engineering materials for mechanical construction as well as the emerging area of nano-sized materials. 3. Develop the interest in the frontier areas of inorganic and material chemistry.	
Course Outcomes (CO)	By the end of the course, the students will be able to: 1. Learn the composition and applications of the different kinds of glass. 2. Understand glazing of ceramics and the factors affecting their porosity. 3. Give the composition of cement and discuss the mechanism of setting of cement. 4. Explain the process of formulation of paints and the basic principle behind the protection offered by the surface coatings. 5. Explain the principle, working and applications of different batteries. 6. List and explain the properties of engineering materials for mechanical construction used in day to day life. 7. Explain the synthesis and properties of nano-dimensional materials, various semiconductor and superconductor oxides.	

UNIT I

Silicate Industries *Glass:* Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fibre.

Cements: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

UNIT II

Fertilizers: Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.

Surface Coatings: Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Ecofriendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying and anodizing.

UNIT III

Batteries: Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery. Fuel cells, Solar cell and polymer cell.

Alloys: Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

UNIT IV

Catalysis: General principles and properties of catalysts, homogenous catalysis (catalytic steps and examples) and heterogenous catalysis (catalytic steps and examples) and their industrial applications, Deactivation or regeneration of catalysts.

Phase transfer catalysts, application of zeolites as catalysts.

Chemical explosives: Origin of explosive properties in organic compounds, preparation and explosive properties of lead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

Reference Books:

- 1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- 2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, WileyPublishers, New Delhi.
- 3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics*, WileyPublishers, New Delhi.
- 4. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
- 5. P. C. Jain, M. Jain: *Engineering Chemistry*, Dhanpat Rai & Sons, Delhi.
- 6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry*, Vikas Publications, New Delhi.
- 7. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Goel Publishing House, Meerut(1996).



CHEMISTRY-VI: INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE PRACTICAL

Semester	VI	
Course Code	CHM372	
Course Title	Chemistry-VI: Inorganic Materials of Industrial Importance Practical	
Type of course	DSE	
LTP	0:0:4	
Credits	2	
Course prerequisite	B.Sc I and B.Sc II year with as Chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Learn diverse roles of inorganic materials in the industry. It gives an insight into	
	how these raw materials are converted into products used in day to day life.	
	2. Learn about silicates, fertilizers, surface coatings, batteries, engineering materials for	
	mechanical construction as well as the emerging area of nano-sized materials.	
	3. Develop the interest in the frontier areas of inorganic and material chemistry.	
Course Outcomes (CO)	By the end of the course, the students will be able to:	
	1. To perform qualitative and quantitative analysis of industrially important chemicals.	
	2. To analyse composition of alloy, cement and fertilizers	
	3. To prepare industrially significant pigments.	

List of Experiments:

- 2. Electroless metallic coatings on ceramic and plastic material.
- 3. Determination of composition of dolomite (by complexometric titration).
- 4. Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples.
- 5. Analysis of Cement.
- 6. Preparation of pigment (zinc oxide).
- 7. Detection of constituents of Ammonium Sulphate fertilizer (Ammonium and Sulphate ions) by qualitative analysis and determine its free acidity.
- 8. Detection of constituents of CAN fertilizer (Calcium, Ammonium and Nitrate ions) fertilizer and estimation of Calcium content.
- 9. Detection of constituents of Superphosphate fertilizer (Calcium and Phosphate ions) and estimation of phosphoric acid content.
- 10. Detection of constituents of Dolomite (Calcium, Magnesium and carbonate ions) and determination of composition of Dolomite (Complexometric titration).
- 11. Analysis of (Cu, Ni) in alloy or synthetic samples (Multiple methods involving Complexometry, Gravimetry and Spectrophotometry).
- 12. Analysis of (Cu, Zn) in alloy or synthetic samples (Multiple methods involving Iodometry, Complexometry and Potentiometry).

Reference Books:

- 1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
- 2. R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley
- 3. Publishers, New Delhi.
- 4. Svehla, G.(1996), Vogel's Qualitative Inorganic Analysis, Prentice Hall. 2. Banewicz, J. J.; Kenner, C.T. Determination of Calcium and Magnesium in Limestones and Dolomites, Anal. Chem., 1952, 24 (7), 1186–1187.



CHEMISTRY VII A: MAIN GROUP CHEMISTRY

Semester	VII		
Course Code	CHM461		
Course Title	Chemistry VII A: Main Group Chemistry		
Type of course	Theory		
LTP	4 0 0		
Credits	4		
Course prerequisite	B.Sc I, B.Sc II and B.Sc III year with as Chemistry as core subject		
Course Objective (CO)	The aim of this course is to enable the students to 1. Know the importance of H-bonding, reactivity of metals and inert pair effect, formation of coordination complexes. 2. Study the tendency of lighter elements to form electron deficient compounds. 3. Study structural features of silicates, organosilcon., inter-halogens, compounds of xenon and krypton. 4. Recognize the importance of group 12 elements.		
Course Outcomes (CO)	By the end of this course, students will be able to 1. Understand importance of H-bonding in natural processes is appreciable 2. Recognise f s-block elements and group 12 elements to form coordination complexes as the latter are having many similarities with the former. 3. Realize importance of silicon as it is the second most abundant element on earth's crust after oxygen and it occurs as SiO2 and silicate materials.		

Unit-I

Chemistry of hydrogen:

Isotopes and ionized forms of hydrogen, Protonic acids and bases, hydrides, The Hydrogen Bond, its influence on Properties and influence on structure, Strength of hydrogen bonds and theoretical description, some natural elegant examples of H-bonding, Information about H-bonding from various techniques like IR, NMR and X-ray.

Noble gases: introduction and oxidation state survey, noble gas clathrates ,haides, oxides and other compounds: synthesis, reactivity and stereochemistry.

Unit-II

Chemistry of S-block metals: Introduction and oxidation state survey, standard redox potentials of alkali and alkaline earth metals, lattice energy and hydration energy and diagonal relationship. Structure and synthesis of Hydrides, Halides, Oxides, Peroxides, Superoxides, Suboxides, Hydroxides, Oxoacid salts, compounds with nitrogen and carbon and complexes of s-block elements. Coordination Complexes of Crowns and Crypts of Alkali and Alkaline EarthMetals ions.

Chemistry of group 12 elements: Introduction, Similarities and differences between these elements and traditional elements, oxidation state, Chemistry of the elements: reactivity, standard redox potentials, their combination with halides. Chalcogenides and their related compounds, oxygen, sulphur and halogen compounds, Formation of coordination complexes, Low valent compounds. (5 lectures)

Unit-III

Chemistry of Boron, Aluminum and Silicon: Borides, Boranes, Bonding in boranes, topology of boranes, synthesis and reactivity. Wade's rules, Carboranes and metallocarboranes, Borazine and boron nitride. Chemistry of boron and Aluminum Halides, Amphoteric nature of Aluminium oxides. Potash alum and Aluminum Alkyls. Low oxidation state Alcompounds. Organosilicon Compoundslike carbosilanes, stability of disilenesand silicones.

Unit-IV

Chemistry of halogens: Interhalogens: Introduction, Diatomic, Tetraatomic, hexaatomic and octa-atomic interhalogens: Synthesis, physical properties, chemical reactions, fluorinating agent, as ionizing solvent and electrical conductivity, Lewis acid behavior. Polyhalide and polyhalonium ions of diatomic interhalogens, Reactivity sequence of various interhalogens. Structures and bonding in some polyiodide anions, Pseudohalogens, Cholorofluorocarbons.

S.No.	Name/Title	Author	Publisher
1	Chemistry VII A: Main Group Chemistry	W. Henderson	Royal Society of Chemistry(2000)
2	Chemistry of Elements	N. N. Greenwood	Pergamon Press(2000)
3	Inorganic Chemistry, Principles of structure	J. E. Huheey, Fourth edition	Pearson(2005)
	and reactivity		
4	Inorganic Chemistry 4th edition	D. F. Shriver and P. W. Atkins,	Oxford University, Oxford(2006)
5	Advanced Inorganic Chemistry	F. A. Cotton and G. Wilkinson, 6 th ed.	John Wiley & Sons (2003)
6	Concepts & Model of Inorganic Chemistry	B. Douglas, third edition	John Wiley & Sons(2001)

CHEMISTRY VII B: ORGANIC REACTION MECHANISM-I

Semester	VII	
Course Code	CHM463	
Course Title	Chemistry VII B: Organic Reaction Mechanism- I	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc I, B.Sc II and B.Sc III year with as Chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Impart knowledge of stereochemical aspects of organic compounds reactive intermediates.	
	2. Impart basic knowledge of mechanism of general organic reactions including substitution,	
	elimination and addition.	
Course Outcomes (CO)	By the end of this course, students will be able to	
	1. Understand Coherent Knowledge of mechanistic aspects in nucleophilic ,electrophilic	
	substitution, addition and elimination reactions.	
	2. Analyze reaction conditions, products formation and mechanisms of some named	
	reactions.	
	3. Apply various reaction pathways to develop new and notable organic compounds.	

Unit-I

Stereochemistry: Elements of symmetry, chirality, projection formulae, configurational and conformational isomerism in acyclic and cyclic compounds, molecules with more than one chiral center. Threo and erythro isomers, methods of resolution, optical purity. stereogenicity, stereoselectivity, diastereoselectivity, D/L, R/S, E/Z and cis/trans configurational notations Prochirality – enantiotopic and diastereotopic atoms, groups. Stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in absence of chiral carbon (Biphenyls, Allenes, Spiranes). conformational analysis of cyclic compounds such as cyclopentane, cyclohexane, cyclohexanone derivatives, decalins, 1,2, 1,3-, 1,4-disubstituted cyclohexane derivatives and D-Glucose, effect of conformation on reactivity.

Unit-II

Nature of Bonding in Organic Reactions: Aromaticity in Benzenoid and non-benzenoid compounds. Huckel Rule, Alternant and non alternant hydrocarbons. Energy levels of $\Pi(pi)$ molecular orbitals in simple systems. Annulenes, Antiaromaticity, Homoaromaticity, PMO approach.

Reaction Mechanism, Structure and Reactivity: Types of mechanisms in different reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control in product formation. Transition states and reaction intermediates, Isotope effects, Hard and Soft Acid Base concept, Study of reactive intermediates – Types of intermediates, isolation and detection of intermediates, trapping of intermediates.

Unit-III

Aliphatic Nucleophilic Substitution: The S_N2, S_N1 and S_Ni mechanisms, mixed S_N1 & S_N2mechanism, SET mechanism. The neighbouring group mechanism (anchimeric assistance). Neighbouring group participation by pi and sigma bonds, Classical non-classical & phenonium cations, Rearrangements in carbocations (general survey). Ester hydrolysis. Nucleophilic substitution at allylic, aliphatic trigonal and vinylic carbon.

Aromatic Electrophilic Substitution: The arenium ion mechanism, orientation and reactivity in mono substituted and di substituted aromatics. Energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Gatterman-Koch reaction, Pechmann reaction, Houben – Hoesch reaction, Fries rearrangement.

Aromatic Nucleophilic Substitution: ArS_N1, ArS_N2 and ArSN via benzyne (Arynes) mechanisms. Reactivity effect of substrate structure, leaving group and nucleophile. The von Richter, Sommelet-Hauser and Smiles rearrangements.

Unit-IV

Free Radical Reactions: Type of free radical reactions, free radical substitution mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation. Coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free Radical Rearrangement. Hunsdiecker reaction, Kolbe reaction, Hydroxylation of aromatics by Fenton's reagent.

S.No.	Name/Title	Author	Publisher
1	Highlights of Organic Chemistry	W.J. L. Nobel	An Advanced Text Book
2	Advanced organic chemistry part-A. 5th Ed	F. A. Carey and R. J. Sundberg	Springer (2007)
3	A guidebook to mechanism in organic chemistry, 6th Ed	Peter Sykes	Orient Longman
4	Stereochemistry conformation and Mechanism	P. S. Kalsi	New Age International
5	Stereochemistry of carbon compounds	Ernest Eliel	McGraw Hill, New York (1962).



CHEMISTRY VII C: CHEMICAL THERMODYNAMICS: AND ITS APPLICATIONS

Semester	VII		
Course Code	CHM 465		
Course Title	Chemistry VII C: Chemical Thermodynamics: and its applications		
Type of course	Theory		
LTP	4 0 0		
Credits	4		
Course prerequisite	B.Sc I, B.Sc I I and B.Sc III year with as Chemistry as core subject		
Course Objective (CO)	The aim of this course is to enable the students to		
	1. Impart knowledge of advanced classical and statistical thermodynamics.		
	2. Understand behavior of activity coefficient, ionic strength, distribution Law,		
	electro kinetic phenomena, diffusion.		
	3. Study electric conduction, irreversible thermodynamics for biological systems		
Course Outcomes (CO)	By the end of this course, students will be able to		
, , ,	1. Understand Coherent Knowledge of different thermodynamic parameters for		
	chemical reactions.		
	2. Analyze advanced classical and statistical thermodynamics.		
	3. Interpret irreversible thermodynamics for biological systems.		

Unit-I

Thermodynamics: First law of thermodynamics, relation between C_p and C_v; enthalpies of physical and chemical changes; temperature dependence of enthalpies. Second law of thermodynamics, entropy, Gibbs-Helmoholtz equation. Third law of thermodynamics and calculation of entropy.

Classical Thermodynamics: Brief concepts of free energy, chemical potential and entropy. Partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significances. Determination of these quantities.

Unit-II

Concept of fugacity and determination of fugacity. Non-ideal systems: Excess functions for non-ideal solutions. Activity, activity coefficients, Debye-Huckel theory for activity coefficient of electrolytic solutions, determination of activity and activity coefficients, ionic strength. Application of phase rule to three component system, second order phase transitions

Statistical Thermodynamics: Concept of distribution law, thermodynamic probability and most probable distribution, Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and microcanonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers). Partition functions: Translational, rotational, vibrational and electronic partition function

Unit-III

Calculation of thermodynamic properties in terms of partition functions. Application of partition functions. Heat capacity behavior of solids-chemical equilibria and equilibrium constants in terms of partition functions, Fermi-Dirac statistics, distribution laws, and application to metals. Bose-Einstein statistics- distribution law and application to helium.

Unit-IV

Non Equilibrium Thermodynamics: Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of generalized fluxes and forces, non-equilibrium stationery states, phenomenological equations, microscopic reversibility and Onsager's reciprocity relations, electro kinetic phenomena, diffusion, electric conduction, irreversible thermodynamics for biological systems, coupled reactions.

S.No.	Name/Title	Author	Publisher
1	Thermodynamics for Chemists	S. Glasstone	East West Press, New Delhi
	-		(1950).
2	Thermodynamics for Students of Chemistry	J. Rajaram and J.C.	Lal Nagin Chand, New
		Kuriacose	Delhi (1986).
3	Elements of Chemical Thermodynamics	L.K. Nash	Addision Wesley (1962).

CHEMISTRY VII D: INDUSTRIAL CHEMICAL ANALYSIS & QUALITY CONTROL

Semester	VII	
Course Code	CHM467	
Course Title	Chemistry VII D: Industrial Chemical analysis & Quality Control	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc I, B.Sc II and B.Sc III year with as Chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Impart basic knowledge of basic Industrial Chemical analysis.	
	2. Study various Quality Control processes.	
Course Outcomes (CO) By the end of this course, students will be able to		
1. Acquire Coherent and advanced knowledge of the basic of Chemistry VII D: Industri		
	Chemical analysis & Quality Control processes.	
	2. Analyze Chemical, biological and radiation hazards in laboratory and safety followed	
	during analysis of Special Industrial Material.	
	3. Apply & Design analytical sample preparation and the analyze the clinical samples and	
	chemical Sensors.	

UNIT-I

Analytical Chemometrics: General introduction and its application in optimisation, Modelling and parameter estimation, Sampling, calibration, Factor analysis, Resolution, Signal processing, Structure-property relationship, Pattern recognition, Propagation of measurement uncertainties (inaccuracy and imprecision), Analytical validation techniques, Non-linear regression analysis, Good manufacturing practice (GMP), Good lab practice (GLP), lab and industrial safety.

UNIT-II

Analysis of Special Industrial Material (General Strategy for Analysis): Analysis of dairy products, oils, soaps and synthetic detergents, food additives, petrochemicals (including liquid and gaseous fuels) pesticides, drugs and pharmaceuticals, fertilizers and paints.

IINIT-III

Clinical Analysis: Sampling and selective analysis of biological fluids (using routine and automatic instruments), glucose, bilirubins, total cholesterol, haemoglobin, creatinine, total proteins, albumin, ureanitrogen, carticosteroids and barbiturates. Immunological methods of analysis: ELISA, RIA and Immunodiffusion.

UNIT-IV

Chemical Sensors: Principles, types of chemical sensors based on the modes of transductions, Types of chemical sensor based on the chemically sensitive materials (solid electrolyte, gas, semiconductor), Humidity sensors, Biosensors, Electrochemical sensors (Potentiometric sensors, Ion-selective electrodes, Membrane electrodes, Amperometric sensors, Clark and Enzyme electrodes).

S.No.	Name/Title	Author	Publisher
1	Green chemistry frontiers in benign chemical	P. Anastas and H. Williamson	Oxford University
	synthesis and processes		Press.
2	Chemical management: Reducing wast and	Lerma and W. Straat	Willey Sons
	cost through innovative supply strategies		
3	Real world cases in green chemistry	M.C. Cann and M. E. Connelly	ACS Publications.
4	Policies for cleaner Technologies	T. Clayton	Earthscan
5	New Trends in Green Chemistry	V. K. Ahluwalia and M. Kidwai	AnamayaPublisher,
			New Delhi.

CHEMISTRY VII E: NANO-SCIENCE & NANO-CHEMISTRY

Semester	VII	
Course Code	CHM469	
Course Title	Chemistry VII E: Nano-Science & Nano-Chemistry	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc I, B.Sc I I and B.Sc III year with as Chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Impart knowledge of nano chemistry and nanomaterials.	
	2. Study chemistry of carbon nanotubes and their applications	
Course Outcomes (CO)	By the end of this course, students will be able to	
	1. Acquire knowledge of Nanotechnology, properties and applications of nanomaterials.	
	2. Cognitive skills to analyse the methodology and fabrication and characterization of nanomaterials, Apply use of carbon nanotubes based nanomaterials.3. Various supramolecular aspects of interaction between two chemical systems.	

Unit-I

Nanochemistry Basics: Nanochemistry, self assembly, Self assembling materials, two dimensional assemblies, Mesoscale self assembly, coercing colloids.

Chemical Patterning, Lithography & Nanocontact Printing: Soft lithography, Dip pen nanolithography, Nanoplotters, Nanoblotters,

GBBSIT

Unit-II

Nanomaterials: Nanoparticles: zero dimensional nanostructure, homogeneous and heterogeneous nucleation, metallic nanoparticles- synthesis and applications; nanowires and nanorods: one dimensional nanostructures, spontaneous growth, VLS, electro spinning, lithography; thin film: two dimensional nanostructure- preparation techniques; Langmuir-Blodgett (LB) film growth techniques, photolithography properties and applications.

Unit-III

Carbon nanostructures: Carbon molecules, clusters, carbon nanotubes and their applications. Nanorod, Nanotube, Nanowire Self- Assembly: Nanorod devices, Nanowire sensors, diodes & transistors. Instrumentation techniques SEM,TEM,AFM for characterization of nano meterials. Scope and opportunities: Nanoscale materials, Nanocrystals, nanotechnology enabled sensors, microelectronics, drug delivery, Bionanoinformation.

Unit-IV

Supramolecular chemistry: Definition and development of supramolecular chemistry, nature of binding interactions in supramolecular structures: ion-ion, ion-dipole, dipole-dipole, h-bonding, cation---interactions, supramolecular chemistry in life, ionophores, porphyrin and other tetrapyrrollic macrocycles, coenzymes, neurotransmitters, DNA and biochemical self-assembly. Classification of supramolecular host-guest compounds, pre- organization and complementarily, receptors, nature of supramolecular interactions.

Supromolecular structures. Host-guest chemistry: synthesis and structure of crown ethers, lariat ether and podands, cryptands, spherands, calixarenes, cylcodextrins, cyclophanes, carcerands and hemicarcerands. Concepts of selectivity, macrocyclic, macrobicyclic synthesis and template effects.

Supramoleular chemistry of dendrimers and its assembly, dendritic nanodevices, Supramolecular polymers including amphiphilic block polymers and molecular imprinter polymers, biological self assembly in amyloids, actins and fibrin, COF and supramolecular gels.

S.No.	Name/Title	Author	Publisher
1	Nanochemistry, A Chemical approach to	G. A. Ozin & Andre, C.	Royal society of
	Nanomaterials	Arsenault	Chemists, 2005.
2	Introduction to Nanotechnology	C. P. Poole, Jr., F. J.	Wiley interscience
		Owens	
3	Real world cases in green chemistry	M.C. Cann and M. E.	ACS Publications.
	-	Connelly	
4	Policies for cleaner Technologies	T. Clayton	Earthscan
5	New Trends in Green Chemistry	V. K. Ahluwalia and M.	Anamaya Publishers, New
		Kidwai	Delhi.

CHEMISTRY VII F: INORGANIC CHEMISTRY PRACTICAL-1

Semester	VII	
Course Code	CHM471	
Course Title	Chemistry VII F:Inorganic Chemistry Practical-1	
Type of course	Practical	
LTP	0 0 4	
Credits	2	
Course prerequisite	B.Sc I, B.Sc II and B.Sc III year with as Chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Synthesize the coordination complexes.	
	2. Impart knowledge of various techniques for analysis of inorganic compounds.	
Course Outcomes (CO) By the end of this course, students will be able to		
	1. Acquire Coherent Knowledge of analytical data for Titrimetric and gravimetric analysis of different cations and anions.	
2. Understand the principles, and methodology involved in precipitations and its tit assaying different ions.		
	3. Discuss and apply the principles involved in the redox titrations and Prepare different	
	types of inorganic compounds.	

<u>List of Experiments Note: Perform at least any two three experiments from each section.</u>

A.Inorganic Preparations & Estimation

Preparation of Reinecke salt, Trinitrotriamine cobalt (III),

Preparation of Potassium trioxalatomangnate(III), Ferrous ammonium sulphate,

Preparation of Potassium trioxalatechromate(III).

Estimation of metal in complexes by Electronic Spectroscopy

Determine the total hardness of water.

B.Oxidation-Reduction Titrations

Standardization with sodium oxalate of KMnO₄ and determination of Ca²⁺ ion.

Standardization of ceric sulphate with Mohr's salt and determination of Cu²⁺, NO₃ -1 and C₂O₄ ions.

Standardization of K₂Cr₂O₇ with Fe²⁺ and determination of Fe³⁺ (Ferric alum)

Standardization of hypo solution with potassium iodate / K₂Cr₂O₇ and determination of available Cl₂ in bleaching powder, Sb³⁺ and Cu²⁺.

Determination of hydrazine with KIO₃ titration.

C.Precipitation Titrations

AgNO₃ standardization by Mohr's method by using adsorption indicator.

Volhard's method for Cl⁻ determination.

Determination of ammonium / potassium thiocyanate.

D.Complexometric Titrations

Analysis of two cation-system using EDTA

Determination of Cu²⁺ and Ni²⁺ by using masking reagent by EDTA titration.

Determination of Ni²⁺ (back titration).

Determination of Ca²⁺ (by substitution method).

E. Gravimetric Analysis

Estimation of chromium (III) as its lead chromate.
Estimation of Cu²⁺ using Ammonium (S. 1)

S.No.	Name/Title	Author	Publisher
1	Vogel's quantitative analysis 6	Mendham, Denny	Pearson Education 2002
	Edn		
2	Synthesis and Technique in	G. S.Girlomi; R.J. Angleci	3rd edn.; University
	Inorganic chemistry	-	Science Books.
3	Advanced Practical Inorganic	Ayodha Singh	Campus Books 2002
	Chemistry	-	-



CHEMISTRY VIII A: CHEMISTRY OF NATURAL PRODUCTS & HETEROCYCLIC CHEMISTRY

Semester	VIII		
Course Code	CHM462		
Course Title	Chemistry VIII A: Chemistry of Natural Products & Heterocyclic Chemistry		
Type of course	Theory		
LTP	4 0 0		
Credits	4		
Course prerequisite	B.Sc I, B.Sc I I and B.Sc III year with as Chemistry as core subject		
Course Objective (CO)	The aim of this course is to enable the students to		
	1. Impart knowledge about classification, occurrence and biosynthesis of various natural		
	products.		
	2. Study synthesis of organic compounds containing N, O, and S like compounds.		
Course Outcomes (CO)	By the end of this course, students will be able to		
	1. Gain Coherent and advanced knowledge of various types of natural products,		
	biosynthesis		
	2. Analyse structure, identify complex structure of natural products.		
	3. Acquaint knowledge about heterocyclic compounds, their structure, synthetic routes		
	4. Predict and elaborate structure and properties of heterocyclics.		

IInit_I

Terpenoids and Carotenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules: Citral, Geraniol, α-Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-Carotene.

Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants. Structure, stereochemistry, synthesis and biosynthesis of Ephedrine, (+)- Coniine, Nicotine, Atropine, Quinine and Morphine.

Unit-II

Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progestrone, Aldosterone. Biosynthesis of steroids.

Plant Pigments: Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein, Butein, Aureusin, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin. Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.

Unit-III

Nomenclature of Heterocycles: Replacement and systematic nomenclature (Hantzsch-widman System) for monocyclic fused and bridged hetrocycles.

Aromatic and Non aromatic Heterocycles: General chemical behaviour of aromatic heterocycles classification (structural type) criteria of aromaticity(bond length ring current and chemical shift in H NMR- Spectra empirical resonance energy delocalization energy and Dewar resonance energy), Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reaction.

Strain-bond angle and torsional strains and their consequences in small ring heterocycles. Conformation of six-membered heterocycles with reference to molecular Geometry

Unit-IV

Small Ring Heterocycles: Three-membered and four-membered heterocyclic –synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes.

Benzo-Fused Five-Memberd Heterocycles

Synthesis and reaction including medicinal applications of benzopyrroles, benzofurans and benzothiophenes.

Reagents in Organic Synthesis: Use of the following reagents in organic synthesis and functional group transformations; Complex metal hydrides, Gilman's reagent, lithium dimethylcuprate, lithium disopropylamide (LDA) dicyclohexylcarbodimide. 1,3-Dithiane (reactivity umpolung), trimethylsilyl iodide, Woodward and prevost hydroxylation, osmium tetroxide, DDQ, selenium dioxide, phase transfer catalysts, crown ethers and Merrifield resin, Peterson's synthesis, Wilkinson's catalyst, Baker yeast.

S.No.	Name/Title	Author	Publisher
1	Organic Chemistry, Vol. 2, 5th edition	Finar, I.L.	ELBS, 1975.
2	Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas	Hostettmann, Kurt; Gupta, M.P.; Marston, A.	Harwood Academic Publishers.
3	Introduction to Flavonoids	Aggarwal, O.P.	Harwood Academic Publishers.
4	Natural Products: Chemistry and Biological Significance,	Mann, J.; Davidson, R.S.; Hobbs, J.B.; Banthrope, D.V.; Harborne, J.B.	Longman, Esse
5	Organic Chemistry	Jerry March	Wiley & Sons
6	Heterocyclic Chemistry	Acheson.	Wiley-Interscience; 3rd edition (March 11, 1985)
7	Advanced Organic Chemistry	F.R.Carey, R.J. Sunberg.	Wiley Publishers
8	Highlights of Organic Chemistry	W.J.L. Nobel	An Advanced Text Book
9	Organic Chemistry	Jerry March	Wiley & Sons



CHEMISTRY VII F: INORGANIC CHEMISTRY PRACTICAL-1

Semester	VIII	
Course Code	CHM464	
Course Title	Chemistry VIII F:Inorganic Chemistry Practical-1	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc I, B.Sc II and B.Sc III year with as Chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to 1. Study Deals with the properties of kinetics and equilibrium of a chemical reaction. 2. Study chemical changes occurring in the reaction medium with time.	
Course Outcomes (CO)		

Unit I:

The rate of a reaction: reaction of molecular bromine and formic acid, decomposition of hydrogen peroxide, reaction rates and stoichiometry, elementary and multistep reaction, relation between reactant concentration and time: order and molecularity of a reaction, rate laws in terms of the advancement of a reaction, differential rate laws for first order, differential rate laws for second order, differential rate laws for zero order reaction, integrated rate laws for second order reaction and integrated rate laws for zero order reaction, pseudounimolecular reactions, determination of the order, kinetics of complex reactions (limited to first order).

Unit II:

Temperature dependence of reaction rates: Arrhenius equation, derivation of arrhenius equation, calculation of activation energy graphically, calculation of activation energy by two different temperature, collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates. opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

Reaction mechanisms: rate laws and elementary steps, hydrogen peroxide decomposition, the hydrogen iodide reaction, experimental support for reaction mechanisms, catalysis, heterogeneous catalysis, the haber synthesis of ammonia, homogeneous catalysis, enzyme catalysis

Unit III:

Spontaneous reactions, free energy of spontaneous reaction, role of temperature, standard free energy change, standard free energy of formulation of compounds, the concept of chemical equilibrium, Law of mass action, thermodynamic derivation of law of chemical equilibrium, van't hoff reaction isotherm, distinction between ΔG and ΔG^0 , relation between K_p , K_c , K_x , relation between K_p and K_c for ideal gas mixture, relation between K_p and K_c for liquid state, calculations of K_p and K_c for different reaction,

Unit IV:

De Donder's treatment of chemical equilibria, degree of advancement of chemical reaction, thermodynamic relation for chemical affinity, enthalpy and affinity, internal energy and affinity, homogeneous equilibrium, Intregrated form of Vant's equation, pressure dependence of equilibrium constant K_p , pressure dependence of equilibrium constant K_x , heterogeneous equilibrium, dissociation of calcium carbonates, equilibrium constants of reactions involving real gas, Le Chatelier's principle: effect of change of temperature, effect of change of pressure, Le Chatelier's principle in physical equilibrium, Vapour pressure of liquid, effect of pressure on the boiling point of the liquid, effect of temperature on solubility, linear free energy relationship, Hammett equation: substituent constant, reaction constant, Hammett equation as a linear free energy relationship, reeaction mechanism, Hammett constants and curved Hammett plot, separation of polar, resonance and steric effects.

S.No.	Name/Title	Author	Publisher
1	Principles of Physical Chemistry	B. R. Puri , Madan S.	Vishal Publishing
		Pathania L.R. Sharma	Company (2020)
2	Atkins' Physical Chemistry, thermodynamics	Peter Atkins, Julio de	Oxford University
	and kinetics	Paula	press,(2014)
3	A Textbook of Physical Chemistry,	K. L. Kapoor	McGraw Hill
	Thermodynamics and Chemical		Education(2019)
	Equilibrium(volume Two)		
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



CHEMISTRY VIII C:COORDINATION CHEMISTRY

Semester	VIII	
Course Code	CHM466	
Course Title	Chemistry VIII C:Coordination Chemistry	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc I, B.Sc I I and B.Sc III year with as Chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Study the coordination complexes.	
	2. Study reactions of coordination complexes and their applications.	
Course Outcomes (CO)	By the end of this course, students will be able to	
	1. Understand Formation, reaction mechanism of coordination complexes, their	
	Kinetic and thermal stability, and determinations.	
	2. Stability of coordination complexes.	
	3. Interpret the electronic and magnetic properties of coordination compounds.	

UNIT - I

Coordination Chemistry and bonding

Nomenclature, isomerism and methods of preparation of coordination complexes- types of ligands. Bonding: Valence bond theory- Crystal field theory - Crystal field effects in tetrahedral, octahedral and square planar symmetries. Crystal field stabilization energy - weak and strong fields- spectrochemical series. Molecular orbital theory: based on group theoretical approach. M.O. diagram of Oh. Td & square planar symmetries involving pi bonding- experimental evidence for the presence of pi bonding. Magnetic behaviour of the transition metal ions in crystal field and molecular orbital theories.

Unit-II

Electronic Spectra and Magnetic Properties of Transition Metal Complexes-I

Term symbols for d configuration. calculations of Dq, B and β parameters, Characteristics of d-d transition - selection rules rules for electronic spectra. Weak and strong field limits. Spectroscopic ground states, correlation ,Orgel diagram and Tanabe – Sugano energy level diagrams. Spectrochemical series, Jahn-Teller tetrahedral distortion and spin orbit couplings. Nephelauxetic effect -charge transfer spectra. Luminescence spectra.

Magnetic moments based on crystal field ground term, Perturbation Theory and its application.

UNIT – III

Reaction Mechanisms of Transition Metal Complexes

Introduction, potential energy diagram and reactivity of metal complexes, ligand substitution reactions, labile and inert metal complexes, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, anation reaction, ligand displacement reactions in octahedral and square planar complexes, Trans effect, mechanism of the substitution reaction reactions without metal ligand bond cleavage, Electron transfer reactions: Inner sphere and outer sphere process.

Stepwise and overall formation constant and their interaction, trends in stepwise constants, Factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin.

Unit-IV

Metal II–Complexes: Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structure elucidation, important reaction of metal carbonyls. Preparation, bonding structure and important reactions of transition metal nitrosyl, Complexes of unsaturated hydrocarbons- alkenes, allyl and pentadienyl complexes.

Arene complexes-complexes of biochemical importance: Cytochromes, Haemoglobin, Myoglobin, Cyanocobalamine, Chlorophyll- structure and functions.

S.No.	Name/Title	Author	Publisher
1	Inorganic Chemistry- Principles of Structure and Reactivity (IV Edition).	Huheey, J. E., Keitler, E. A., & Keitler, R. L. (2012).	Singapore: Pearson Education.
2	Basic Inorganic Chemistry (III Edition).	Cotton, F. A., Wilkinson, G., & Paul. L. (2007).	New York: John Wiley & Sons.

		DEGI: DWALL	I
3	Inorganic Chemistry	D.F.Shriver, P.W.Atkins and C.H.Langford,	Oxford, 2nd. edn. 1994.
4	Magnetism and Transition Metal Complexes	F. E. Mabbs and D. J. Machin	(Chapman and Hall) London (1973).
5	Introduction to Magnetochemistry	A. Earnshaw	Academic Press, (1968)
6	Co-ordination Chemistry.(Ist Edition)	Sarn, K. (2005).	New Delhi: Rajat Publications.
7	An Introduction to Inorganic Chemistry	K.F.Purcell and J.C.Kotz	Saunders 1990, Chapter 14.
8	Organotransition Metal Chemistry	Anthony F.Hill	Royal Society of Chemistry, Tutorial Chemistry Text, 2002. Chapters 1 to 7.
9	Comprehensive Coordination Chemistry	Vol.1. G Wilkinson (Ed)	Wiley, New York, 1967
10	Inorganic Chemistry,	Gary L. Miessler, Paul J. Fischer and Donald A. Tarr, (2013).	Pearson



CHEMISTRY VIII D: BIO-ORGANIC CHEMISTRY

Semester	VIII	
Course Code	CHM468	
Course Title	Chemistry VIII D: Bio-Organic Chemistry	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc I, B.Sc I I and B.Sc III year with as Chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Know about structure, function, and physicochemical properties of biomolecules.	
	2. Aware about the metalloenzymes, heme proteins, oxygen carriers, and non-heme proteins	
	and therapatic Agents.	
Course Outcomes (CO)	By the end of this course, students will be able to	
	1. Understand structure, function and physicochemical properties of biomolecules.	
	2. Interpret Structure & Properties of enzymes, Mechanism of Enzyme Action	
	metalloenzymes heme proteins and oxygen carriers.	
	3. Apply and use of non-heme proteins and therapatic Agents.	

Unit-I

Enzymes: Basic considerations. Proximity effects and molecular adaptation. Introduction and historical prospective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and enzyme modification by site-directed mutagenesis.

Co-Enzyme Chemistry: Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes.Structure and biological function of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, LIPOIC ACID, vitamin B12. Mechanisms of reactions catalysed by the above cofactors.

Unit-II

Mechanism of Enzyme Action: Enzyme kinetics, Michaelis-menten and lineweaver-Burk plots, reversible and irreversible inhibition. Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chymotrypsin, ribonucleases, lysozyme and carboxypeptidase A

Metalloenzymes: Definitions: Apoenzyme, Coenzyme, Metalloenzyme, structure and functions of carbonic anhydrase A & B, carboxy peptidases.

Unit-III

Vitamins: Introduction of fat soluble and water soluble vitamins, sources, structure, requirements and functions of vitamin A,D,E and vitamin B1 and C.

Antibiotics: B- Lactumrings, structure and synthesis of penicillin – G, penicillin-V, Amoxycillin, cholamphenicol, streptomycin.

Unit-IV

Transport and storage of metals: The transport mechanism, transport of alkali and alkaline earth metals, ionophores, transport by neutral macrocycles and anionic carriers, sodium/potassium pump, transport and storage of Iron (Transferrin & Ferritin). Transport of Iron in microorganisms (sidrophores), types of sidrophores (catecholate and Hydroxmato siderophores).

Inorganic compounds as therapatic Agents:- Introduction chelation therapy, synthetic metal chelates as antimicrobial agents, antiarthritis drugs, antitumor, anticancer drugs (Platinum complexes), Lithium and mental health.

S.No.	Name/Title	Author	Publisher
1	The Inorganic Chemistry of Biological	M. N. Hughes	John Wiley & Sons Ltd
	processes		
2	Medicinal Chemistry-the role of organic	C. R. Ganellin, and S. M.	Mount Kisko, NY 1973
	chemistry in drug research	Roberts	
3	Bio Inorganic Chemistry	Robert Wittay	
4	Advanced Inorganic Chemistry (4 th Edn)	Cotton and Wilkinson	
5	Topics in current chemistry (Inorganic	Davison and Coworkers	
	Biochemistry) vol. 64 (1976)		
6	Inorganic chemistry	James E. Huheey.	

CHEMISTRY VIII E: INDUSTRIAL CHEMISTRY

Semester	VIII	
Course Code	CHM470	
Course Title	Chemistry VIII E: Industrial Chemistry	
Type of course	Theory	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc. with Chemistry as main subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Know about basic industrial processes and Industrial Chemicals.	
	2. Design, perform experiments, analyse and interpret data in industrial chemistry.	
Course Outcomes (CO)	By the end of this course, students will be able to	
	1. Understand various industrial chemicals and their synthesis.	
	2. Understand the use and handling of important reagents used in industrial	
	chemistry.	
	3. Analyse statistical data from different chemical experiments.	

UNIT I

Chemical Technology: Basic principles of distillation, solvent extraction, solid-liquid leaching and liquid-liquid extraction, separation by absorption, and adsorption. An introduction to the scope of different types of equipment needed in chemical technology, including reactors, distillation columns, extruders, pumps, mills, emulgators. Scaling up operations in the chemical industry. Introduction to clean technology.

Industrial Gases and Inorganic Chemicals: (a) Industrial Gases: Large scale production, uses, storage, and hazards in handling of the following gases: oxygen, nitrogen, argon, neon, helium, hydrogen, acetylene, carbon monoxide, chlorine, fluorine, sulphur dioxide, and phosgene.

(b) Inorganic Chemicals: Manufacture, application, analysis, and hazards in handling the following chemicals: hydrochloric acid, nitric acid, sulphuric acid, caustic soda, common salt, borax, bleaching powder, sodium thiosulphate, hydrogen peroxide, potash alum, chrome alum, potassium dichromate, and potassium permanganate.

UNIT II

Surface Coatings & Dyes: A. Objectives of coatings surfaces, preliminary treatment of the surface, classification of surface coatings. Paints and pigments-formulation, composition, and related properties. Oil paint, Vehicle, modified oils, Pigments, toners, lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electroless), metal spraying, and anodizing.

B. Dyes: General introduction and classification with special reference to textile and edible dyes and fabric brighteners. Industrial preparation and uses of methyl orange, malachite green, indigo, bismark brown, alizarin.

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UNIT III

Oils and Fats: Classification of oils, fat splitting, distillation of completely miscible and non-miscible oils, hydrogenation of oils, rancidity, saponification value, iodine number, acid value, Soap, and Synthetic Detergent, preparation of soap and detergent, different types of soap and their composition, surfactants (LAS, ABS, LABS), detergent binders and builders.

Lubricants: Classification of lubricants, lubricating oils (conducting and non-conducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants (viscosity index, cloud point, pore point) and their determination.

Food chemistry: Food additives A general study of food flavours, colours and preservatives, artificial sweeteners.

UNIT IV

Practical Industrial Chemistry

Preparation of cosmetics: Talcum powder, soap, shampoo, enamels, hair remover, face cream, nail polish and nail polish remover.

Preparation of simple organophosphates, phosphonates and thiophosphates, magnesium bisilicate (Antacid).

Separation of essential oils by soxhlet extractor.

Analysis of oils and fats (iodine value, saponification value, acid value).

Testing of turmeric powder, milk, and mustard oil for adulterants.

Extraction of natural colouring and flavouring agents from flowers and fruits

Preparation of dyes: Malachite Green, Methyl Orange.

Polymeric synthesis: Maleic Anhydride/ glyptal resin, caprolactum, phenol-formaldehyde and urea-formaldehyde, Preparation of Hexamethylenediamine and Adipic acid, Preparation of nylon 6,6.

Reference Books:

- 1. E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
- 2. R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, WileyPublishers, New Delhi.
- 3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics, WileyPublishers, New Delhi.
- 4. J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
- 5. P. C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi.
- 6. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
- 7. Sharma, B.K. & Gaur, H. Industrial Chemistry, Goel Publishing House, Meerut (1996).



CHEMISTRY VIII F: ORGANIC CHEMISTRY PRACTICAL-1

Semester	VIII	
Course Code	CHM472	
Course Title	Chemistry VIII F:Organic Chemistry Practical-1	
Type of course	Practical	
LTP	0 0 4	
Credits	2	
Course prerequisite	B.Sc I, B.Sc I I and B.Sc III year with as Chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Learn the basic organic preparations.	
	To use organic reagents like reducing agents and oxidizing agents in various organi	
	synthesis.	
Course Outcomes (CO)	By the end of this course, students will be able to	
	1. Adopt safe laboratory practices by handling laboratory glassware, equipment and	
	chemicals.	
	2. Understand the basic nature of reagents like reducing agents and oxidizing agents.	
	3. Apply & propose starting materials, functional groups, mechanism, and typical reaction conditions.	

List of Experiments

Synthesis: Synthesis, purification and identification of organic compounds by recrystallization/functional group identification:

1	delitification.
i.	Oxidation: Adipic acid from cyclohexanol
ii.	Aldol condensation: Dibenzal acetone from benzaldehyde
iii.	Sandmeyer reaction: p-Chlorotoluene from p-toluidine
iv.	Cannizzaro reaction: Benzyl alcohol and benzoic acid from benzaldehyde
v.	Aromatic electrophilic substitutions: p-nitroaniline from aniline
vi.	Aromatic electrophilic substitutions: Picric acid from phenol
vii.	Beckmann Rearrangement: Benzanilide ← Benzophenone oxime ← Benzaldehyde
viii.	Reduction: Benzhydrol from benzophenone [NaBH ₄ reduction]
ix.	Esterification: Methyl benzoate from benzoic acid
Χ.	Carbohydrate Modification: Osazone derivative from carbohydrates
xi.	Haloform reaction: Iodoform synthesis from acetone / ethyl alcohol
xii.	Sublimation: Synthesis/purification of Phthalic anhydride from Phthalic acid
xiii.	Preparation of p- Iodonitrobenzene from p-nitroaniline.
xiv.	Preparation of benzyl alcohol and benzoic acid (Cannizzaro's reaction).
XV.	Preparation of Dibenzal acetone from benzaldehyde (Claisen-Schmidt reaction).
xvi.	Preparation of Acetanilide, bromoacetanilide, bromoaniline.

S.No.	Name/Title	Author	Publisher
1	Experimental Organic Chemistry,	Harwood, L.M., Moody, C.J.	1st edition, Blackwell Scientific Publishers, 1989.
2	Text Book of Practical Organic Chemistry	Vogel, A.I.	ELBS, IVth edition, Longman Group Ltd., 1978.
3	Practical Organic Chemistry	Mann, F.G.; Saunders, B.C.	4th edition, New Impression, Orient Longman Pvt. Ltd., 1975

CHEMISTRY VIII G: PHYSICAL CHEMISTRY PRACTICAL- I

Semester	VIII	
Course Code	CHM474	
Course Title	Chemistry VIII G: Physical Chemistry Practical- I	
Type of course	Laboratory Course	
LTP	0 0 4	
Credits	2	
Course prerequisite	B.Sc I, B.Sc II and B.Sc III year with as Chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Impart knowledge and hand-on experiences of different analytical techniques.	
	2. Perform and utilize various thermodynamic techniques (conductometry, pHmetry and other	
	viscosity and surface tension measurements) for chemical and biomolecular analysis	
Course Outcomes (CO)	By the end of this course, students will be able to	
	1. Acquire basic knowledge about analytical techniques such as conductometric, pH metric	
	potentiometry techniques.	
	2. Understand and apply different thermodynamic techniques like viscosity and surface tens measurements for solutions.	
	3. Analyze determination of solubility of different inorganic and organic salt.	

1. Viscosity:

- (i) To determine the coefficient of viscosity of given liquid by Ostwald's viscometer.
- (ii) Determination of relative and absolute viscosity of a given liquid.
- (iii) Determination of percentage composition of a liquid mixture by viscosity measurement.
- (iv) Determination of molecular weight of a high polymer (say polystyrene) by viscosity measurement.

2. Surface Tension:

- (i) Determination of surface tension of given liquid by drop no. method by stalgmometer.
- (ii) To determine the C.M.C. of a soap (sodium or potassium lauryl sulphate by surface tension measurements and to compare cleansing power of two detergents.
- (iii) Determination of surface tension of alcohols & Determination of Parachor value of >CH₂ group.
- (iv) To measure interfacial tension and to test the validity of Antonoff's rule.

3. Solubility:

- (i)Determination of solubility of inorganic salt in water at different temperatures and hence to draw the solubility curve.
- (ii)Determination of heat of solution of a substance by solubility method
- (iii) To study the effect of addition of an electrolyte on the solubility of an organic acid.
- (iv) To study the variation of solubility of Ca (OH)₂ in NaOH solution and hence determine the solubility product.
- (v)Determine the solubility (g/litre) of sparingly soluble lead sulphate from conductance measurements.
- (vi)To obtain the mutual solubility curve of phenol + H2O, and hence the Upper Consolute point,

4. Colloidal State:

- (i) To compare the precipitation power of Na⁺, Ba⁺² & A1⁺³ ions for As₂S₃ sol.
- (ii) To study interaction between arsenious sulphide and ferric hydroxide sol.

5. Potentiometric/ conductometric titrations:

- (i) Preparation of buffers and measurement of their pH.
- (ii) To determine the strength, dissociation constant of given acid pH metrically.
- (iii)Titration of weak acid /Weak base conductometrically.
- (iv)Titration of strong acid /strong base conductometrically.
- (v)To determine dissociation constant of given acid conductometrically.
- (vi)Compare the relative strength of CH₃COOH and CICH₂COOH from conductance measurements.
- (vii)Titrate a given mixture of HCl and CH₃COOH against NaOH solution conductometrically
- (viii)Determine the dissociation constant of acetic acid in DMSO, DMF and dioxane by titrating it with KOH.
- (ix)Determine the activity coefficient of an electrolyte at different molalities by e.m.f. measurements.

Note: Perform at least any three from each section.

S.No.	Name/Title	Author	Publisher
1	Experimental Physical Chemistry	Arthur M. Halpern, George C. McBane	Freeman,2006.
2	Experiments in Physical Chemistry, 5th ed.,	Schoemaker et al.	MGH, 1989
3	Chemistry Experiments for Instrumental Methods	Sawyer, Heineman, Beebe	Wiley, 1984.
4	Physical Chemistry Practical.	Maity S., and Ghosh, N.(New Central Book Agency (P) Ltd. 2012).
5	Senior Practical Physical Chemistry.	Khosla, B.D., Garg, V.C., and Gulati A.R.	S. Chand and Sons. (2007).
6	Advanced Practical Physical Chemistry.	Yadav, J. B.	Krishna Prakashan Media. (2006).
7	Experiments in Physical Chemistry,	Ghosh, J.C.	Bharati Bhavan. (1990).





SKILL ENHANCEMENT COURSES

(Semester III - VI)

KHIALA, DISTT. JALANDHAR (PUNJAB)

BASIC ANALYTICAL CHEMISTRY

Semester	ш	
Course Code	CHM 265	
Course Title	Basic Analytical Chemistry	
Type of course	Skill Enhancement Course	
LTP	2:0:0	
Credits	2	
Course prerequisite	B.sc. Ist, IInd year with Chemistry as core subject	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Aware about concepts of analytical Chemistry various spectrophotometric,	
	electroanalytical methods of analysis.	
	2. Exposed to important separation methods like solvent extraction and chromatography.	
Course outcome (CO)	By the end of this course, students will be able to:	
	1. Handle analytical data & Expresses the role of analytical chemistry in science.	
	2. Determine composition and pH of soil, which can be useful in agriculture	
	3. Do qualitative and quantitative analysis of water, food adultrants & cosmetics	
	4. Estimate macro nutrients using Flame photometry & Separate mixtures using	
all and the second	separation techniques	

UNIT I:

Introduction: Introduction to Analytical Chemistry and its interdisciplinary nature. Concept of sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.

Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators a. Determination of pH of soil samples. b. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.

Analysis of water: Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. a. Determination of pH, acidity and alkalinity of a water sample. b. Determination of dissolved oxygen (DO) of a water sample.

UNIT II:

Chromatography: Definition, general introduction on principles of chromatography, paper chromatography, TLC etc.

- a. Paper chromatographic separation of mixture of metal ion (Fe³⁺ and Al³⁺)
- b. To compare paint samples by TLC method.

Ion-exchange: Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).

UNIT III:

Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration.

- a. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc.
- b. Analysis of preservatives and colouring matter.

Analysis of cosmetics: Major and minor constituents and their function

- a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate.
- b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.

Unit IV:

Suggested Applications (Any one):

- a. To study the use of phenolphthalein in trace cases.
- b. To analyze arson accelerants.

c. To carry out analysis of gasoline.

Suggested Instrumental demonstrations:

- a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.
- b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.
- c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft drink

S. No	Name	Author(S)	Publisher
1	Analytical Chemistry,	Christian, G.D. (2004),	John Wiley & Sons.
2	Principles of Instrumental Analysis,	Skoog, D.A.; Holler F.J.;	Thomson
		Nieman, T.A. (2005),	Asia Pvt. Ltd.
3	Vogel's Qualitative Inorganic Analysis (7th	G Svehla	Prentice Hall
	Edition).		
4	Instrumental Analysis	G.D. Christian and J.E.G.	Allegn Becon, Latest
	4 5 2 2	Reily	edition
5	Instrumental Methods of Chemical Analysis	G.W.Ewing,	McGraw Hill Pub, 1975.



GREEN METHODS IN CHEMISTRY

Semester	IV	
Course Code	CHM 270	
Course Title	Green Methods in Chemistry	
Type of course	Skill Enhancement Course	
LTP	2:0:0	
Credits	2	
Course prerequisite	Bsc. Ist, IInd year with Chemistry as core subject	
Course Objective (CO)	 The aim of this course is to enable the students to Impart Coherent knowledge about principles of green chemistry. Study scope of Green chemistry and applications of green chemistry in current scenario. 	
Course Outcome (CO)	By the end of this course, students will be able to: 1. Understand the twelve principles of green chemistry and will build the basic understanding of toxicity, hazard and risk of chemical substances. 2. Analyze a process and identify parameters that make environmentally friendly/sustainable/green. 3. Learn to design safer chemical ,products and processes that are less toxic, than current alternatives. 4. Appreciate the use of green chemistry in problem solving skills, critical thinking and valuable skills to innovate and find out solution to environmental problems.	

UNIT - I

Introduction: Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity, green solvents, Green Chemistry and catalysis and alternative sources of energy, Green energy and sustainability.

UNIT - II

The Real world Cases in Green Chemistry:

Surfactants for carbon dioxide – Replacing smog producing and ozone depleting solvents with CO for precision cleaning and dry cleaning of garments.

Designing of environmentally safe marine antifoulant.

UNIT -III

Right fit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments.

An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

UNIT - IV

Practical Aspects: Preparation and characterization of biodiesel from vegetable oil.

Extraction of D-limonene from orange peel using liquid CO prepared from dry ice.

Mechano- chemical solvent free synthesis of azomethine.

Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).

S.	Name	Author(S)	Publisher
No			
1	Green Chemistry- Theory and Practical, 1998	Anastas, P.T. & Warner, J.K.	Oxford University Press
2	Introduction to Green Chemistry, 2001	Matlack, A.S.	Marcel Dekker
3	Real-World cases in Green Chemistry, 2000	Cann, M.C. & Connely, M.E.	American Chemical Society, Washington
4	Introduction to Green Chemistry, 2002	Ryan, M.A. & Tinnesand, M.	American Chemical Society, Washington

FUEL CHEMISTRY

Semester	V	
Course Code	CHM 375	
Course Title	Fuel chemistry	
Type of course	Skill enhancement Course	
LTP	2:0:0	
Credits	2	
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject	
Course Objective (CO)	The aim of this course is to enable the students to 1. Know about basic scientific and technical understanding of the production, behaviour and handling of hydrocarbon fuels and lubricants. 2. Study emerging alternative & renewable fuels. 3. Be industry ready to contribute effectively in the field of petroleum chemistry and technology.	
Course Outcome (CO)	By the end of this course, students will be able to: 1. Understanding of both conventional petroleum-based fuels, and alternative & renewable fuels, including gaseous fuels. 2. understand the refining processes used to produce fuels and lubricants and their usage in different applications. 3. Analyze origin of petroleum, crude oil, composition, different refining processes employed industrially to obtain different fractions of petroleum. 4. Catagorize alternative and renewable fuels like Biofuels (Different generations), Gaseous Fuels (e.g. CNG, LNG, CBG, Hydrogen etc.). 5. Apply various test methods used to qualify different types of fuels as well characterization methods.	

UNIT I:

Review of energy sources (renewable and non-renewable). Classification of fuels and

their calorific value. Determination of calorific value by Bomb calorimeter and Junker's calorimeter.

Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses.

Fractionation of coal tar, uses of coal tar bases chemicals, requisites of a good metallurgical coke, Coal gasification (Hydro gasification and Catalytic gasification), Coal liquefaction and Solvent Refining.

UNIT II:

Petroleum and Petrochemical Industry: Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking)

UNIT III:

Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass), fuel from waste, synthetic fuels (gaseous and liquids), clean fuels. **Petrochemicals:** Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.

UNIT IV:

Lubricants: Classification of lubricants, lubricating oils (conducting and nonconducting) Solid and semisolid lubricants, synthetic lubricants. Properties of lubricant (viscosity index, cloud point, pore point) and determination.

S. No	Name	Author(S)	Publisher
1	Principles of Instrumental Methods	D. A. Skoog and	Saunder's College Publ. Latest
	of analysis	D.M.West	edition.
2	Engineering Chemistry	Jain, P.C. & Jain, M.	Dhanpat Rai & Sons, Delhi
3	Instrumental methods of chemical	B.K.sharma	Krishna prakashan media LTD
	analysis		
4	Industrial Chemistry	Sharma, B.K. & Gaur, H.	Goel Publishing House, Meerut
5	Industrial Chemistry Vol-I	Stocchi, E.	Ellis Horwood Ltd. UK (1990).

BASIC PHARMACEUTICAL CHEMISTRY

Semester	VI	
Course Code	CHM 374	
Course Title	Basic Pharmaceutical Chemistry	
Type of course	Skill enhancement course	
LTP	2:0:0	
Credits	2	
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject	
Course Objective (CO)	The aim of this course is to enable the students to 1. Develop basic understanding of drugs discovery, design, development and their side effects. 2. Impart knowledge of fermentation process and production of certain dietary supplements and certain common antibiotics.	
Course outcome (CO)	By the end of this course, students will be able to: 1. Gain insight into retro-synthesis approach in relation to drug design and drug discovery. 2. Learn synthetic pathways of major drug classes. 3. Understand the fermentation process and production of ethanol, citric acids, antibiotics and some classes of vitamins.	

Unit 1:

Introduction: Drug discovery, design and development: Sources of drugs: biological, marine, minerals and plant tissue culture, physio-chemical aspects (optical, geometric and bioisosterism) of drug molecules and biological action, drug receptor interaction, basic retro-synthetic approach for development of drug. Cause of side effect of drugs like ibuprofen, cetirizine, thalidomide. Difference between drug and poison.

Unit II

Drugs and Pharmaceuticals: Study of pharmaceutical aids like talc, diatomite, kaolin, bentomite, gelatin and natural colours. Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim); antiviral agents (Acyclovir), central nervous system agents (Phenobarbital, Diazepam), Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT-Zidovudine).

Unit 3:

Fermentation: Aerobic and anaerobic fermentation, Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C.

UNIT 4

- 1. Preparation of aspirin and its analysis.
- 2. Preparation of paracetamol and its analysis.
- 3. Preparation of sulphacetamide of sulphonamide and its analysis.
- 4. Determination of alcohol contents in liquid drugs/galenical.
- 5. Determination of ascorbic acid in vitamin C tablets by iodometric or coulometric titrations.
- 6. Synthesis of ibuprofen.
- 7. Analysis of commercial vitamin C tablets by iodometric and coulometric titrimetry.

S. No	Name	Author(S)	Publisher
1	Introduction to Medicinal Chemistry	G.L. Patrick	Oxford University Press, UK.
2	Medicinal and Pharmaceutical Chemistry	Hakishan, V.K. Kapoor	Vallabh Prakashan,
			Pitampura, New Delhi
3	Principles of Medicinal Chemistry	William O. Foye Thomas L.,	B.I. Waverly Pvt. Ltd. New
		Lemke, David A. William	Delhi
4	Medicinal Chemistry-the role of organic	C. R. Ganellin,	Academic Press
	chemistry in drug, 1993	and S. M. Roberts	
5	Medicinal Chemistry-principles and	F. D. King	Royal Society
	practice,1994		of Chemistry

CHEMISTRY OF COSMETICS AND PERFUMES

Semester	VII	
Course Code	CHM 376	
Course Title	Chemistry of Cosmetics and Perfumes	
Type of course	Skill enhancement course	
LTP	2:0:0	
Credits	2	
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject	
Course Objective (CO) The aim of this course is to enable the students to		
	1. Get introduce to the world of cosmetic chemistry.	
	2. Impart the theoretical and practical knowledge on basic principles of cosmetic	
	chemistry, manufacture, formulation of various cosmetic products.	
Course Outcome (CO) By the end of this course, students will be able to:		
	1. Learn basic of cosmetics, various cosmetic formulation, ingredients and their	
	roles in cosmetic products.	
	2. Learn the use of safe, economic and body-friendly cosmetics	
	3. Prepare new innovative formulations.	

UNIT I

Cosmetics- Definition, History, Classification, Ingredients, Nomenclature, Regulations. Face Preparation: Structure of skin, Face powder, Compact powder, Talcum powder.

UNIT-II

Skin Preparation: Face cream, vanishing cream, cold cream, suntan cream, lather shaving cream,

Hair preparation: Structure of hair, classification of hair, Hair dye- classification – temporary, semipermanent, demi permanent, permanent, formulation, hair sprays, shampoo- types of shampoo, conditioners

UNIT III

Colored preparation: Nail preparation Structure of nail, Nail lacquers, Nail polish remover Lipsticks, Personal hygiene products: Antiperspirants and deodorants, oral hygiene products, flavours and essential oils

UNIT -IV

Practicals

Preparation of: 1. Talcum powder. 2. Shampoo. 3. Enamels. 4. Face cream. 5. Nail polish and nail polish remover. 6. Hand wash 7. Hand sanitizer 8. Body lotion 9. Soap 10. Tooth powder 11. Tooth paste

S. No	Name	Author(S)	Publisher
1	Handbook of Cosmetic Science and	Barel, A.O.; Paye, M.;	CRC Press.
	Technology,	Maibach, H.I.(2014)	
2	Text Book of Cosmetics	Garud, A.; Sharma,	Pragati Prakashan
		P.K.; Garud, N. (2012),	
3	Pharmaceutics and Cosmetics,	Gupta, P.K.; Gupta,	Pragati Prakashan
		S.K.(2011),	
4	Poucher's Perfumes, Cosmetic and	Butler, H. (2000),	Springer
	Soap,		
5	Chemistry of Cosmetics	Kumari, R.(2018),	Prestige Publisher

(AEC)

Ability Enhancement Courses

Semester I - VIII

VERS

KHIALA, DISTT. JALANDHAR (PUNJAB)

COMMUNICATION SKILLS-I

Semester	I		
Course Code	ENG121		
Course Title	Communication skills-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 (CO)	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.	Communications Skills	Vi <mark>s</mark> hal Publishing
	Dheer	TT TAT ANDHAR (PUN)	Company
3	The Essence of Effective	Ludlow and Panton	Prentice Hall of India
	Communication		
4	Essentials of Business	Pal and Korlahalli	S. Chand and Sons. New
	Communication		Delhi

COMMUNICATION SKILLS-1 LAB

Semester	I		
Course Code	ENG123		
Course Title	Communication Skills-1 Lab		
Type of Course	Practical		
L T P	0 0 2		
Credits	1		
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 (CO)	C		

UNIT-I

Speaking and Discussion Skills: Oral Presentation, Planning and organizing content for presentation, Use of audio /visual Aids, Making Slides for presentation, Group Discussion

Debate, Extempore speaking, Interview Skills, Mock interview, Mock Dialogues (Pair Speaking), Cue Card Speaking, Meeting/Conferences.

IINIT-II

Listening Skills: Listening to any recoded material and asking oral/written questions for listening comprehension. Reading Skills: Active reading of passages for Reading comprehensions, paraphrase, Summary writing.

UNIT-III

Writing Skills: Guidelines of effective writing, Paragraph Writing, Email Writing.

UNIT-IV

Grammar and Vocabulary:

Parts of Speech, Tenses, GRE words (List of 50 Words).

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-II

Semester	II	
Course Code	ENG114	
Course Title	Communication Skills-II	
Type of Course	Theory	
LTP	200	
Credits	2	
Course pre-requisite	NA	
Course Objectives (CO)	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 (CO)	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 **Business Communication** K. K. Sinha Galgotia Publishing Company, 2 Media C. S. Rayudu Himalaya Publishing House, and Communication Management Essentials Business Rajendra Pal and J. Sultan Chand Communication S. Korlahalli & Sons, New Delhi

COMMUNICATION SKILLS-II LAB

Semester	II		
Course Code ENG116			
Course Title	Communication Skills-II Lab		
Type of Course	Practical		
L T P	0:0:2		
Credits	1		
Course pre-requisite	+ 2 with any stream		
Course Objectives	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:

To recognize part of speech of particular word in given sentence, To use appropriate tense, Exercise on: Voice, Reported speech and Sentence Structure, Vocabulary-One word substitution.

UNIT-II

Writing Skills:

Job Application, Resume Writing, Paragraph Writing, Preparing of Matter for meeting: Notice, agenda, Conference.

UNIT-III

Speaking Skills: How to deliver an effective power point Presentation, Slide making, Effective use of audio Visual aids,

UNIT-IV

Oral Communication and its Application:

Group Discussion, Mock Interview (Conducting and appearing for interviews), and Role plays. Conducting a successful official meeting.

Recommended Books

S. No	Name	Author(s)	Publisher
1	Business Communication	K. K. Sinha	Galgotia Publis <mark>h</mark> ing
	LIE, DIS	ATT VALVERONIVAGE	Company,
2	Media and Communication	C. S. Rayudu	Himalaya Publishing House,
	Management		
3	Essentials of Business	Rajendra Pal and J.	Sultan Chand
	Communication	S. Korlahalli	& Sons, New Delhi

ENVIRONMENTAL SCIENCE

Semester	III		
Course Code	EVS001		
Course Title	Environmental Science		
Type of course	Theory		
LTP	3 0 0		
Credits	3		
Course prerequisite	NA		
Course Objective (CO)	The aim of this course is to enable the students to 1. Aware about environment and need of maintaining it with best possible knowledge. 2. Develop an attitude of concern for the environment.		
Course Outcome (CO)	By the end of this course, students will be able to: 1. Gain understanding of enviornment and ecosystem 2. Study environmental pollutions and natural resources. 3. Study social issues related to envionment.		

UNIT-I

Introduction to Environment and Ecosystem: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness, Concept of Ecosystem, Structure, interrelationship, producers, Consumers and decomposers, ecological pyramids-biodiversity and importance. Hot spots of biodiversity.

UNIT-II

Environmental Pollution & Natural Resources: 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. Role of an individual in prevention of pollution. Pollution case studies, Disaster Management: Floods, earthquake, cyclone and landslides, Natural Resources and associated problems, use and over exploitation, case studies of forest mresources and water resources.

UNIT-III

Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection 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

UNIT-IV

Human Population and the Environment & Field Work: Population growth, variation among nations. Population explosion –Family Welfare Programme. Environment and human health, Human Rights, Value Education, HIV/AIDS. Women and child Welfare. Role of Information Technology in Environment and human health. Case studies

Visit to a local area to document environemntal assetsriver /forest/grassland/hill/mountain; Visit to a local polluted site-Urban/Rural/Industrial/Agricultural;Study of common plants, insects, birds;Study of simple ecosystems-pond, river, hill slopes, etc.

Text and reference books:

S. No	Title	Author(S)	Publisher
1	A Textbook for Environmental Studies	Erach Bharucha	
2	Environmental Biology,	Agarwal, K.C. 2001	Nidi Publ. Ltd. Bikaner.
3	Environmental Science.	Miller T.G. Jr.	Wadsworth

GENDER EQUITY

Semester	IV	
Course Code	SSC001	
Course Title	Gender Equity	
Type of course	ID	
LTP	3:0:0	
Credits	3	
Course prerequisite	NA	
Course Objectives (CO)	The aim of this course is to enable the students to	
	1. Acquire knowledge and understanding of theory and concepts related to gender and	
	gender relations	
	2. Critically reflect how gender is a development issue.	
Course Outcome (CO)	By the end of this course, students will be able to:	
	1. Know important mathematical concepts in abstract algebra such as definition of a group,	
	order of a finite group and order of an element.	
	2. Understand different types of subgroups such as normal subgroups, cyclic subgroups	
	and understand the structure and characteristics of these subgroups.	
	3. See and understand the connection and transition between previously studied	
	mathematics and more advanced mathematics.	

UNIT I

Concept of sex and gender

Gender attributes and questions of identity.

UNIT II

Empowerment-concept and meaning.

Definition of feminism, feminist and women movements in U.S.A, U.K., France and India

UNIT III

Women development and development organizations.

Impact of development on gender.

UNIT IV

Policies and current debates on women rights. Role of UN in establishing gender equality.

Violence against women and need for reforms.

S.No.	Author(S)	Year	Title	Publisher
1	Jayachandran, Seema	2014		NBER Working Paper No.20380. Issued in August 2014
2	Duflo, Esther	2012	Women's Empowerment and Economic Development Journal of Economic Literature, 1051-79.	

HUMAN VALUES & PROFESSIONAL ETHICS

Semester	V	
Course Code	SSC006	
Course Title	Human values & Professional Ethics	
Type of Course	ID	
LTP	3:0:0	
Credits	3	
Course Prerequisites	None	
Course Objectives (CO)	The aim of this course is to enable the students to	
	1. Discriminate between valuable and superficial in the life and develop sensitivity and	
	awareness; leading to commitment and courage to act on their own belief.	
	2. Discover what they consider valuable. Accordingly, they should be able to discriminate	
	between valuable and the superficial in real situations in their life.	
Course Outcome (CO)	By the end of this course, students will be able to:	
	1. Behave ethically, professionally and promote human values in society.	
	2. Understand about global issues.	
	3. Learn the rights and responsibilities as an employee, team member and a global citizen.	

UNIT-I: Course Introduction-Need, Basic Guidelines, Content and Process for Value Education

Understanding the need, basic guidelines, content and process for Value Education, Understanding Happiness and Prosperity correctly.

Understanding Harmony in the Human Being: Understanding the harmony with self and the Body: Sanyam and Swasthya.

UNIT II: Harmony in Human Relationship:

Understanding harmony in the Family- the basic unit of human interaction, visualizing a universal harmonious order in society **Understanding Harmony in the Nature and Existence**: Understanding the harmony in the Nature, Holistic perception of harmony at all levels of existence

UNIT III: Understanding of Harmony on Professional Ethics:

Ability to utilize the professional competence for augmenting universal human order, Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems

UNIT IV:Strategy for transition from the present state to Universal Human Order:

At the level of individual, at the level of society. Case studies: typical holistic technologies, management models and production systems

Recommended Books

S. No.	Author(S)	Year	Publisher
1	A Foundation Course in Value Education	R R Gaur, R Sangal	Excel Books Publishers
2	Energy & Equity	Ivan Illich	The Trinity Press, Worcester, and HarperCollins, USA
3	Human Values and Professional Ethics	RishabhAnand	Satya Prakashan, New Delhi
4	Jeevan VidyaekParichay.	A Nagraj	Divya Path Sansthan

4 1

BASICS OF COMPUTER SCIENCES

Semester	VII	
Course Code	CSE014	
Course Title	Basics of Computer Sciences	
Type of Course	Theory	
LTP	200	
Credits	2	
Course Prerequisites	Basic of Computer	
Course Objectives (CO)	The aim of this course is to enable the students to	
	1. Understand the basic concepts of computer, office automation, information	
	technology and internet.	
	2. Familarize with computing problems and apply principles of computing.	
Course Outcomes (CO)	By the end of this course, students will be able to:	
	Understand basics of computer and its operating system	
	2. Distinguish the types of software.	
	3. Learn the MS-Windows basics and applications	

UNIT-I

Introduction to Computers

Define a Computer System, Block diagram of a Computer System and its working, Applications of computer system, Input and Output device, memories, RAM, ROM, secondary storage devices, Computer Software and Hardware.

UNIT-II

Operating System: Definition, Need for operating system, Functions of operating system (Processor Management, Memory Management, File Management and Device Management), Working with GUI operating System.

Computer Languages: Machine language, assembly language, higher level language.

UNIT-III

Working Knowledge of Computer System

Word Processor- Introduction to word processors and its features, creating, editing, printing and saving documents, spell check, mail merge

PowerPoint: creating power point presentations, creating spreadsheets and simple graphs, evolution of Internet and its applications and services.

Spreadsheets- Introduction to spreadsheets and its features, Using different types of formulae, Creating graphs and charts, Exporting charts to word processor.

UNIT-IV

Introduction to Information Technology: Introduction to Information Technology and itsapplications. Introduction of internet- Definition, Applications of internet, Impact of Internet on Society Crime on/through the Internet, E-mail, WWW.

Text and	1 Reference Books	ANDHAR (PUN	JAB)
Sr. no.	Name	Author(s)	<u>Publisher</u>
1	Fundamentals of Computers	R. S. Salaria	Salaria Publishing
			House
2	Computer Fundamentals	P.K. Sinha and	BPB Publication
3	Absolute Beginners Guide to Computer Basics	Miller M	Pearson Education
<u></u>	MS Office for Windows XP	Sagman S	Pearson Education

BASICS OF COMPUTER SCIENCES LAB

Semester	VII	
Course Code	CSE016	
Course Title	Basics of Computer Sciences Lab	
Type of course	Practical	
LTP	0 0 2	
Credits	1	
Course prerequisite	NA	
Course Objective	The aim of this course is to enable the students to	
(CO)	1. Familiarize with basic concepts of computers including office automation and	
	internet concepts.	
	2. Familarize with computing problems and apply principles of computing.	
Course Outcomes (CO)	By the end of this course, students will be able to:	
	1. Understand basics of computer and its operating system	
	2. Distinguish the types of software	
	3. Learn the MS-Windows basics and applications	

LIST OF EXPERIMENTS

- 1. Given a PC, name its various components and peripherals. List their functions
- 2. Installation of operating System viz. Windows XP, Windows 2007 etc.

Features of Windows as an operating system

- Start
- Shutdown and restore
- Creating and operating on the icons
- Opening closing and sizing the windows
- Using elementary job commands like creating, saving, modifying, renaming, finding and deleting
- Creating and operating on a folder
- Changing setting like, date, time, colour (back ground and fore ground)
- Using shortcuts
- 3. Using on line help Word Processing (MS Office/Open Office)
- a) File Management:

Opening, creating and saving a document, locating files, copying contents in some different file(s), protecting files, giving password protection for a file

b) Page Set up:

Setting margins, tab setting, ruler, indenting

c) Editing a document:

Entering text, Cut, copy, paste using tool-bars

d) Formatting a document:

Using different fonts, changing font size and colour, changing the appearance through bold/ italic/underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods

- Aligning of text in a document, justification of document, Inserting bullets and numbering
- Formatting paragraph, inserting page breaks and column breaks, line spacing
- Use of headers, footers: Inserting footnote, end note, use of comments
- Inserting date, time, special symbols, importing graphic images, drawing tools
- e) Tables and Borders:

Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table

Print preview, zoom, page set up, printing optionsUsing Find, Replace options

f) Using Tools like:

Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printingenvelops and lables

Using shapes and drawing toolbar,

Working with more than one window in MS Word,

Conversion between different text editors, software and MS word

4. Spread Sheet Processing (MS Office/Open Office)

- a) Starting excel, open worksheet, enter, edit, data, formulae to calculate values, format data, create chart, printing chart, save worksheet, switching between different spread sheets
- b) Menu commands:

Create, format charts, organize, manage data, solving problem by analyzing data, exchange withother applications. Programming with Excel Work Sheet, getting information while working

- c) Work books:
- 5. PowerPoint Presentation (MS Office/Open Office)
- a) Introduction to PowerPoint
 - a. How to start PowerPoint
 - b. Working environment: concept of toolbars, slide layout, templates etc.
 - c. Opening a new/existing presentation
 - d. Different views for viewing slides in a presentation: normal, slide sorter etc.
- b) Addition, deletion and saving of slides
- c) Insertion of multimedia elements
 - e. Adding text boxes
 - f. Adding/importing pictures
 - g. Adding movies and sound
 - h. Adding tables and charts etc.
 - i. Adding organizational chart
- d) Formatting slides
 - j. Using slide master
 - k. Text formatting
 - 1. Changing slide layout
 - m. Changing slide colour scheme
 - n. Changing background
 - O. Applying design template
- How to view the slide show?



RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS

Semester	VII	
Course Code	RM403	
Course Title	Research Methodology and Intellectual Property Rights	
Type of course	Theory course	
LTP	4 0 0	
Credits	4	
Course prerequisite	B.Sc I, B.Sc II and B.Sc III year	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Identify a research problem.	
	2. Know the importance of educational research and role of Intellectual Property Rights (IPR) in	
	research and development.	
Course Outcomes (CO)	By the end of this course, students will be able to:	
	1. Acquire & Understand significace of IPR, copyright laws in present scinario.	
	2. Identify a research problem, educational research, interpretation of the results and report writing.	
	3. Apply role of Intellectual Property Rights (IPR) in research and development.	

UNIT I

Research Methodology: Types and method of research, Research process; criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, Meaning of research design; need for research design; important concepts related to research design; different research designs. Writing research proposal: Characteristics of a proposal; content and organization of a proposal.

UNIT II

Interpretation and report writing: Meaning of interpretation; technique of interpretation; precautions in interpretation; significance of report writing; layout of research report; types of reports; Organization and writing of research paper, Presentation of research work-oral, poster and writing of research paper; Precautions for writing research report, Application and uses of common softwares in chemistry and physics.

UNIT III

IPR: Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Copyright, protection under copyright law, rights, transfer of copyright, infringement, Trademarks its objectives, types, rights, protection of goodwill, infringement, passing off, Defenses, Domain name, trade secrets. Design, Geographical Indication.

Introduction to the leading International Instruments concerning Intellectual Property Rights: the Berne Convention, Universal Copyright Convention, The Paris Convention, Patent Co-operation Treaty, TRIPS, The World Intellectual Property Organization (WIPO) and the UNESCO. Infringement. IPR in Pharmaceuticals and drug designing

UNIT IV

Ethical issues: Citation and acknowledgement, Reproducibility, Review of published research in the relevant field, plagiarism.

Patent and Patents Writing, Patent Act 1970 and its amendments. Procedure of obtaining patents,

Chemical safety and ethical handling of chemicals. Safety rules of laboratory acquaintance of experimental set up, importance of safety and security of data.

Industrial Designs its objectives, rights, registration, infringements, and Defenses of Design, Need for Protection of Industrial Designs, The Designs Act, 2000.

S.No.	Name/Title	Author	Publisher
1	Research Methodology: Methods &	C.R. Kothari	New Age International.
	Techniques (Rev. Ed.)		New Delhi
2	An Introduction to Research Methodology	B.L. Garg, R. Karadia, R., F. Agarwal,	RBSA Publishers
		F. and U.K. Agarwal	
3	Qualitative Inquiry and Research Design:	John W. Creswell	SAGE Publication
	Choosing Among Five Approaches		
4	Principles of Intellectual Property	N.S. Gopalakrishnan, and T.G. Agitha	Eastern Book Company
5	Law relating to patents, trademarks,	B.L.Wadehra	Universal Law Publishing
	copyright designs and geographical		
	indications		

REVIEW OF LITERATURE & SEMINAR

Semester	VII	
Course Code	RLS401	
Course Title	Review of literature & Seminar	
Type of course	Ability Enhancement Course	
LTP	0 0 8	
Credits	8	
Course prerequisite	B.Sc three year completetion	
Course Objective (CO)	The aim of this course is to enable the students to	
	1. Develop scientific aptitude and identify a problem.	
	2. Carry out literature survey, design an experiment, perform experiment, analyse data and	
	write a report.	
Course Outcomes (CO)	By the end of this course, students will be able to:	
	1. Do survey, study and cite published literature on a particular area of interest and analy	
	current literature research.	
	2. Correlate the experimental observations with theoretical understanding Design a resear	
	problem and prepare synopsis.	
	3. Plan future experiments in the laboratory & Use laboratory resources judiciously.	
	4. Work in a team under the supervision of a teacher and develop scientific writing skills.	

SBBST

Content:

Unit 1: Identification of research problem

Unit 2: Survey of literature

Unit 3: Formulation of hypothesis, experimental design and methodology

Unit 4: Analysis of data and interpretation of results, Discussion and conclusion

Project supervisor would be allocated at the start of the semester and research project would be undertaken in discussion with the project supervisor.

Regular evaluation of project progress will be done through regular seminars and presentations as per the schedules.

Upon submission of the project report, the projects would be evaluated based on a project presentation before the departmental committee.

Assessment Methods: The assessment will be through evaluation of the presentation through regular seminars and viva voce involving external and internal examiners.



Dissertation/Project report

Semester	VIII	
Course Code	DPR402	
Course Title	Dissertation/Project report	
Type of course	Practical Course /SEC	
LTP	0 0 12	
Credits	6	
Course prerequisite	B.Sc I, B.Sc II and B.Sc III year with as Chemistry as core subject	
Course Objective (CO)	The project would develop scientific aptitude, reviewing of literature, critical thinking,	
	hypothesis development, experiment planning, synopsis writing, problem presentation and way	
	to solve the problem.	
Course Outcomes (CO)	By the end of this course, students will be able to:	
	1. Explore research aptitude & practical ability of knowledge gained by student in understanding	
	the basics of research	
	2. Develop critical thinking through the detailed review of literature comprehend expertise for	
	writing the research reports in form of review article as well as research publications.	
	3. Analyze & generate experimental skills towards the industrial applications.	
	4. Equiped for the industrial outreach through the experimental knowledge gained through	
	project work.	

Content:

Unit 1: Formulation of hypothesis, experimental design and methodology

Unit 2: Experimentation, Characterization/Analysis of data and interpretation of results

Unit 3: Discussion and conclusion

Unit 4: Report writing,

Project supervisor would be allocated at the start of the semester and research project would be undertaken in discussion with the project supervisor.

Regular evaluation of project progress will be done through regular seminars and presentations as per the schedules.

Upon submission of the project Dissertation, the projects would be evaluated based on a project presentation before the departmental committee.

Assessment Methods: The assessment will be through evaluation of the presentation through regular seminars and viva voce involving external and internal examiners.

