

# SCHEME & SYLLABUS

## B.Sc Medical

(3 Year Programme)

Programme 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)**

### **(3 Year Programme)**

**B.Sc (Medical)** is a three 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**

3 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, "welcoming for all students"

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

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

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

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

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

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

### PROGRAMME SPECIFIC OUTCOMES (PSO)

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

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

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

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



## 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 be 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 which 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 categorized 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

## 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)	BOT101	Plant Biodiversity	4:0:0	4:0:0	4	4
2	Major (Core)	CHM101	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	4:0:0	4:0:0	4	4
3	Major (Core)	ZOO101	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

## II. Practical Subjects

1	Major (Core)	BOT103	Plant Biodiversity (Practical)	0:0:4	0:0:2	4	2
2	Major (Core)	CHM103	Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons (Practical)	0:0:4	0:0:2	4	2
3	Major (Core)	ZOO103	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
5	Minor (Skill)	PT101/ PT103/ PT105	NSO/NCC/NSS	2:0:0	Non-credit	2	NC
<b>Total</b>						<b>30</b>	<b>21</b>

Total Contact Hours: 30

Total Credit Hours: 21

Major/CR- Core Course

Minor/AEC-Ability Enhancement Compulsory Courses

## Course Scheme for B.Sc. Medical

## 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)	BOT102	Plant Ecology and Taxonomy	4:0:0	4:0:0	4	4
2	Major (Core)	CHM102	Chemical Energetics, Equilibrium & Functional Groups Organic Chemistry-I	4:0:0	4:0:0	4	4
3	Major (Core)	ZOO102	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

## II. Practical Subjects

1	Major (Core)	BOT104	Plant Ecology and Taxonomy (Practical)	0:0:4	0:0:2	4	2
2	Major (Core)	CHM104	Chemical Energetics, Equilibrium & Functional Group Organic Chemistry-I (Practical)	0:0:4	0:0:2	4	2
3	Major (Core)	ZOO104	Comparative Anatomy and Developmental Biology of Vertebrates Practical	0:0:4	0:0:2	4	2
4	Minor (AEC)	ENG116	Communication Skill-II Lab	0:0:2	0:0:1	2	1
5	Minor (Skill)	PT102/PT104/PT106	NSO/NCC/NSS	2:0:0	Non-credit	2	NC
<b>Total</b>						<b>30</b>	<b>21</b>

Total Contact Hours: 30

Total Credit Hours: 21

Major/CR- Core Course

Minor.AECC-Ability Enhancement Compulsory Courses

## Course Scheme for B.Sc. Medical

## 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)	BOT201	Anatomy and Embryology of Angiosperms	4:0:0	4:0:0	4	4
2	Major (Core)	CHM201	Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Group Organic Chemistry-II	4:0:0	4:0:0	4	4
3	Major (Core)	ZOO201	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(SE C-I)	BOT205 CHM205 ZOO205	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)	BOT203	Anatomy and Embryology of Angiosperms(Practical)	0:0:4	0:0:2	4	2
2	Major (Core)	CHM203	Solutions, Phase Equilibrium, Conductance, Electrochemistry & Functional Group Organic Chemistry-II (Practical)	0:0:4	0:0:2	4	2
3	Major (Core)	ZOO203	Animal Physiology and Biochemistry Practical	0:0:4	0:0:2	4	2
<b>Total</b>						<b>29</b>	<b>23</b>

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

## 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)	BOT202	Plant Physiology and Metabolism	4:0:0	4:0:0	4	4
2	Major (Core)	CHM202	Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics	4:0:0	4:0:0	4	4
3	Major (Core)	ZOO202	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)	BOT206 CHM210 ZOO206	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)	BOT204	Plant Physiology and Metabolism Practical	0:0:4	0:0:2	4	2
2	Major (Core)	CHM204	Transition Metal & Coordination Chemistry, States of Matter & Chemical Kinetics Practical	0:0:4	0:0:2	4	2
3	Major (Core)	ZOO204	Genetics and Evolutionary Biology Practical	0:0:4	0:0:2	4	2
<b>Total</b>						<b>29</b>	<b>23</b>

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

## Semester-V

## 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(D SE-I)	BOT301 BOT305 BOT309	Discipline specific Elective course-I(any one of the following) Cell and Molecular Biology Analytical Techniques in Plant Sciences MycologyandPhytopathology	4:0:0	4:0:0	4	4
2	Major(D SE-I)	CHM301 CHM305  CHM309	Discipline specific Elective course-I(any one of the following) Molecules of Life Organometallic, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy Industrial chemicals and Environment	4:0:0	4:0:0	4	4
3	Major(D SE-I)	ZOO301  ZOO305 ZOO309	Discipline specific Elective course-I(any one of the following) Cell Biology, Biotechnology, and Reproductive biology Applied Zoology 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)	BOT313 CHM315 ZOO313	Elective subject(Skill Enhancement Course)-III(any one of the following) Ethnobotany Fuel Chemistry Apiculture	2:0:0	2:0:0	2	2

## II. Practical Subjects

1	Major(D SE-I)	BOT303 BOT307 BOT311	Discipline specific Elective Practical-I (any one of the following) Cell and Molecular Biology Practical Analytical Techniques in Plant Sciences Practical MycologyandPhytopathology Practical	0:0:4	0:0:2	4	2
2	Major(D SE-I)	CHM303 CHM307  CHM311	Discipline specific Elective Practical-I(any one of the following) Molecules of Life(Practical) Organometallic, BioinorganicChemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy(Practical) Industrial chemicals and Environment(Practical)	0:0:4	0:0:2	4	2
3	Major(D SE-I)	ZOO303  ZOO307 ZOO311	Discipline specific Elective Practical-I(any one of the following) Cell Biology, Biotechnology and Reproductive biology Practical Applied Zoology Practical Aquatic Biology Practical	0:0:4	0:0:2	4	2
<b>Total</b>						<b>29</b>	<b>23</b>

**Total Contact Hours: 29**  
**Total Credit Hours: 23**

**DSE-Discipline Specific Elective**  
**SEC-Skill Enhancement Course**

## Course Scheme for B.Sc. Medical

## 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(DS E-II)	BOT302 BOT306 BOT310	Discipline specific Elective course-II(any one of the following) Economic Botany and Biotechnology Bioinformatics Archegoniate	4:0:0	4:0:0	4	4
2	Major(DS E-II)	CHM302 CHM306 CHM310	Discipline specific Elective course-II(any one of the following) Chemistry of main group elements, theories of acids and bases Analytical method in chemistry Inorganic Materials of Industrial	4:0:0	4:0:0	4	4
3	Major(DS E-II)	ZOO362 ZOO366 ZOO370	Discipline specific Elective course-II(any one of the following) Zoology VI - A : Immunology and Biostatistics Zoology VI - B : Reproductive Biology Zoology VI - C : Insect, Vector and Diseases	4:0:0	4:0:0	4	4
4	Minor(SEC-IV)	BOT314 CHM314 CHM316 ZOO314	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(DS E-II)	BOT304 BOT308 BOT312	Discipline specific Elective Practical-II(any one of the following) Economic Botany and Biotechnology Practical Bioinformatics Practical Archegoniate Practical	0:0:4	0:0:2	4	2
2	Major(DS E-II)	CHM304 CHM308 CHM312	Discipline specific Elective Practical-II(any one of the following) Chemistry of main group elements, theories of acids and bases (Practical) Analytical method in chemistry (Practical) Inorganic Materials of Industrial Importance (Practical)	0:0:4	0:0:2	4	2
3	Major(DS E-II)	ZOO304 ZOO308 ZOO312	Discipline specific Elective Practical-II(any one of the following) Immunology and Biostatistics Practical Reproductive Biology Practical Insect, Vector and Diseases Practical	0:0:4	0:0:2	4	2
4	Minor(ID/SEC)	CSE016	Basics of Computer Sciences Lab	0:0:2	0:0:1	2	1
<b>Total</b>						<b>30</b>	<b>23</b>

Total Contact Hours: 30

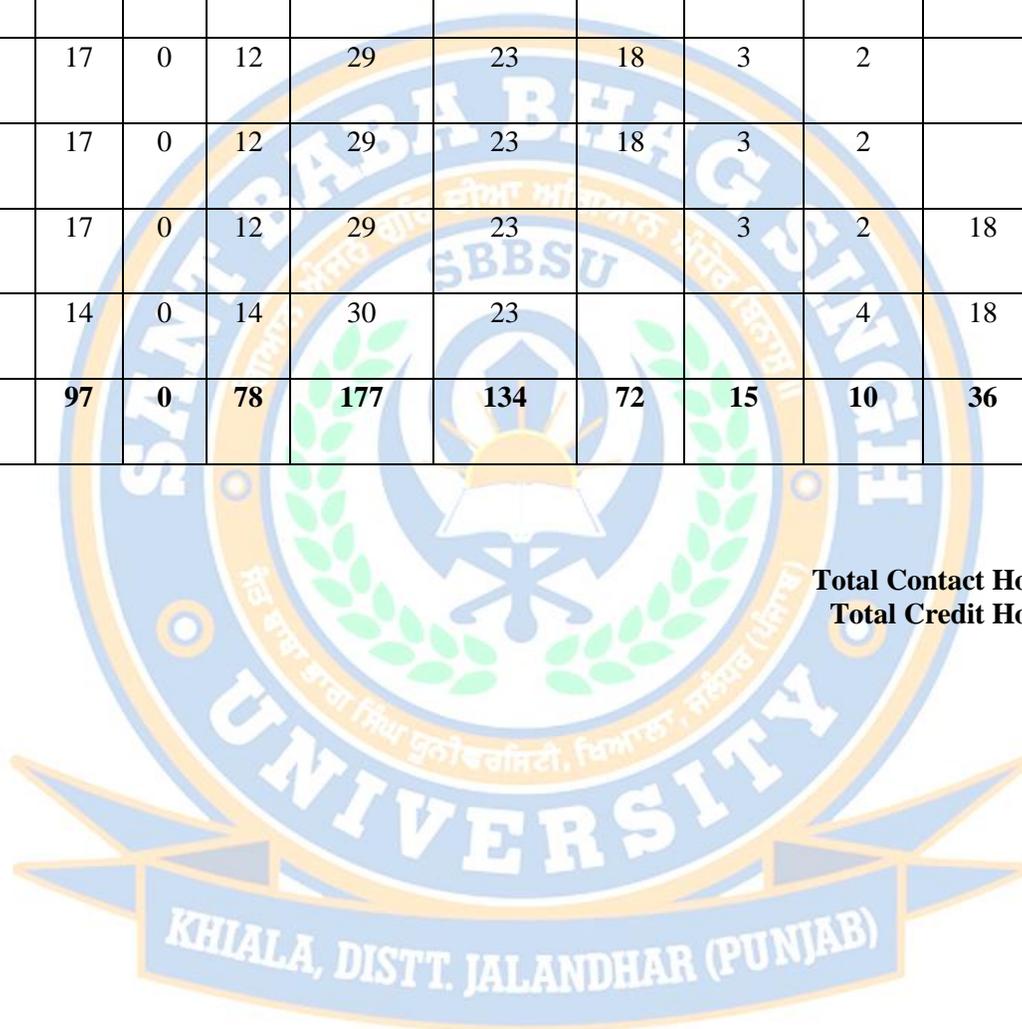
Total Credit Hours: 23

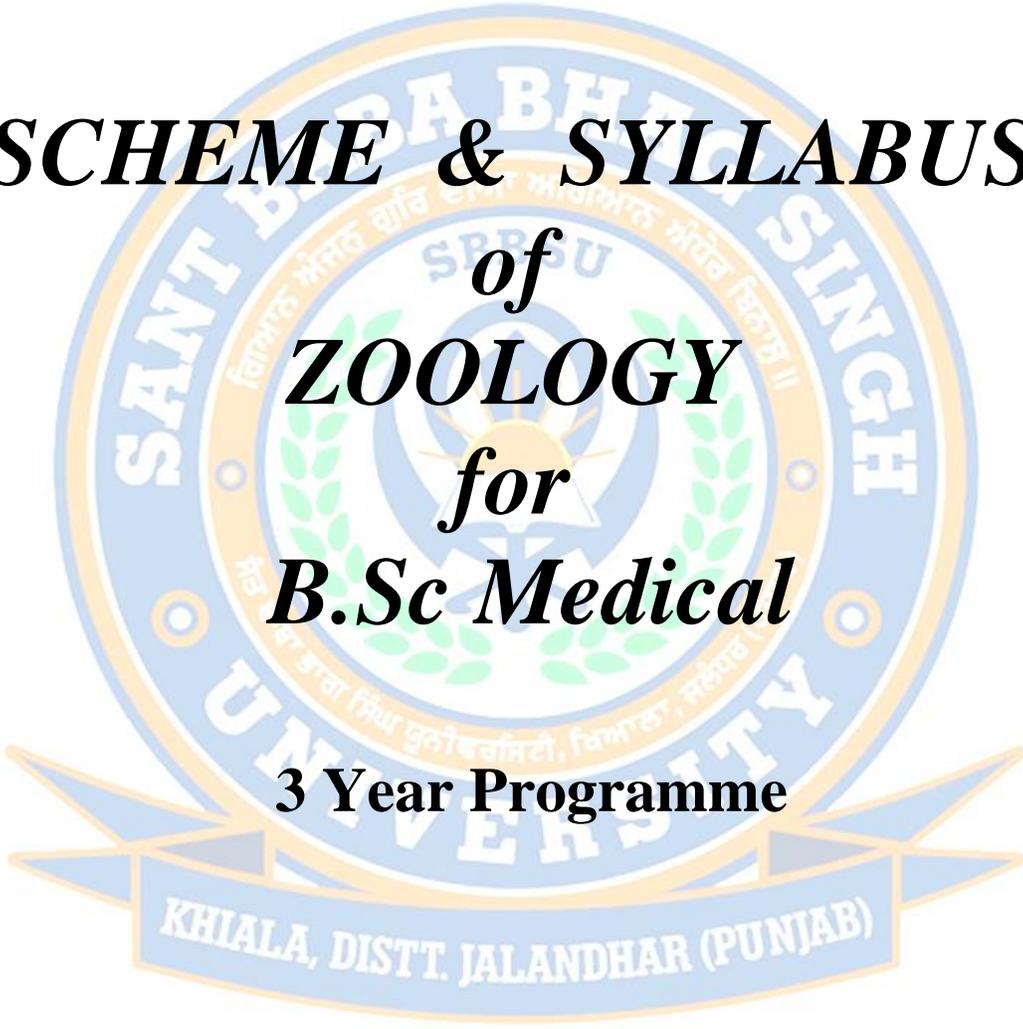
DSE-Discipline Specific Elective  
SEC-Skill Enhancement Course

## Course Scheme Summary

Semester	L	T	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		3	2	18	
6	14	0	14	30	23			4	18	1
<b>Total</b>	<b>97</b>	<b>0</b>	<b>78</b>	<b>177</b>	<b>134</b>	<b>72</b>	<b>15</b>	<b>10</b>	<b>36</b>	<b>1</b>

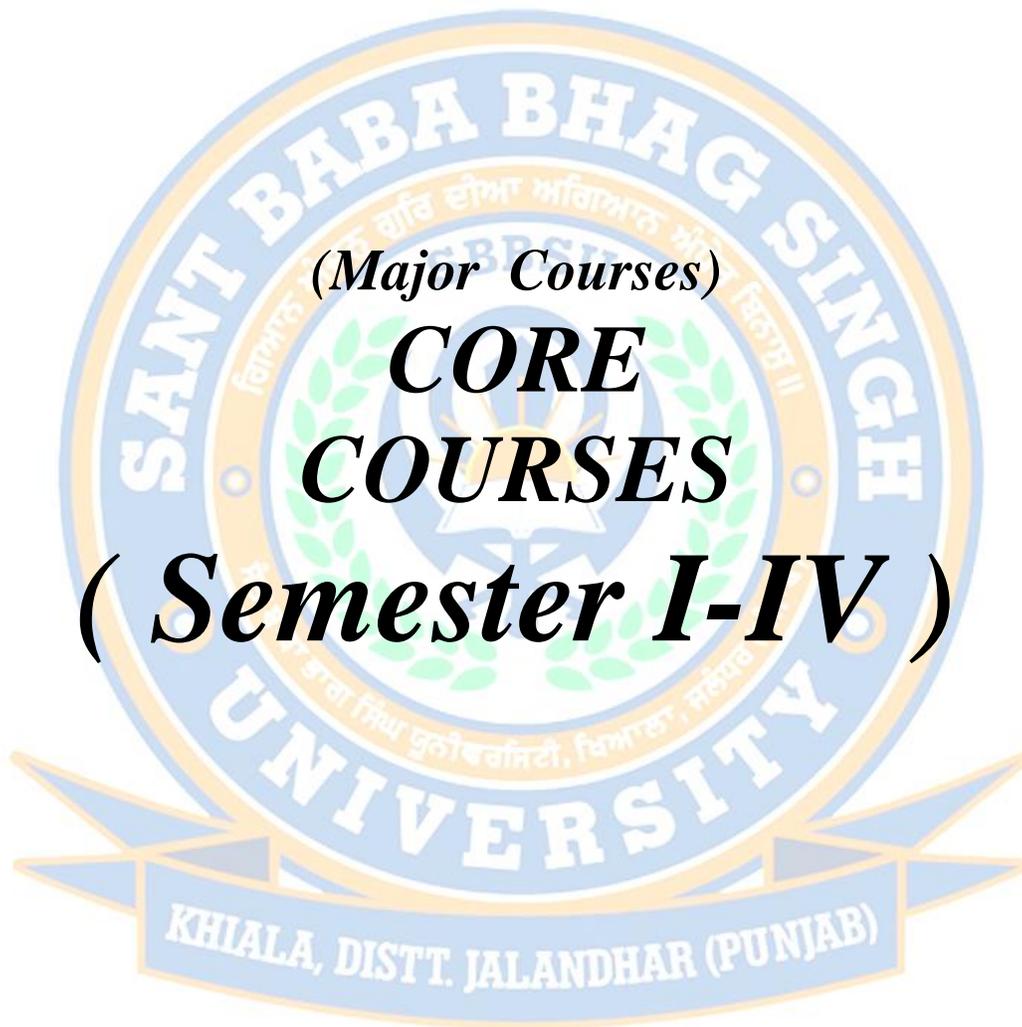
**Total Contact Hours : 177**  
**Total Credit Hours : 134**





***SCHEME & SYLLABUS***  
***of***  
***ZOOLOGY***  
***for***  
***B.Sc Medical***  
***3 Year Programme***

KHIALA, DISTT. JALANDHAR (PUNJAB)





## ANIMAL BIODIVERSITY

<b>Semester</b>	<b>I</b>
<b>Course Code</b>	<b>ZOO101</b>
<b>Course Title</b>	<b>Animal Biodiversity</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 00
<b>Credits</b>	4
<b>Course prerequisite</b>	10+2 Medical
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Impart knowledge about co-existence of different forms of living organisms ranging from acellular to multicellular animals. 2. Know about classification and general characters of the phyla up to classes/orders.
<b>Course Outcomes (CO)</b>	<b>By the end of this course, students will be able to</b> 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 Nematelminthes:** General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its 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 in Insects

**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.

**Text and Reference Books:**

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



## ANIMAL BIODIVERSITY PRACTICAL

<b>Semester</b>	<b>I</b>
<b>Course Code</b>	<b>ZOO103</b>
<b>Course Title</b>	<b>Animal Biodiversity Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	004
<b>Credits</b>	2
<b>Course prerequisite</b>	10+2 Medical
<b>Course Objective</b>	<b>The aim of this course is to enable the students to</b> 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 studying the slides
<b>Course Outcomes (CO)</b>	<b>By the end of this course, students will be able to</b> 1. Comparing and contrasting structural features in members of different animal phyla. 2. To know about the anatomy and life history of some important animals. 3. To identify the poisonous and non-poisonous snakes.

**LIST OF SUGGESTED LAB EXERCISES:****1. Study of the following specimens:**

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

**2. Study of the following permanent slides:**

T.S. and L.S. of *Sycon*, Study of life history stages of *Taenia*, T.S. of Male and female *Ascaris*

**3. Key for Identification of poisonous and non-poisonous snakes**

An “**animal album**” containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

**Text and Reference Books:**

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



***SEMESTER***  
***II<sup>nd</sup>***

## COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

Semester	II
Course Code	ZOO102
Course Title	Comparative Anatomy and Developmental Biology of Vertebrates
Type of course	Theory
L T P	4 00
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 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)	<b>By the end of this course, students will be able to</b> 1. To know about the different organ systems present in vertebrates. 2. To know about the receptors and evolution of organs in vertebrates. 3. To know about the comparative development among vertebrates.

**UNIT-I**

**Integumentary System:** Derivatives of integument w.r.t. glands and digital tips

**Digestive System:** Brief account of alimentary canal and digestive glands

**Respiratory System:** Brief account of Gills, lungs, air sacs and swim bladder

**Circulatory System:** Evolution of heart

**UNIT-II**

**Nervous System:** Comparative account of brain

**Sense Organs:** Types of receptors

**Urinogenital System:** Succession of kidney, Evolution of urinogenital ducts

**UNIT-III**

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

**UNIT-IV**

**Late Embryonic Development:** Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation.

**Control of Development:** Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death.

**Text and Reference Books:**

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

**COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES  
PRACTICAL**

<b>Semester</b>	<b>II</b>
<b>Course Code</b>	<b>ZOO104</b>
<b>Course Title</b>	<b>Comparative Anatomy and Developmental Biology of Vertebrates practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	00 4
<b>Credits</b>	2
<b>Course prerequisite</b>	10+2 Medical
<b>Course Objective</b>	<b>The aim of this course is to enable the students to</b> 1. Study skeletons of different vertebrates, different developmental stages of frog and development of human. 2. Impart knowledge about histology of gonads.
<b>Course Outcomes (CO)</b>	<b>By the end of this course, students will be able to</b> 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 through permanent slides.

**3. Study of the different types of placenta-**

Histological sections through permanent slides or photomicrographs.

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

**5. Examination of gametes - frog/rat**

Sperm and ova through permanent slides or photomicrographs.

Study of histological section of testis and ovary through permanent slides.

**Text and Reference Books:**

<b>Sr No.</b>	<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
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



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## ANIMAL PHYSIOLOGY AND BIOCHEMISTRY

<b>Semester</b>	<b>III</b>
<b>Course Code</b>	<b>ZOO201</b>
<b>Course Title</b>	<b>Animal Physiology and Biochemistry</b>
<b>Type of course</b>	CORE
<b>L T P</b>	4:0:0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Medical I year
<b>Course Objective</b>	<b>The aim of this course is to enable the students to</b> 1. Impart knowledge about the physiological processes and metabolism. 2. Develop the basic understanding of endocrine system and its interaction with other systems.
<b>Course Outcomes (CO)</b>	<b>By the end of this course, students will be able to</b> 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

**UNIT-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

**Text and reference books:**

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

## ANIMAL PHYSIOLOGY AND BIOCHEMISTRY PRACTICAL

Semester	III
Course Code	ZOO203
Course Title	Animal Physiology and Biochemistry Practical
Type of course	Practical
L T P	00 4
Credits	2
Course prerequisite	B.Sc. Medical I year
Course Objective	<b>The aim of this course is to enable the students to</b> 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)	<b>By the end of this course, students will be able to</b> 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), aminoacids 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.

## Text and reference books:

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



## GENETICS AND EVOLUTIONARY BIOLOGY

<b>Semester</b>	<b>IV</b>
<b>Course Code</b>	<b>ZOO202</b>
<b>Course Title</b>	<b>Genetics and Evolutionary Biology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 00
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Medical I year
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 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.
<b>Course Outcomes (CO)</b>	<b>By the end of this course, students will be able to</b> 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.

**Text and Reference Books:**

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

## GENETICS AND EVOLUTIONARY BIOLOGY PRACTICAL

<b>Semester</b>	<b>IV</b>
<b>Course Code</b>	<b>ZOO204</b>
<b>Course Title</b>	<b>Genetics and Evolutionary Biology Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	00 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Medical I year
<b>Course Objective</b>	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>1. Aware about genetic material, chromosomes, their structure and function, basis of genetics/inheritance and changes occurring in animal species during various evolutionary eras.</li> <li>2. Understand the concept of Mendels laws in genetics.</li> </ol>
<b>Course Outcomes (CO)</b>	<p><b>By the end of this course, students will be able to</b></p> <ol style="list-style-type: none"> <li>1. Understand the Mendelian inheritance and gene interaction using suitable examples.</li> <li>2. Understand linkage, recombination and gene mapping.</li> <li>3. Know fossil evidences in support of evolution.</li> </ol>

## 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

## Text and Reference Books:

S.No	Title	Author(s)	Publisher
1	Principles of Genetics, 8 <sup>th</sup> edition	Gardner, E.J., Simmons, M.J., Snustad, D.P.	Wiley India
2	Principles of Genetics, 5 <sup>th</sup> edition	Snustad, D.P., Simmons, M.J	John Wileyand Sons Inc.



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## CELL BIOLOGY, BIOTECHNOLOGY AND REPRODUCTIVE BIOLOGY

Semester	V
Course Code	ZOO301
Course Title	Cell Biology, Biotechnology and Reproductive Biology
Type of course	Theory
L T P	4 00
Credits	4
Course prerequisite	B.Sc. Medical II year
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 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 (CO)	<b>By the end of this course, students will be able to</b> 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, Lambda 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

**Text and reference books:**

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 <sup>th</sup> Edn 1995.
5.	Albert	Essential Cell Biology	, New York , 3 <sup>rd</sup> Edn , 1997



## CELL BIOLOGY, BIOTECHNOLOGY AND REPRODUCTIVE BIOLOGY PRACTICAL

Semester	V
Course Code	ZOO303
Course Title	Cell Biology, Biotechnology and Reproductive biology Practical
Type of course	Practical
L T P	00 4
Credits	2
Course prerequisite	B.Sc medical IInd year
Course Objective(CO)	<b>The aim of this course is to enable the students to</b> 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)	<b>By the end of this course, students will be able to</b> 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.

**Text and reference books:**

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

## APPLIED ZOOLOGY

<b>Semester</b>	<b>V</b>
<b>Course Code</b>	<b>ZOO305</b>
<b>Course Title</b>	<b>Applied Zoology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 00
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc Medical II year
<b>Course Objective (CO)</b>	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>1. Aware about the various types of parasites and their relationship with their hosts.</li> <li>2. Learn the basic principles involved in the culture and breeding of common edible and ornamental fishes.</li> </ol>
<b>Course Outcomes (CO)</b>	<p><b>By the end of this course, students will be able to</b></p> <ol style="list-style-type: none"> <li>1. Identify various methodology and perspectives of applied branches of zoology for the possibilities of self-employment.</li> <li>2. Gain knowledge about various disease related vectors and their impact on human.</li> <li>3. Understand concepts of fisheries, poultry, dairy and pest management techniques.</li> </ol>

**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, Pyrrillaperpusilla 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

**Text and Reference Books:**

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

## APPLIED ZOOLOGY PRACTICAL

Semester	V
Course Code	ZOO307
Course Title	Applied Zoology Practical
Type of course	Practical
L T P	00 4
Credits	2
Course prerequisite	B.Sc Medical II year
Course Objective(CO)	<b>The aim of this course is to enable the students to</b> 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)	<b>By the end of this course, students will be able to</b> 1. Analyse the relationship among animals and microbes. 2. Know the art of maintenance of aquarium. 3. Understands the principles of poultry and dairy along with pest management techniques.

## LIST OF EXPERIMENTS

1. Study of *Plasmodium vivax*, *Entamoeba histolytica*, *Trypanosoma gambiense*, *Ancylostoma duodenale* and *Wuchereriabancrofti* 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*, *Pyrrillaperpusilla*, *Callosobruchuschinensis*, *Sitophilus oryzae* and *Triboliumcastaneum*
5. Visit to poultry farm or animal breeding centre. Submission of visit report
6. Maintenance of freshwater aquarium

## Text and Reference Books:

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

## AQUATIC BIOLOGY

<b>Semester</b>	V
<b>Course Code</b>	ZOO309
<b>Course Title</b>	Aquatic Biology
<b>Type of course</b>	Theory
<b>L T P</b>	4 00
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc Medical II year
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 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.
<b>Course Outcomes (CO)</b>	<b>By the end of this course, students will be able to</b> 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.

**Text and Reference Books:**

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	

## AQUATIC BIOLOGY PRACTICAL

Semester	V
Course Code	ZOO311
Course Title	Aquatic Biology Practical
Type of course	Practical
L T P	00 4
Credits	2
Course prerequisite	B.Sc Medical II year
Course Objective(CO)	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>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.</li> <li>2. To know about water pollution and its control.</li> </ol>
Course Outcomes (CO)	<p><b>By the end of this course, students will be able to</b></p> <ol style="list-style-type: none"> <li>1. Gain information about phytoplanktons, zooplanktons and other microscopic organisms.</li> <li>2. Analyse and evaluate abiotic and biotic conditions in aquatic systems account for structure and dynamics in biogeochemical cycles.</li> <li>3. Carry out basic sampling and analyses in freshwater field/laboratory systems.</li> </ol>

## 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.

## Text and Reference Books:

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



***SEMESTER***  
***VI<sup>th</sup>***

## IMMUNOLOGY AND BIOSTATISTICS

Semester	VI
Course Code	ZOO302
Course Title	Immunology and Biostatistics
Type of course	Theory
L T P	4 00
Credits	4
Course prerequisite	B.Sc Medical II year
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 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)	<b>By the end of this course, students will be able to</b> <b>By the end of this course, students will be able to</b> 1. Imparts in depth knowledge of tissues, cells and molecules involved in host defense mechanisms 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,

**Text and Reference Books:**

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

### IMMUNOLOGY AND BIOSTATICS PRACTICAL

<b>Semester</b>	<b>VI</b>
<b>Course Code</b>	<b>ZOO304</b>
<b>Course Title</b>	<b>Immunology and Biostatistics Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	00 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc Medical II year
<b>Course Objective(CO)</b>	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>1. Study the histology of immune system and physiology of immunological reactions.</li> <li>2. Use the best data analysis methods in research projects.</li> </ol>
<b>Course Outcomes (CO)</b>	<p><b>By the end of this course, students will be able to</b></p> <ol style="list-style-type: none"> <li>1. Know about immune system and allows the student to create insight as how to improve their immune system and good health.</li> <li>2. Use of Math in science for study of different data.</li> <li>3. Perform routine blood analysis.</li> </ol>

#### 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 Immuno-electrophoresis
6. Demonstration of ELISA
7. Chromatography (Paper and TLC).

#### Text and reference books:

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

## REPRODUCTIVE BIOLOGY

Semester	VI
Course Code	ZOO306
Course Title	Reproductive Biology
Type of course	Theory
L T P	4 00
Credits	4
Course prerequisite	B.Sc Medical II year
Course Objective(CO)	<b>The aim of this course is to enable the students to</b> 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)	<b>By the end of this course, students will be able to</b> 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, stem 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.

**Text and reference books:**

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

## REPRODUCTIVE BIOLOGY PRACTICAL

<b>Semester</b>	<b>VI</b>
<b>Course Code</b>	<b>ZOO308</b>
<b>Course Title</b>	<b>Reproductive Biology Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	00 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc Medical II year
<b>Course Objective(CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Aware about the different techniques used in studying various types of cells involved in formation of reproductive organs. 2. Familiarize with various contraceptive technologies and surgical techniques.
<b>Course Outcomes (CO)</b>	<b>By the end of this course, students will be able to</b> 1. Gain knowledge about histological and biological processes of reproduction and learn about the reproductive health. 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. Ovaryectomy, hysterectomy, 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.

## Text and reference books:

<b>S. no.</b>	<b>Title</b>	<b>Author</b>	<b>Publisher</b>
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

## INSECT, VECTOR AND DISEASES

Semester	VI
Course Code	ZOO310
Course Title	Insect, Vector and Diseases
Type of course	Theory
L T P	4 00
Credits	4
Course prerequisite	B.Sc Medical II year
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 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)	<b>By the end of this course, students will be able to</b> 1. Understand insect vector host interactions of many diseases like Malaria, Filariasis, Dengue, etc. 2. Understand 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

**UNIT-IV**

**Hemiptera as Disease Vectors:** Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures.

**Text and reference books:**

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	Pedigo L.P	Prentice Hall Publication
4	Integrated Vector Management	Mathews, G.	Wiley-Blackwell

## INSECT VECTORS AND DISEASES PRACTICAL

Semester	VI
Course Code	ZOO312
Course Title	Insect, Vector and Diseases Practical
Type of course	Practical
L T P	00 4
Credits	2
Course prerequisite	B.Sc Medical II year
Course Objective(CO)	<b>The aim of this course is to enable the students to</b> 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)	<b>By the end of this course, students will be able to</b> 1. Understand 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*, *Phthirus pubis*, *Xenopsyllacheopsis*, *Cimex lectularius*, *Phlebotomus argentipes*, *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.

## Text and reference books:

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	Pedigo L.P	Prentice Hall Publication
4	Integrated Vector Management	Mathews, G.	Wiley-Blackwell



### MEDICAL DIAGNOSTICS

<b>Semester</b>	<b>III</b>
<b>Course Code</b>	<b>ZOO205</b>
<b>Course Title</b>	Medical Diagnostics
<b>Type of course</b>	Skill Enhancement Courses
<b>L T P</b>	2 00
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc Ist year with zoology as core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Familiar with various techniques available to diagnose different diseases. 2. Know about the importance of medical diagnostics.
<b>Course outcome(CO)</b>	<b>By the end of this course, students will be able to:</b> 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).

#### Text and reference books:

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

## SERICULTURE

<b>Semester</b>	<b>IV</b>
<b>Course Code</b>	<b>ZOO406</b>
<b>Course Title</b>	Sericulture
<b>Type of course</b>	Skill Enhancement Courses
<b>L T P</b>	2 0 0
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc Ist year with zoology as core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. To gain basic knowledge about rearing of silkworms for commercial production of silk. 2. Understand about various pests and diseases of silkworm.
<b>Course Outcome (CO)</b>	<b>By the end of this course, students will be able to:</b> 1. Gain knowledge about silkworm rearing and their products. 2. Know about life cycle of silkworm. 3. Start their own business i.e employability.

## 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.

## Text and Reference Books

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

## APICULTURE

<b>Semester</b>	<b>V</b>
<b>Course code</b>	<b>ZOO313</b>
<b>Course title</b>	<b>Apiculture</b>
<b>Type of course</b>	Skill enhancement Course
<b>LTP</b>	2 00
<b>Credits</b>	2
<b>Course prerequisite</b>	Bsc. Ist, IInd year with Zoology as core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. To gain basic knowledge about rearing of honey bees for commercial production of honey. 2. Understand about various pests and diseases of honeybees.
<b>Course outcome(CO)</b>	<b>By the end of this course, students will be able to:</b> 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 employability.

**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.

**Text and reference books:**

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

<b>Semester</b>	<b>VI</b>
<b>Course Code</b>	<b>ZOO314</b>
<b>Course Title</b>	<b>Aquarium fish keeping</b>
<b>Type of course</b>	<b>Skill enhancement Course</b>
<b>L T P</b>	2 00
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc IInd year with zoology as a core subject
<b>Course Objective</b>	<b>The aim of this course is to enable the students to</b> 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.
<b>Course outcome(CO)</b>	<b>By the end of this course, students will be able to:</b> 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**

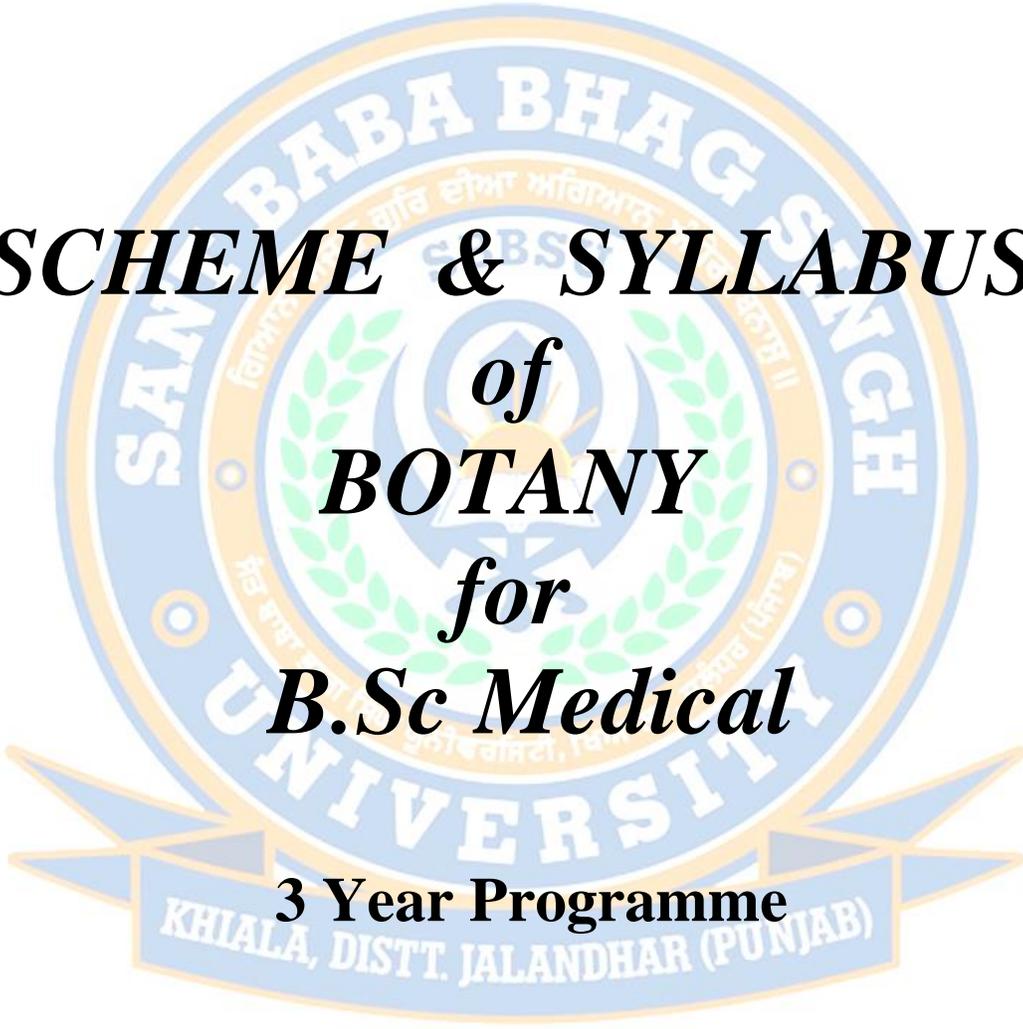
Live fish transport - Fish handling, packing and forwarding techniques.

**Unit 5: Maintenance of Aquarium**

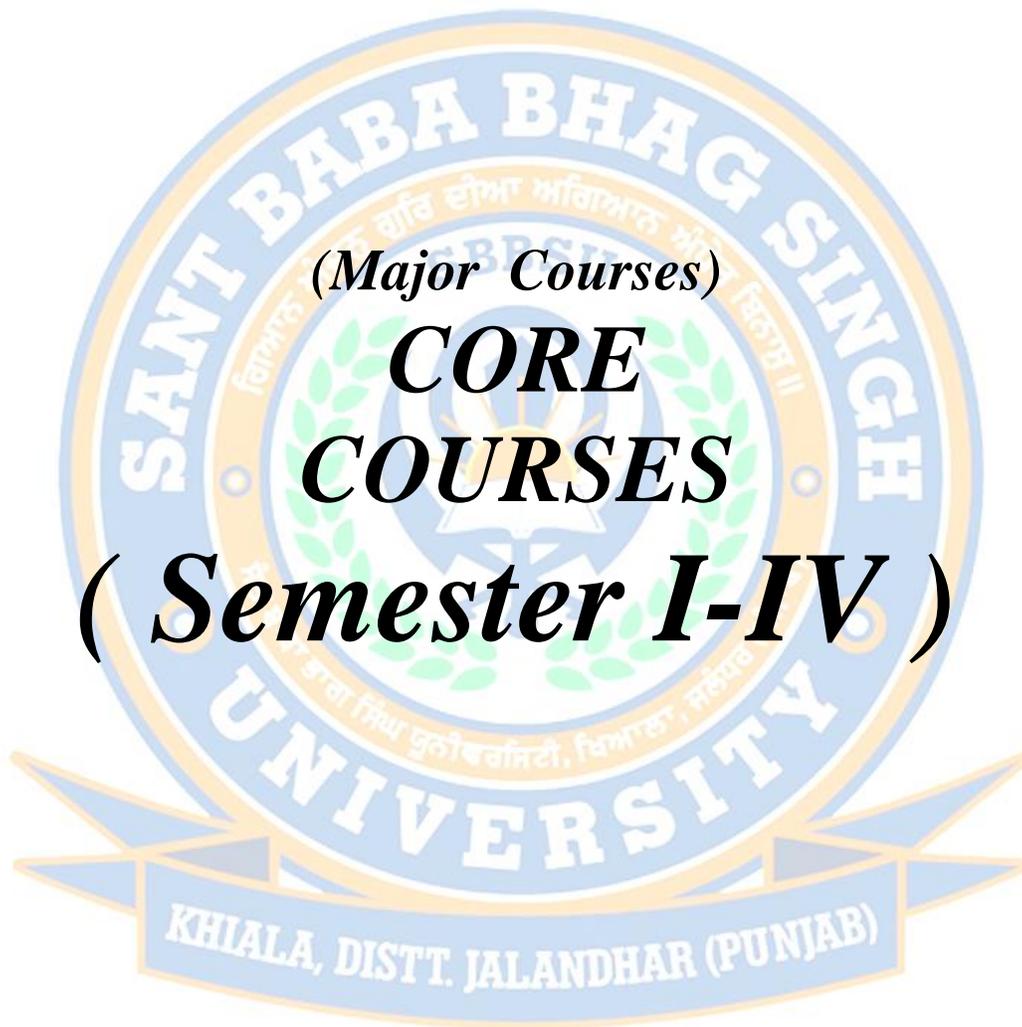
General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry.

**Text and reference books:**

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



***SCHEME & SYLLABUS***  
***of***  
***BOTANY***  
***for***  
***B.Sc Medical***  
**3 Year Programme**  
KHIALA, DISTT. JALANDHAR (PUNJAB)





## PLANT BIODIVERSITY

<b>Semester</b>	<b>I</b>
<b>Course Code</b>	<b>BOT101</b>
<b>Course Title</b>	<b>Plant Biodiversity</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	10+2 Medical
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 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.
<b>Course outcomes (CO)</b>	<b>By the end of this course, students will be able to:</b> 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, mycorrhiza and their significance 4. Understand about the diversity archaegoniates(Bryophytes,Pteridophytesand 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.

**Text and Reference books:**

Sr No.	Book Title	Author	Publisher
1	Diversity of Microbes andCryptogams	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

## PLANT BIODIVERSITY PRACTICAL

<b>Semester</b>	<b>I</b>
<b>Course Code</b>	<b>BOT103</b>
<b>Course Title</b>	<b>Plant Biodiversity Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	10+2 Medical
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 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.
<b>Course Outcomes (CO)</b>	<b>By the end of this course, students will be able to:</b> 1. Know about the structure of virus and bacteriophages 2. Aware about the structure and life cycles of Algae, fungi by preparing temporary and permanent slides 3. Learn about the various forms of Lichens by watching the specimens and live samples. 4. Learn about the morphological structure, anatomy and reproductive structure of Bryophytes, Pteridophytes and Gymnosperms by watching the specimens of organism, live or preserved and by section cutting and experiencing the anatomical structure in microscope.

## LIST OF EXPERIMENTS

- EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
- Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
- Gram staining
- 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)
- Rhizopus* and *Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.
- Alternaria*: Specimens; photographs and tease mounts.
- Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
- Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
- Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
- Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
- 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).
- 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).
- 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).
- 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).
- 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).
- 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).

## 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 Thallophtes	O.P.Sharma	Tata McGraw Hill
3	Text Book of Pteridophyta	O.P.Sharma	McMillan India Ltd
4	The Fungi	P.D. Sharma	Rastogi Publisher
5	Cryptogamic Botany, Vol. II, Bryophytes & Pteridophytes	G.M Smith	Tata McGraw Hill
6	Biology	P H Raven, G B Johnson, SIR R Singer	Tata McGraw Hill
7	Gymnosperms	SP Bhatnagar and A Moitra	S Chand



## PLANT ECOLOGY AND TAXONOMY

<b>Semester</b>	<b>II</b>
<b>Course Code</b>	<b>BOT102</b>
<b>Course Title</b>	<b>Plant Ecology and Taxonomy</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	2
<b>Course prerequisite</b>	10+2 Medical
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Understand basics of ecosystem and its working. 2. Understand the basic of taxonomy, its history and general angiosperm families.
<b>Course Outcomes (CO)</b>	<b>By the end of this course, students will be able to:</b> 1. Understand the basics of ecology with its interaction 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.

**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 law of 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 phosphorus.  
**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, Rosaceae Umbelliferae, Rutaceae, Asteraceae, Asclepiadaceae, Solanaceae, Euphorbiaceae, Lamiaceae, Liliaceae, Gramineae)

**Text and Reference Books:**

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

**PLANT ECOLOGY AND TAXONOMY PRACTICAL**

<b>Semester</b>	<b>II</b>
<b>Course Code</b>	<b>BOT104</b>
<b>Course Title</b>	<b>Plant Ecology and Taxonomy Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	10+2 Medical
<b>Course Objective (CO)</b>	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>1. Give practical knowledge about the various parameters in ecology, its measurements and ecosystem components</li> <li>2. Understanding by observing the plants flowers and floral description of important angiosperm families.</li> </ol>
<b>Course Outcomes (CO)</b>	<p><b>By the end of this course, students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Understand the principle and use various instruments used in the study of the ecology</li> <li>2. Analyse various physico chemical parameters of soil</li> <li>3. Learn the morphological adaptation of some special plants in different habitat</li> <li>4. Know about the quantitative analysis of plant species diversity by using quadrat methods.</li> <li>5. Learn the classification of angiosperms and some families by observing the common members available for the experiment.</li> </ol>

### 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.
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 (Orobanchae), 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 – *Tagetes erecta/Ageratum conyzoides*  
 Solanaceae – *Solanum tuberosum, Withania*  
 Fabaceae- *Pisum sativum/Cassia fistula/Acacia nilotica*  
 Lamiaceae - *Salvia, Ocimum*  
 Liliaceae - *Asphodelus / Lilium / Allium*.  
 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).

### Text and Reference Books:

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



***SEMESTER  
III<sup>rd</sup>***

KHIALA, DISTT. JALANDHAR (PUNJAB)

## ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS

<b>Semester</b>	III
<b>Course Code</b>	BOT201
<b>Course Title</b>	<b>Anatomy and Embryology of Angiosperms</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	10+2 Medical
<b>Course Objective</b>	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>1. Understand the basic body plan of flowering plant, various tissue systems in higher plants, their structure, development and function.</li> <li>2. Study the structure, development and function of reproductive structures in flowering plants.</li> </ol>
<b>Course Outcomes (CO)</b>	<p><b>By the end of this course, students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Understand the basic body and its parts of flowering plants</li> <li>2. Learn about the shoot and root apical meristem, cambium and secondary growth and its significance in the plant development.</li> <li>3. Understand the diversity of plants and leaf origin and development</li> <li>4. Know about the various methods of propagation of plant and development of flower and fruits</li> </ol>

**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.

**Text and reference books:**

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

## ANATOMY AND EMBRYOLOGY OF ANGIOSPERMS PRACTICAL

Semester	III
Course Code	BOT203
Course Title	Anatomy and Embryology of Angiosperms Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc Ist year
Course Objective(CO)	<b>The aim of this course is to enable the students to</b> 1. Understand the morphology and anatomy of various parts of angiosperm plants 2. Understand the flower and floral parts and embryology of angiosperm.
Course Outcomes (CO)	<b>By the end of this course, students will be able to:</b> 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, microsporogenesis (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:

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



## PLANT PHYSIOLOGY AND METABOLISM

Semester	IV
Course Code	BOT202
Course Title	Plant Physiology and Metabolism
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	10+2 Medical
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 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)	<b>By the end of this course, students will be able to:</b> 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 development 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.

## UNIT-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,  $\beta$ -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), red and far red light responses on photomorphogenesis; Vernalization.

## Text and reference books:

S. No.	Title	Author	Publisher
1	Plant Physiology	H N Srivastava	Pradeep Publishers
2	A Textbook of Plant Physiology, Biochemistry and Biotechnology	Dr S K Verma and Mohit Verma	S. Chand Publishing
3	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 Grisse and Russell L Jones	Wiley International
6	Experiments in Plant Physiology- A Laboratory Manual.	D Bajracharya	Narosa Publishing House

### PLANT PHYSIOLOGY AND METABOLISM PRACTICAL

<b>Semester</b>	<b>IV</b>
<b>Course Code</b>	<b>BOT204</b>
<b>Course Title</b>	<b>Plant Physiology and Metabolism Practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	10+2 Medical
<b>Course Objective</b>	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>1. Impart knowledge about plant functions through simple physiological experiments</li> <li>2. Demonstration of many physiological processes</li> </ol>
<b>Course Outcomes (CO)</b>	<p><b>By the end of this course, students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Understand various plants physiological processes with the help of experiments.</li> <li>2. Study and calculate stomatal index.</li> <li>3. Learn about impact of light on chlorophyll and phytochrome pigment</li> <li>4. Demonstrate various physiological processes to understand properly.</li> </ol>

#### 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 O<sub>2</sub> 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.

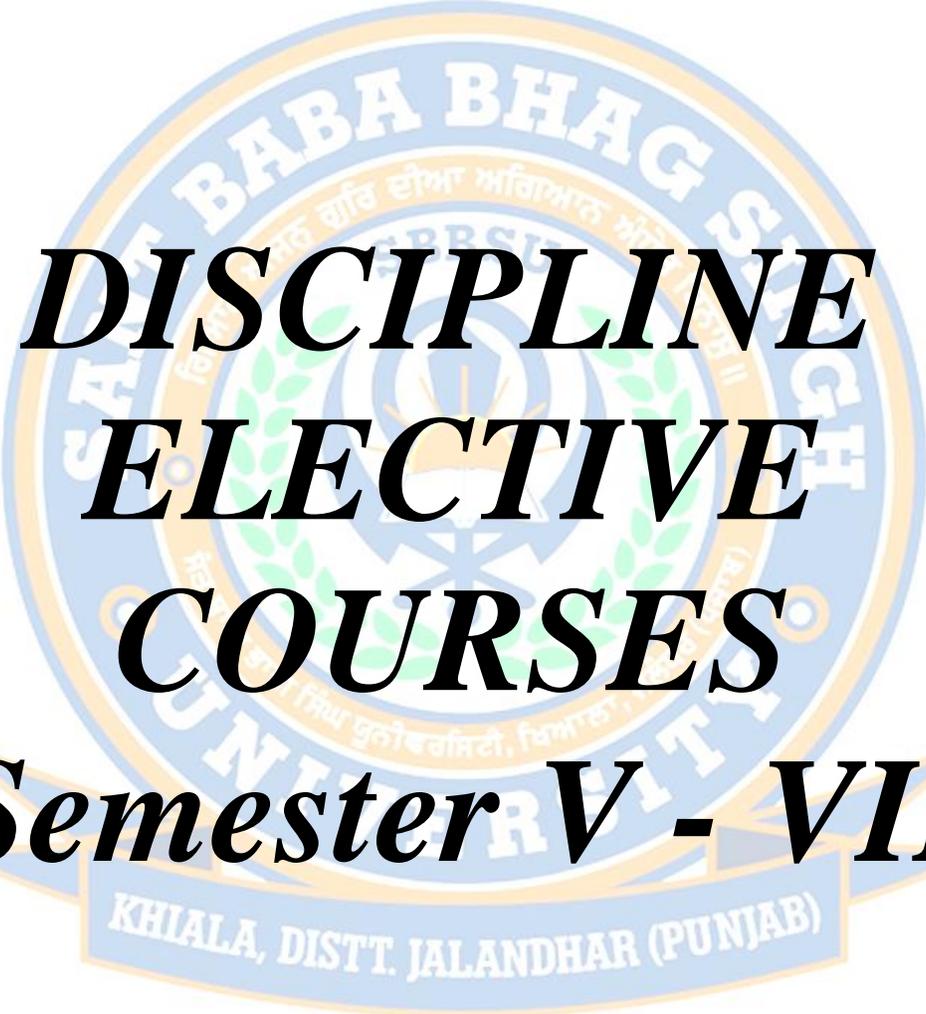
#### Demonstration experiments (any two)

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

#### Text and reference books:

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

KHALA, DISTT. JALANDHAR (PUNJAB)



***DISCIPLINE  
ELECTIVE  
COURSES  
( Semester V - VII )***



## CELL AND MOLECULAR BIOLOGY

<b>Semester</b>	<b>V</b>
<b>Course Code</b>	<b>BOT301</b>
<b>Course Title</b>	<b>Cell and Molecular Biology</b>
<b>Type of course</b>	Discipline Elective Courses (Theory)
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. Medical II year
<b>Course Objective</b>	<b>The aim of this course is to enable the students to</b> 1. Impart the knowledge about details of cell structure, cell organelles and their functions 2. Impart knowledge DNA and functional details of genetic material.
<b>Course Outcomes (CO)</b>	<b>By the end of this course, students will be able to understand:</b> 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; molecular organization, 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,  $\theta$  (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.

**Text and Reference Books:**

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

## CELL AND MOLECULAR BIOLOGY PRACTICAL

<b>Semester</b>	<b>V</b>
<b>Course Code</b>	<b>BOT303</b>
<b>Course Title</b>	<b>Cell and Molecular Biology Practical</b>
<b>Type of course</b>	Discipline Elective Courses (Practical)
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	B. Sc Medical II year
<b>Course Objective</b>	<b>The aim of this course is to enable the students to</b> 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
<b>Course Outcomes (CO)</b>	<b>By the end of this course, students will be able to understand:</b> 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

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 Rhoecium 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.

## Text and Reference Books:

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

## ANALYTICAL TECHNIQUES IN PLANT SCIENCES

Semester	V
Course Code	BOT305
Course Title	Analytical Techniques in Plant Sciences
Type of course	Discipline Elective Courses (Theory)
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc Medical II year
Course Objective	<b>The aim of this course is to enable the students to</b> 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	<b>By the end of this course, students will be able to understand:</b> 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, CsCl<sub>2</sub> 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.

## Text and Reference Books:

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

## ANALYTICAL TECHNIQUES IN PLANT SCIENCES PRACTICAL

Semester	V
Course Code	BOT307
Course Title	Analytical Techniques in Plant Sciences Practical
Type of course	Discipline Elective Courses (Practical)
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Medical II year
Course Objective	<b>The aim of this course is to enable the students to</b> 1. Demonstration and use of various instrument used in plant sciences 2. Demonstration of various methods used in plant sciences
Course Outcomes	<b>By the end of this course, students will be able to:</b> 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).

## Text and Reference Books:

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

## MYCOLOGY AND PHYTOPATHOLOGY

<b>Semester</b>	V
<b>Course Code</b>	BOT309
<b>Course Title</b>	<b>Mycology and phytopathology</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4:0:0
<b>Credits</b>	4:0:0
<b>Course prerequisite</b>	10+2 (Medical)
<b>Course Objective</b>	<b>By the end of this course, students will be able to:</b> 1. Know about the diversity of Fungi and its classification 2. Learn about the symptoms, diseases and plant fungi interactions
<b>Course Outcome</b>	<b>By the end of this course, students will be able to understand:</b> 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, Mycoinsecticides, 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.

**Text and Reference books:**

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., Blackwell, M. (1996)	John Wiley & Sons (Asia) Singapore. 4th edition



### MYCOLOGY AND PHYTOPATHOLOGY PRACTICAL

<b>Semester</b>	<b>V</b>
<b>Course Code</b>	<b>BOT311</b>
<b>Course Title</b>	<b>Mycology and phytopathology practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0:0:4
<b>Credits</b>	0:0:2
<b>Course prerequisite</b>	10+2 (Medical)
<b>Course Objective</b>	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>1. Acquaint students about the diversity of Fungi by observing the wet specimens and slides in the laboratory</li> <li>2. Understand the symptoms of the diseases of plants and the life cycle of the fungus by observing the spores in the slides</li> </ol>
<b>Course Outcome</b>	<p><b>By the end of this course, students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Learn about the diversity and life cycles of fungi</li> <li>2. Learn about the phytopathology and diseases in plants caused by fungus</li> <li>3. Learn about the commercial and industrial application of fungi.</li> <li>4. Learn about the diversity of Lichens and their ecological importance</li> <li>5. Learn about the Mycorrhiza interaction with plants and its role</li> </ol>

#### 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.

#### **Text and Reference books:**

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., Blackwell, M. (1996)	John Wiley & Sons (Asia) Singapore. 4th edition



## ECONOMIC BOTANY AND BIOTECHNOLOGY

Semester	VI
Course Code	BOT302
Course Title	Economic Botany and Biotechnology
Type of course	Theory
L T P	4 0 0
Credits	4
Course prerequisite	B.Sc Medical II year
Course Objective	<b>The aim of this course is to enable the students to</b> 1. Study economically important plants 2. Study the tissue culture and recombinant DNA techniques.
Course Outcomes (CO)	<b>By the end of this course, students will be able to understand:</b> 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.

**Text and reference books:**

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

## ECONOMIC BOTANY AND BIOTECHNOLOGY PRACTICAL

Semester	VI
Course Code	BOT304
Course Title	Economic Botany and Biotechnology Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc. Medical II year
Course Objective	<b>The aim of this course is to enable the students to</b> 1. Impart the practical knowledge about economically important plants 2. Tissue culture and recombinant DNA techniques.
Course Outcomes (CO)	<b>By the end of this course, students will be able to understand:</b> 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.

## Text and reference books:

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

## BIOINFORMATICS

<b>Semester</b>	<b>VI</b>
<b>Course Code</b>	<b>BOT306</b>
<b>Course Title</b>	<b>Bioinformatics</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc Medical II year
<b>Course Objective</b>	<b>The aim of this course is to enable the students to</b> 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.
<b>Course Outcomes</b>	<b>By the end of this course, students will be able to understand:</b> 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 Database 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.

**Text and reference books:**

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

## BIOINFORMATICS PRACTICAL

Semester	VI
Course Code	BOT308
Course Title	Bioinformatics Practical
Type of course	Practical
L T P	0 0 4
Credits	2
Course prerequisite	B.Sc Medical II year
Course Objective	<b>The aim of this course is to enable the students to</b> 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	<b>By the end of this course, students will be able to understand:</b> 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 Applications	Ghosh Z. and Bibekanand M	Oxford University Press
2	Bioinformatics and Functional Genomics	Pevsner J	Wiley-Blackwell
3	Discovering Genomics, Proteomics and Bioinformatics	Campbell A. M., Heyer L. J	Benjamin Cummings

## ARCHEGONIATE

<b>Semester</b>	<b>VI</b>
<b>Course Code</b>	<b>BOT310</b>
<b>Course Title</b>	<b>Archegoniate</b>
<b>Type of course</b>	Theory
<b>L T P</b>	4:0:0
<b>Credits</b>	4:0:0
<b>Course prerequisite</b>	10+2 (Medical)
<b>Course Objective</b>	<b>The aim of this course is to enable the students to</b> <ol style="list-style-type: none"> <li>1. Acquaint about basic knowledge bryophytes, pteridophytes and gymnosperms</li> <li>2. Acquaint about the fossil plants of archegoniate and its evolution, adaptation with the changing climate</li> </ol>
<b>Course Outcome</b>	<b>By the end of this course, students will be able to understand:</b> <ol style="list-style-type: none"> <li>1. The evolution of fossil plants and its adaptation in land.</li> <li>2. About the diversity, habitat and life cycle of bryophytes</li> <li>3. About the diversity, habitat and life cycle of Pteridophytes</li> <li>4. About the diversity, habitat and life cycle of Gymnosperm</li> </ol>

**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, Pelliella, 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. Bryophyta.	Parihar, N.S. (1991).	Central Book Depot. Allahabad.
2	Introduction to Bryophytes	Vanderpoorten, A. & Goffinet, B. (2009)	Cambridge University Press.
3	Biology.	Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005)	Tata McGraw Hill, Delhi
4	Pteridophyta	Vashistha, P.C., Sinha, A.K., Kumar, A. (2010).	S. Chand. Delhi, India.
5	Gymnosperms	Bhatnagar, S.P. & Moitra, A. (1996)	New Age International (P) Ltd Publishers, New Delhi, India.

### ARCHEGONIATE PRACTICAL

<b>Semester</b>	<b>VI</b>
<b>Course Code</b>	<b>BOT312</b>
<b>Course Title</b>	<b>Archegoniate practical</b>
<b>Type of course</b>	Practical
<b>L T P</b>	0:0:4
<b>Credits</b>	0:0:2
<b>Course prerequisite</b>	10+2 (Medical)
<b>Course Objective</b>	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>About the fossil plants early adaptation of land plants by observing photographs and fossil structure.</li> <li>Acquaint about bryophytes, pteridophytes and gymnosperm</li> </ol>
<b>Course Outcome</b>	<p><b>By the end of this course, students will be able to understand:</b></p> <ol style="list-style-type: none"> <li>The evolution of land plants and their adaptation</li> <li>About the diversity, habitat and life cycle of bryophytes</li> <li>About the diversity, habitat and life cycle of Pteridophytes</li> <li>About the diversity, habitat and life cycle of Gymnosperm</li> </ol>

#### LIST OF EXPERIMENTS

- Riccia** – Morphology of thallus.
- 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).
- Anthoceros**- Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).
- Pellia, Porella**- Permanent slides.
- Sphagnum**- Morphology of plant, whole mount of leaf (permanent slide only).
- 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.
- Psilotum**- Study of specimen, transverse section of synangium (permanent slide).
- 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).
- 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).
- Pteris**- Morphology, transverse section of rachis, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).
- 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).
- 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).
- Gnetum**- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide)
- Botanical excursion.**

#### **Text and Reference books:**

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



## MEDICINAL BOTANY

<b>Semester</b>	<b>III</b>
<b>Course Code</b>	<b>BOT 205</b>
<b>Course Title</b>	<b>Medicinal Botany</b>
<b>Type of course</b>	<b>Skill Enhancement Courses</b>
<b>L T P</b>	2 0 0
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. Medical II year
<b>Course Objective</b>	<b>The aim of this course is to enable the students to</b> 1. Understand medicinal plant with references to Botany. 2. Understand the concept of Ayurveda, Siddha, Unani and Ethnobotany
<b>Course Outcome</b>	<b>By the end of this course, students will be able to understand:</b> 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: Umooor-e- tabiya, tumors treatments/ therapy, polyherbal formulations.

**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.

**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.

**Text and Reference Books**

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

## FLORICULTURE

<b>Semester</b>	<b>IV</b>
<b>Course Code</b>	<b>BOT206</b>
<b>Course Title</b>	<b>Floriculture</b>
<b>Type of course</b>	Theory
<b>L T P</b>	2 0 0
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc IInd year
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Know about the different types of gardens and their management 2. Learn about various nursery techniques and growth and cultivation of flower
<b>Course Outcome</b>	<b>By the end of this course, students will be able to understand:</b> 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, Liliium, Orchids).

**Diseases and Pests of Ornamental Plants.**

**Text and reference books:**

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

## ETHNOBOTANY

<b>Semester</b>	<b>IV</b>
<b>Course Code</b>	<b>BOT208</b>
<b>Course Title</b>	<b>Ethnobotany</b>
<b>Type of course</b>	Theory
<b>L T P</b>	0 0 4
<b>Credits</b>	2
<b>Course prerequisite</b>	10+2 Medical
<b>Course Objective</b>	<b>The aim of this course is to enable the students to</b> 1. Impart knowledge various plants used in ethnobotany 2. Learn about various medicinal plants used by tribal people
<b>Course Outcome</b>	<b>By the end of this course, students will be able to understand:</b> 1. Concept, scope and importance of ethnobotany 2. Various ethnic tribals groups and use of plants in their daily life style 3. Field work, collection of plants and herbarium preparation, 4. About plant sources of various modern drug and their conservation by ethnic tribal people 5. Legal aspects of ethnobotany, Biopiracy, IPR and Traditional Knowledge.

**Unit 1: Ethnobotany**

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

**Unit 2: Methodology of Ethnobotanical studies**

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

**Unit 3: Role of ethnobotany in modern Medicine**

Medico-ethnobotanical sources in India; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiracantha 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 *Rauwolfia serpentina*, *Trichopus zeylanicus*, *Artemisia*, *Withania*. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

**Unit 4: Ethnobotany and legal aspects**

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

**Text and reference books:**

S. No.	Title	Author	Publisher
1	Manual of Ethnobotany,	S.K. Jain	Scientific Publishers, Jodhpur, 1995
2	Glimpses of Indian. 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	BOT314
Course Title	Mushroom Culture Technology
Type of course	Theory
L T P	2 0 0
Credits	2
Course prerequisite	B.Sc IInd year
Course Objective	<b>The aim of this course is to enable the students to</b> 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	<b>By the end of this course, students will be able to understand:</b> 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

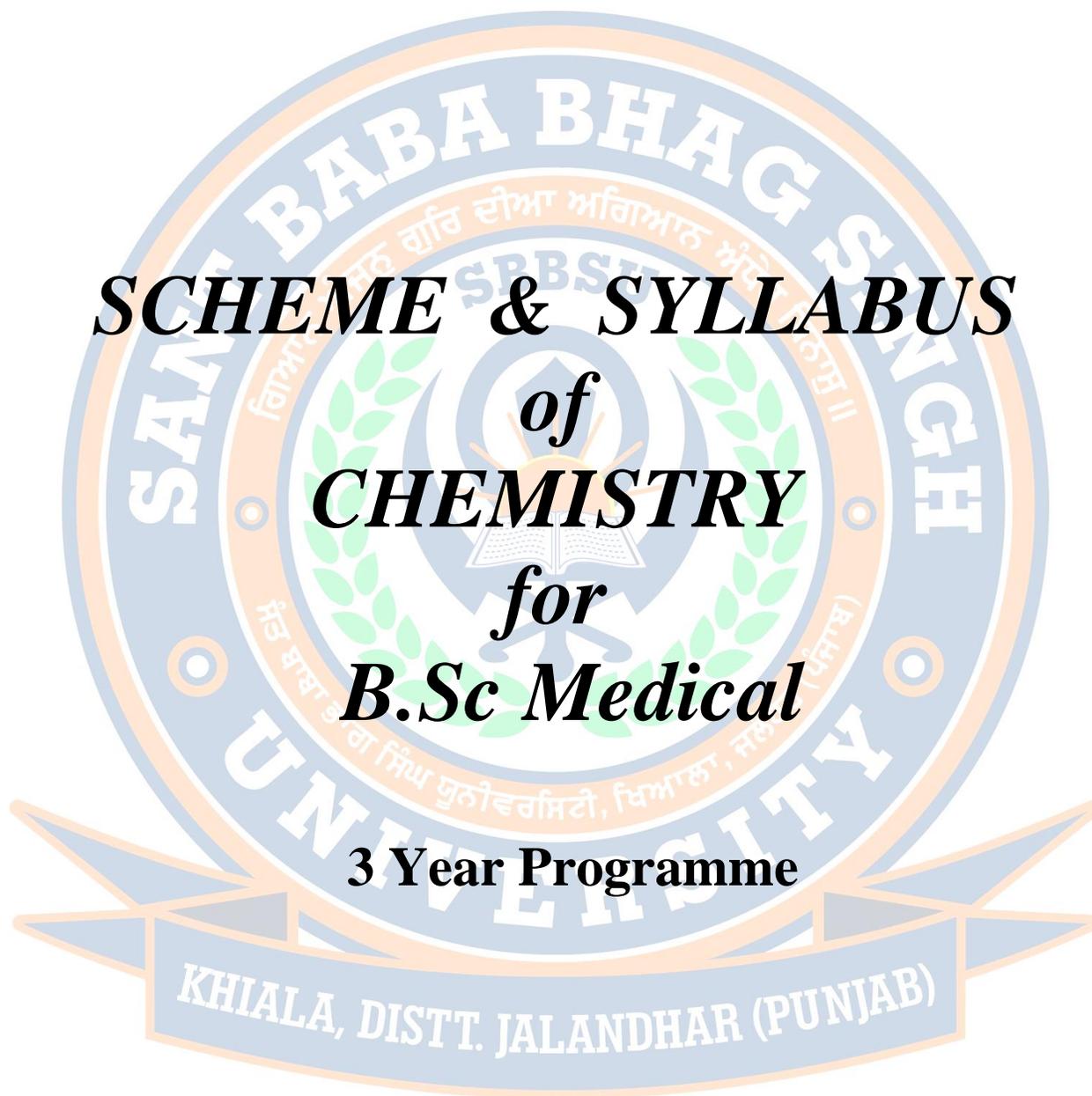
**Storage and nutrition :** Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.

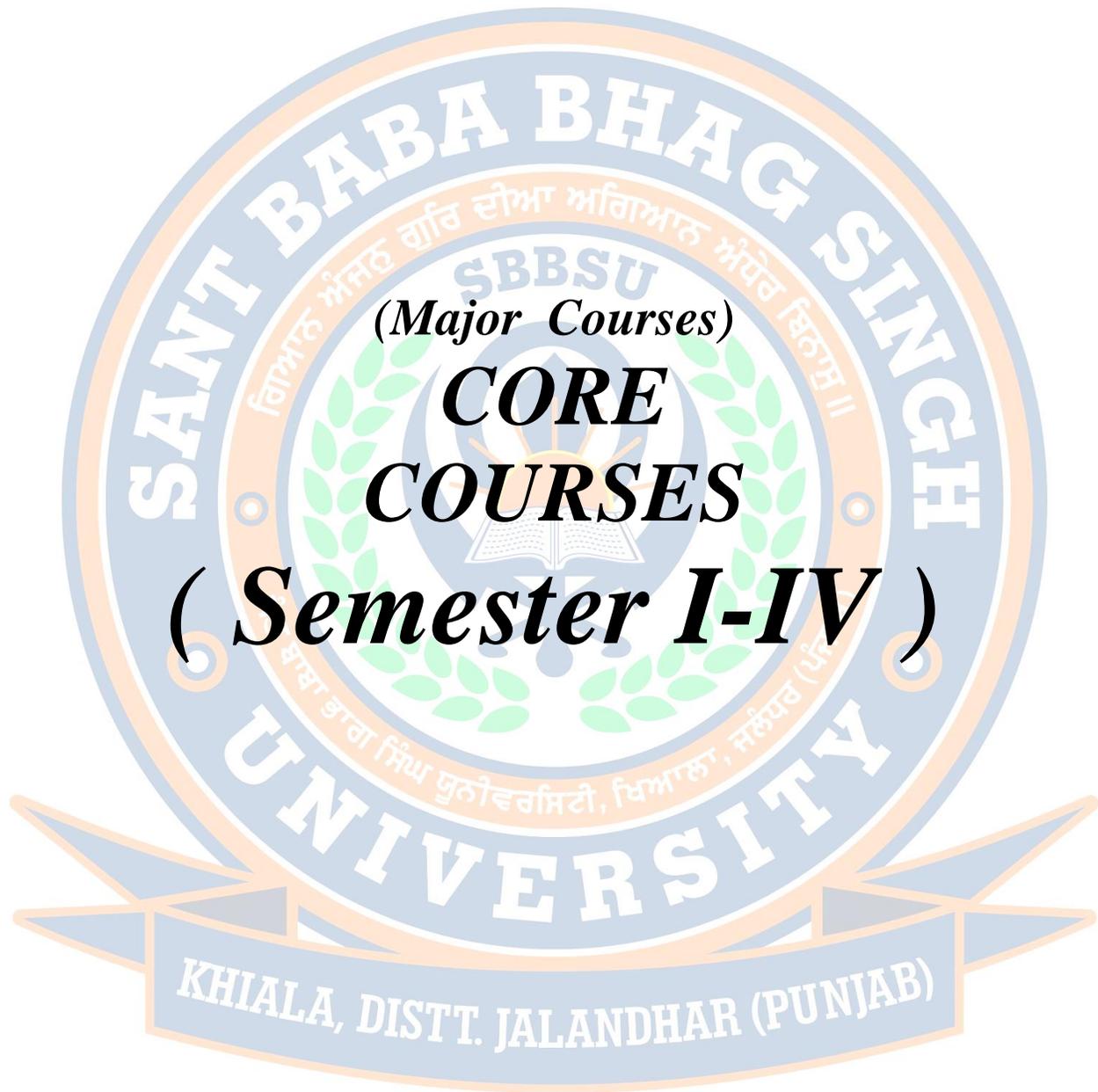
## UNIT-IV

**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.

## Text and Reference Books:

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
4	Food and Nutrition	M Swaminathan	Bangalore Printing and Publishing Co.







# ***SEMESTER***

***1st***

**ATOMIC STRUCTURES , BONDING , GENERAL ORGANIC CHEMISTRY AND ALIPHATIC HYDROCARBONS**

<b>Semester</b>	<b>I</b>
<b>Course Code</b>	<b>CHM101</b>
<b>Course Title</b>	<b>Atomic Structures , Bonding , General Organic Chemistry and Aliphatic Hydrocarbons</b>
<b>Type of course</b>	CORE (Theory)
<b>L T P</b>	4 0 0
<b>Credits</b>	4
<b>Course prerequisite</b>	10+2 with chemistry as core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 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.
<b>Course Outcome (CO)</b>	<b>By the end of the course, the students will be able to:</b> 1. Solve the conceptual questions using the knowledge gained from quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular 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 Rules, VSEPR theory and MO diagrams. 3. Able to explain significance of quantum numbers , de-Broglie's dual behaviour of matter 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  $\psi$  and  $\psi^2$ , 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  $m_l$  and  $m_s$ . Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number ( $s$ ) and magnetic spin quantum number ( $m_s$ ). 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  $\text{NO}^+$ . 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.  $\text{KMnO}_4$ ) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation

**Alkynes:** (Upto 5 Carbons) Preparation: Acetylene from  $\text{CaC}_2$  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  $\text{KMnO}_4$ , ozonolysis and oxidation with hot alk.  $\text{KMnO}_4$

#### Text and Reference Books :

S. No	Name	Author(S)	Publisher
1	Concise Inorganic Chemistry	I.D. Lee	ELBS
2	Inorganic Chemistry	A.G. Sharpe	ELBS
3	Organic Chemistry	Morrison and Boyd	Prentice Hall
4	Fundamentals of Organic Chemistry	Solomons	John Wiley
5	Stereochemistry	P.S. Kalsi	New age International
6	Organic reaction mechanism	Singh and Mukharje	New age International



**ATOMIC STRUCTURES , BONDING , GENERAL ORGANIC AND CHEMISTRY AND ALIPHATIC HYDROCARBONS PRACTICAL**

<b>Semester</b>	<b>I</b>
<b>Course Code</b>	<b>CHM103</b>
<b>Course Title</b>	<b>Atomic Structures , Bonding , General Organic and Chemistry and Aliphatic Hydrocarbons Practical</b>
<b>Type of course</b>	CORE (Practical)
<b>L T P</b>	0:0:4
<b>Credits</b>	2
<b>Course prerequisite</b>	10+2 with chemistry as core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Impart practical knowledge about the separation of organic molecules. 2. Study estimation of inorganic salt and metal ions.
<b>Course Outcome (CO)</b>	<b>By the end of the course, students will be able to:</b> 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  $\text{KMnO}_4$ .

Estimation of water of crystallization in Mohr's salt by titrating with  $\text{KMnO}_4$ .

Estimation of Fe (II) ions by titrating it with  $\text{K}_2\text{Cr}_2\text{O}_7$  using internal indicator.

Estimation of Cu (II) ions iodometrically using  $\text{Na}_2\text{S}_2\text{O}_3$ .

#### **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  $R_f$  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).

*\*Perform any four experiments from each section*

#### **Text and References Books**

<b>S. No</b>	<b>Name</b>	<b>Author(S)</b>	<b>Publisher</b>
1	Vogel's Qualitative Inorganic Analysis (7 <sup>th</sup> 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 Analysis (revised),	J. Basseff, R.C. Denney, G.H. Jeffery and J. Mendham	ELBS



## CHEMICAL ENERGETIC, EQUILIBRIUM AND FUNCTIONAL GROUP ORGANIC – I

Semester	II
Course Code	CHM 102
Course Title	Chemical Energetic, Equilibrium and Functional Group Organic – I
Type of course	CORE (Theory)
L T P	4:0:0
Credits	4
Course prerequisite	10+2 with chemistry as core subject
Course Objective (CO)	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>1. Enhance the knowledge regarding Physical concepts of chemistry like Chemical Energetic, Chemical Equilibrium.</li> <li>2. Impart knowledge of general organic chemistry of aromatic systems and functional groups.</li> </ol>
Course Outcome (CO)	<p><b>By the end of the course, students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Acquire the knowledge of thermodynamic property of any system, Chemical &amp; Ionic equilibria of various systems.</li> <li>2. Apply the concepts of concept of ionization of electrolytes with emphasis on weak acid and base and hydrolysis of salt, pH and electrolytes.</li> <li>3. Understand preparation, properties and reactions of haloalkanes, haloarenes and oxygen containing functional groups.</li> <li>4. Use the synthetic chemistry for functional group transformations &amp; to propose plausible mechanisms for any relevant reaction.</li> </ol>

**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  $G^\circ$ , Le Chatelier's principle. Relationships between  $K_p$ ,  $K_c$  and  $K_x$  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 ( $SN_1$ ,  $SN_2$  and  $SN_i$ ) 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:  $KNH_2/NH_3$  (or  $NaNH_2/NH_3$ ). 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  $1^\circ$ ,  $2^\circ$  and  $3^\circ$  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.KMnO<sub>4</sub>, acidic dichromate, conc. HNO<sub>3</sub>). 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, acetone and benzaldehyde)Preparation: from acid chlorides and from nitriles. Reactions – Reaction with HCN, ROH, NaHSO<sub>3</sub>, NH<sub>2</sub>-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Ponndorf Verley reduction.

#### Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Organic reaction mechanism, 3 <sup>rd</sup> ed. Latest edition	V. K. Ahluwalia	Narosa publishing house, New 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



**CHEMICAL ENERGETIC, CHEMICAL EQUILIBRIUM AND FUNCTIONAL GROUP ORGANIC-I**

<b>Semester</b>	<b>II</b>
<b>Course Code</b>	<b>CHM 104</b>
<b>Course Title</b>	<b>Chemical energetic, Chemical Equilibrium and Functional Group organic-I</b>
<b>Type of course</b>	Core (Practical)
<b>L T P</b>	0:0:4
<b>Credits</b>	2
<b>Course prerequisite</b>	10+2 with chemistry as core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Get provide practical knowledge about the preparation of organic compounds. 2. Study basis of thermo-chemistry and Ionic equilibrium.
<b>Course Outcome (CO)</b>	<b>By the end of the course, students will be able to:</b> 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**

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO<sub>3</sub>, NH<sub>4</sub>Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of  $\Delta H$ .

**Ionic equilibria**

1. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps using pH-meter.
2. Preparation of buffer solutions: Sodium acetate-acetic acid; Ammonium chloride-ammonium hydroxide
3. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

**Section B: Organic Chemistry**

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. 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

*\*Perform any four experiments from each section*

**Text and Reference Books**

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



**SOLUTIONS , PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY AND  
FUNCTIONAL GROUP ORGANIC-II**

<b>Semester</b>	<b>III</b>
<b>Course Code</b>	<b>CHM 201</b>
<b>Course Title</b>	<b>Solutions , Phase Equilibrium, conductance, electrochemistry and functional group organic-II</b>
<b>Type of course</b>	Core (Theory)
<b>L T P</b>	4:0:0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc. 1 <sup>st</sup> with chemistry as core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Impart knowledge about basic of solution chemistry, phase equilibria. 2. Impart knowledge of Electrochemistry. 3. Acquint students about organic chemistry and natural polymers.
<b>Course Outcome (CO)</b>	<b>By the end of the course, students will be able to:</b> 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 and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes.

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

**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, FeCl<sub>3</sub>-H<sub>2</sub>O 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 HNO<sub>2</sub>, 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  $-\text{COOH}$  group, acetylation of  $-\text{NH}_2$  group, complexation with  $\text{Cu}^{2+}$  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 (openchain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in mono-saccharides.

**Text and Reference Books**

S. No	Name	Author(S)	Publisher
1	Natural Products: Chemistry and Biological Significance,	Mann, J.;Davidson,R.S.;Hobbs, J.B.;Banthrope,D.V.;Harborne, J.B.	Longman, Esse
2	Organic reaction mechanism, 3 <sup>rd</sup> ed. Latest edition	V. K. Ahluwalia	Narosa publishing 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, Techniques and Applications	Eliezer Gileadi,	Wiley-VCH



**SOLUTIONS , PHASE EQUILIBRIUM, CONDUCTANCE, ELECTROCHEMISTRY AND FUNCTIONAL ORGANIC-II (PRACTICAL)**

<b>Semester</b>	<b>III</b>
<b>Course Code</b>	<b>CHM 203</b>
<b>Course Title</b>	<b>Solutions , Phase equilibrium, Conductance, Electrochemistry and Functional Organic-II (Practical)</b>
<b>Type of course</b>	Core (Practical)
<b>L T P</b>	0:0:4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc. 1 <sup>st</sup> with chemistry as core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Gain practical knowledge about conductometry. 2. Perform potentiometric analysis and qualitative organic analysis.
<b>Course outcome (CO)</b>	<b>By the end of the course, students will be able to:</b> 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.  $I_2(aq) + I^-(aq) \rightleftharpoons I_3^-(aq)$   $Cu^{2+}(aq) + xNH_3(aq) \rightleftharpoons [Cu(NH_3)_x]^{2+}$
3. Distribution of acetic/ benzoic acid between water and chloroform or cyclohexane.
4. To find EMF of the cell. To calculate the Gibbs free energy change of the cell reaction.
5. To calculate the equilibrium constant.

**Phase equilibria**

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

**Conductance**

Determination of cell constant

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

**Potentiometry**

1. Perform the following potentiometric titrations:  
Strong acid vs. strong base; Weak acid vs. strong base; Potassium dichromate vs. Mohr's salt

**Section B: Organic Chemistry**

1. Systematic Qualitative Organic Analysis of Organic Compounds 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

*\*Perform any four experiments from each section*

**Text and Reference Books**

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



**TRANSITION METAL & COORDINATION CHEMISTRY, STATES OF MATTER AND  
CHEMICAL KINETICS**

<b>Semester</b>	<b>IV</b>
<b>Course Code</b>	<b>CHM 202</b>
<b>Course Title</b>	<b>Transition Metal &amp; Coordination Chemistry, States of Matter and Chemical Kinetics</b>
<b>Type of course</b>	CORE (Theory)
<b>L T P</b>	4:0:0
<b>Credits</b>	4
<b>Course prerequisite</b>	BSc. 1 <sup>st</sup> with chemistry as core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 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.
<b>Course Outcome (CO)</b>	<b>By the end of the course, the students will be able to:</b> 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 $\Delta_o$ , $\Delta_t$ , 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).

**Text and Reference Books**

S. No	Name	Author(S)	Publisher
1	Concise Inorganic Chemistry	I.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



**TRANSITION METAL & COORDINATION CHEMISTRY, STATES OF MATTER AND CHEMICAL KINETICS (PRACTICAL)**

<b>Semester</b>	<b>IV</b>
<b>Course Code</b>	<b>CHM204</b>
<b>Course Title</b>	<b>Transition Metal &amp; Coordination Chemistry, States of Matter and Chemical Kinetics (Practical)</b>
<b>Type of course</b>	Core (Practical)
<b>L T P</b>	0:0:4
<b>Credits</b>	2
<b>Course prerequisite</b>	BSc. 1 <sup>st</sup> with chemistry as core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Impart practical knowledge to the students about semi micro qualitative analysis. 2. Study practically physical properties of solutions.
<b>Course Outcome (CO)</b>	<b>By the end of the course, students will be able to:</b> 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**

- Semi-micro qualitative analysis** (using H<sub>2</sub>S or other methods) of mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of the following:
- Cations : NH<sub>4</sub><sup>+</sup>, Pb<sup>2+</sup>, Bi<sup>3+</sup>, Cu<sup>2+</sup>, Cd<sup>2+</sup>, Fe<sup>3+</sup>, Al<sup>3+</sup>, Co<sup>2+</sup>, Ni<sup>2+</sup>, Mn<sup>2+</sup>, Zn<sup>2+</sup>, Ba<sup>2+</sup>, Sr<sup>2+</sup>, Ca<sup>2+</sup>, K<sup>+</sup>
- Anions : CO<sub>3</sub><sup>2-</sup>, S<sup>2-</sup>, SO<sub>3</sub><sup>2-</sup>, S<sub>2</sub>O<sub>3</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, CH<sub>3</sub>COO<sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, PO<sub>4</sub><sup>3-</sup>, BO<sub>3</sub><sup>3-</sup>, C<sub>2</sub>O<sub>4</sub><sup>2-</sup>, F<sup>-</sup> (*Spot tests should be carried out wherever feasible*)
- Estimate the amount of nickel present in a given solution as bis(dimethylglyoximate) nickel(II) or aluminium as oximate in a given solution gravimetrically.
- Estimation of (i) Mg<sup>2+</sup> or (ii) Zn<sup>2+</sup> by complexometric titrations using EDTA.
- Estimation of total hardness of a given sample of water by complexometric titration.

**Section B: Physical Chemistry**

**Surface tension measurement** (use of organic solvents excluded).

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

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

**Viscosity measurement** (use of organic solvents excluded).

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

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

**Chemical Kinetics**

Study the kinetics of the following reactions.

**Initial rate method:** Iodide-persulphate reaction

**Integrated rate method:**

Acid hydrolysis of methyl acetate with hydrochloric acid.

Saponification of ethyl acetate.

Compare the strengths of HCl and H<sub>2</sub>SO<sub>4</sub> by studying kinetics of hydrolysis of methyl acetate

*\*Perform any four experiments from each section*

**Text and Reference Books**

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





## MOLECULES OF LIFE

Semester	V
Course Code	CHM 301
Course Title	Molecules of Life
Type of course	Discipline Elective course (Theory)
L T P	4:0:0
Credits	4
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as one core subject
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 1. Impart coherent knowledge to the students about organometallic chemistry. 2. Impart knowledge of polynuclear hydrocarbons and organic spectroscopy.
Course Outcome (CO)	<b>By the end of this course, students will be able to</b> 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, -NH<sub>2</sub> 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.

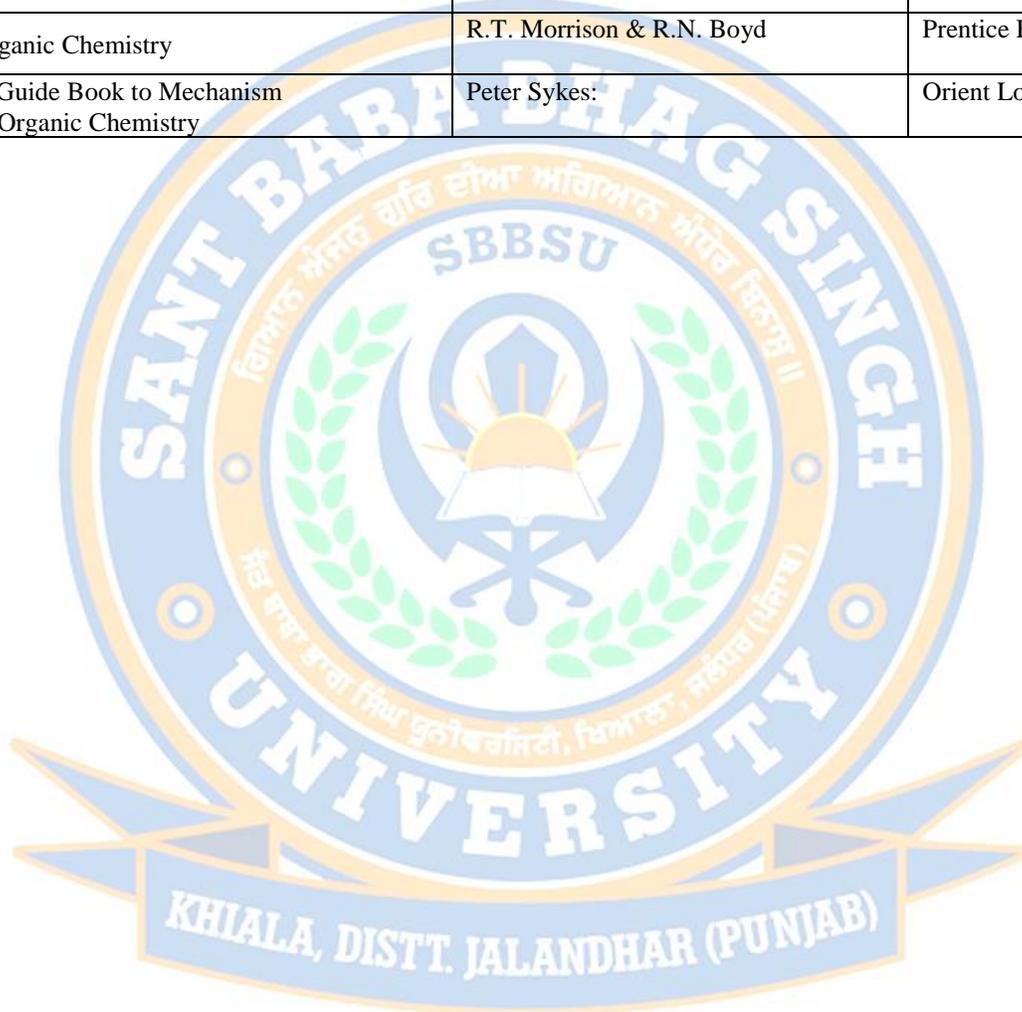
**Lipids** Introduction to lipids, classification. Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

**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.

## Text and Reference Books

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.



## MOLECULE OF LIFE (PRACTICAL)

<b>Semester</b>	V
<b>Course Code</b>	CHM 303
<b>Course Title</b>	Molecule of life (Practical)
<b>Type of course</b>	Discipline elective(Practical)
<b>L T P</b>	0:0:4
<b>Credits</b>	2
<b>Course prerequisite</b>	Bsc. Ist, IInd year with CHEMISTRY as one core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Impart practical knowledge about the biochemical analysis. 2. Study extraction and purification of organic biomolecules.
<b>Course Outcome (CO)</b>	<b>By the end of the course, the students will be able to:</b> 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 the ingredient of an aspirin tablet by TLC.

**Text and Reference Books**

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.

**ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY**

Semester	V
Course Code	CHM 305
Course Title	Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR spectroscopy
Type of course	Discipline Elective course (theory)
L T P	4:0:0
Credits	4
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as one core subject
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 1. Impart coherent knowledge about organometallic chemistry. 2. Impart basic knowledge of polynuclear hydrocarbons and organic spectroscopy.
Course Outcome (CO)	<b>By the end of the course, the students will be able to:</b> 1. Apply 18-electron rule to rationalize the stability of organometallic 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,  $K_2Cr_2O_7$ ,  $KMnO_4$ ,  $[Fe(CN)_6]$ , Sodium nitroprusside,  $[Co(NH_3)_6]Cl_3$ ,  $Na_3[Co(NO_2)_6]$ .

**UNIT -II**

**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  $Na^+$ ,  $K^+$ ,  $Mg^{2+}$  ions, Na/K pump; Role of  $Mg^{2+}$  ions in energy production and chlorophyll. Role of  $Ca^{2+}$  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,  $\lambda_{max}$  &  $\epsilon_{max}$ , chromophore, auxochrome, bathochromic and hypsochromic shifts, Solvent Effect in UV and IR Spectroscopy. Application of electronic spectroscopy and Woodward rules for calculating  $\lambda_{max}$  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).

## Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Concise Inorganic Chemistry	I.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 <sup>th</sup> 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



**ORGANOMETALLICS, BIOINORGANIC CHEMISTRY, POLYNUCLEAR HYDROCARBONS AND UV, IR SPECTROSCOPY (PRACTICAL)**

Semester	V
Course Code	CHM 307
Course Title	Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy (Practical)
Type of course	Discipline elective(Practical)
L T P	0:0:4
Credits	2
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as one core subject
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 1. Impart practical knowledge about organometallic chemistry. 2. Perform organic qualitative analysis.
Course Outcome (CO)	<b>By the end of this course, students will be able to</b> 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 R<sub>f</sub> value in each case. (Combination of two ions to be given)

Paper chromatographic separation of Fe<sup>3+</sup>, Al<sup>3+</sup> and Cr<sup>3+</sup>

Paper chromatographic separation of Ni<sup>2+</sup>, Co<sup>2+</sup>, Mn<sup>2+</sup> and Zn<sup>2+</sup>.

2. Preparation of any two of the following complexes and measurement of their conductivity:

(i) tetraamminecarbonatocobalt (III) nitrate

(ii) tetraamminecopper (II) sulphate

(i) potassium trioxalato ferrate (III) trihydrate

Compare the conductance of the complexes with that of M/1000 solution of NaCl, MgCl<sub>2</sub> and LiCl<sub>3</sub>

**Section B: Organic Chemistry**

Verification of Lambert-Beer's law and determination of concentration of a coloured species (CuSO<sub>4</sub>, KMnO<sub>4</sub>, CoCl<sub>2</sub>, CoSO<sub>4</sub>)

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

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

**Text and Reference Books**

S. No	Name	Author(S)	Publisher
1	Vogel's Qualitative Inorganic Analysis (7 <sup>th</sup> Edition).	A.I. Vogel, G Svehla	Prentice Hall
2	Vogel's Quantitative Chemical Analysis (6 <sup>th</sup> 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,

## INDUSTRIAL CHEMICAL AND ENVIRONMENT

Semester	V
Course Code	CHM 309
Course Title	Industrial Chemical and Environment
Type of course	Discipline elective(Theory)
L T P	4:0:0
Credits	4
Course prerequisite	B.Sc. Ist, IInd year with Chemistry as core subject
Course Objective (CO)	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>1. Get familiar with the concepts of different gases and their industrial production, uses, storage and hazards.</li> <li>2. Study manufacturing, applications, analysis and hazards of the Inorganic Chemicals.</li> <li>3. Study Air and Water pollution, control measures for Air and Water Pollutants, Catalyst and Biocatalyst, Energy and Environment.</li> </ol>
Course outcome (CO)	<p><b>By the end of this course students will be able to</b></p> <ol style="list-style-type: none"> <li>1. Understand the vital role played by chemistry in industry.</li> <li>2. Give solution based on chemical knowledge in the field of various industries such as manufacturing processes, handling and storage of inorganic chemicals &amp; hazardous effects of the inorganic chemicals.</li> <li>3. Composition of air, various air pollutants, effects and control measures of air pollutants.</li> <li>4. Different sources of water, water quality parameters, impacts of water pollution, water treatment.</li> <li>5. Different industrial effluents and their treatment methods.</li> <li>6. Different sources of energy &amp; generation of nuclear waste and its disposal.</li> </ol>

**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 SO<sub>2</sub>, CO<sub>2</sub>, CO, NO<sub>x</sub>, H<sub>2</sub>S and other foul smelling gases. Methods of estimation of CO, NO<sub>x</sub>, SO<sub>x</sub> 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.

### Text and Reference Books

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.



## INDUSTRIAL CHEMICAL AND ENVIRONMENT (PRACTICAL)

Semester	V
Course Code	CHM 311
Course Title	Industrial chemical and environment (Practical)
Type of course	Discipline elective (practical)
L T P	0:0:4
Credits	2
Course prerequisite	Bsc. Ist, IInd year with Chemistry as one core subject
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 1. Impart practical knowledge to the students in Industrial processes. 2. Study and analyse various pollutants through different analytical methods
Course Outcome (CO)	<b>By the end of this course students will be able to:</b> 1. Identify and analyse various water quality parameters. 2. Analyse quantitatively air, water pollutants. 3. Estimate bioindicators of pollution through titrimetrically and spectrophotometrically.

- Determination of dissolved oxygen in water.
- Determination of Chemical Oxygen Demand (COD)
- Determination of Biological Oxygen Demand (BOD)
- Percentage of available chlorine in bleaching powder.
- Measurement of chloride, sulphate and salinity of water samples by simple titration method (AgNO<sub>3</sub> and potassium chromate).
- Estimation of total alkalinity of water samples (CO<sub>3</sub><sup>2-</sup>, HCO<sub>3</sub><sup>-</sup>) using double titration method.
- Measurement of dissolved CO<sub>2</sub>.
- Study of some of the common bio-indicators of pollution.
- Estimation of SPM in air samples.
- Preparation of borax/ boric acid.

## Text and Reference Books

S. No	Name	Author(S)	Publisher
1	(2008), A Laboratory Manual for Environmental Chemistry,	Gopalan, R.; Anand, A.; Sugumar R.W.	I. K. International.
2	(2010), Environmental Pollution Analysis,	Khopkar, S.M.,	New Age International Publisher.
3	(1980), Experiments in Environmental Chemistry: A Laboratory Manual, Vol.4,	Vowles, P.D.; Connell, D.W.	Pergamon Series in Environmental Science.
4	Waste water treatment disposal and release-, INC second Edn., 1990.	Metcalf and eddy	Tata Mc Graw Hill
5	Environmental pollution control and engineering, 1995.	C. S. Rao	Wiley Eastern Ltd.
6	Principles of Instrumental Methods of analysis	D. A. Skoog and D.M. West	Saunders College Publ. Latest edition.



***SEMESTER***  
***VI<sup>th</sup>***

## CHEMISTRY OF MAIN GROUP ELEMENT, THEORIES OF ACIDS AND BASES

Semester	VI
Course Code	CHM 302
Course Title	Chemistry of Main Group Element, Theories of Acids and Bases
Type of course	Discipline Elective Course(Theory)
L T P	4:0:0
Credits	4
Course prerequisite	Bsc. Ist, IInd year with Chemistry as core subject
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 1. Impart detailed knowledge of Main group elements. 2. Study industrial important processes based upon Chemistry VII A: Main Group Chemistry.
Course Outcome (CO)	<b>By the end of the course, the students will be able to:</b> 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. Oxides

**Noble gases:** Rationalization of inertness of noble gases, catharses, preparation and properties of XeF<sub>2</sub>, XeF<sub>4</sub> and XeF<sub>6</sub>, 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 (NPCl<sub>2</sub>)<sub>3</sub>. of N and P, Ox acids of P, S and Cl. Halides and ox halides of P and S (PCl<sub>3</sub>, PCl<sub>5</sub>, SOCl<sub>2</sub> and SO<sub>2</sub>Cl<sub>2</sub>). Interhalogen compounds. A brief idea of pseudo halides.

**Text and Reference Books**

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



## CHEMISTRY OF MAIN GROUP ELEMENT, THEORIES OF ACIDS AND BASES (PRACTICAL)

Semester	VI
Course Code	CHM 304
Course Title	Chemistry of Main Group Element, Theories of Acids and Bases (Practical)
Type of course	Discipline Elective Course (Practical)
L T P	0:0:4
Credits	2
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 1. Impart practical knowledge of iodometric, complexometric. 2. Perform gravimetric titration used for analysis of Main group elements.
Course Outcome (CO)	<b>By the end of the course, the students will be able to:</b> 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  $Mg^{2+}$ ,  $Zn^{2+}$
- (ii) Estimation of  $Ca^{2+}$  by substitution method

**(C) Gravimetric Analysis**

1. Gravimetric estimation of sulphate as barium sulphate.
2. Gravimetric estimation of aluminium as oximate complex

**(D) Inorganic preparations**

1. Preparation of the following :
  - (i) Cuprous Chloride,  $Cu_2Cl_2$
  - (ii) Aluminium potassium sulphate  $KAl(SO_4)_2 \cdot 12H_2O$  (potash alum) or Chromium potassium sulphate  $KCr(SO_4)_2 \cdot 12H_2O$  (chrome alum).
  - (iii) tetraamminecopper(II) sulphate monohydrate, potassium trioxalatoferrate(III) (any two, including one double salt and one complex).

**Text and Reference Books**

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

## ANALYTICAL METHOD IN CHEMISTRY

Semester	VI
Course Code	CHM 306
Course Title	Analytical Method in Chemistry
Type of course	Discipline Elective Course(theory)
L T P	4:0:0
Credits	4
Course prerequisite	Bsc. Ist, IInd year with Chemistry as core subject
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 1. Get familiar with concepts of analytical Chemistry various spectrophotometric, electroanalytical and thermal methods of analysis. 2. Exposed to important separation methods like solvent extraction and chromatography.
Course Outcome (CO)	<b>By the end of this course, students will be able to:</b> 1. Understand basic principle of instrument of various spectrophotometric, electroanalytical and thermal 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, monochromator, 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.

**Text and Reference Books**

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	Saunders's College Publ. Latest edition.
4	Vogel's Qualitative Inorganic Analysis (7 <sup>th</sup> Edition).	G Svehla	Prentice Hall
5	Vogel's Quantitative Chemical Analysis (6 <sup>th</sup> 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.



## ANALYTICAL METHOD IN CHEMISTRY (PRACTICAL)

Semester	VI
Course Code	CHM 308
Course Title	Analytical Method in Chemistry (Practical)
Type of course	Discipline Elective (Practical)
L T P	0:0:4
Credits	2
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 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)	<b>By the end of this course, students will be able to:</b> 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 Photometry 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 R<sub>f</sub> values.
2. Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on the basis of their R<sub>f</sub> 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 Ni<sup>2+</sup> & Fe<sup>2+</sup> by complexation with DMG and extracting the Ni<sup>2+</sup>- 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 (CuSO<sub>4</sub>, KMnO<sub>4</sub>, CoCl<sub>2</sub>, CoSO<sub>4</sub>)
2. Determination of pK<sub>a</sub> values of indicator using spectrophotometry.
3. Structural characterization of compounds by infrared spectroscopy.

## Text and Reference Books

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	Saunders's College Publ. Latest edition.
4	Vogel's Qualitative Inorganic Analysis (7 <sup>th</sup> Edition).	G Svehla	Prentice Hall
5	Vogel's Quantitative Chemical Analysis (6 <sup>th</sup> 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 Analysis	G.W.Ewing,	McGraw Hill Pub, 1975.



### INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE

<b>Semester</b>	<b>VI</b>
<b>Course Code</b>	<b>CHM310</b>
<b>Course Title</b>	<b>Inorganic Materials of Industrial Importance</b>
<b>Type of course</b>	DSE
<b>L T P</b>	4:0:0
<b>Credits</b>	4
<b>Course prerequisite</b>	B.Sc I and B.Sc II year with as Chemistry as core subject
<b>Course Objective (CO)</b>	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>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.</li> <li>2. Learn about silicates, fertilizers, surface coatings, batteries, engineering materials for mechanical construction as well as the emerging area of nano-sized materials.</li> <li>3. Develop the interest in the frontier areas of inorganic and material chemistry.</li> </ol>
<b>Course Outcomes (CO)</b>	<p><b>By the end of the course, the students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Learn the composition and applications of the different kinds of glass.</li> <li>2. Understand glazing of ceramics and the factors affecting their porosity.</li> <li>3. Give the composition of cement and discuss the mechanism of setting of cement.</li> <li>4. Explain the process of formulation of paints and the basic principle behind the protection offered by the surface coatings.</li> <li>5. Explain the principle, working and applications of different batteries.</li> <li>6. List and explain the properties of engineering materials for mechanical construction used in day to day life.</li> <li>7. Explain the synthesis and properties of nano-dimensional materials, various semiconductor and superconductor oxides.</li> </ol>

#### 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, Eco-friendly 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).



### INORGANIC MATERIALS OF INDUSTRIAL IMPORTANCE PRACTICAL

<b>Semester</b>	<b>VI</b>
<b>Course Code</b>	<b>CHM312</b>
<b>Course Title</b>	<b>Inorganic Materials of Industrial Importance Practical</b>
<b>Type of course</b>	DSE
<b>L T P</b>	0:0:4
<b>Credits</b>	2
<b>Course prerequisite</b>	B.Sc I and B.Sc II year with as Chemistry as core subject
<b>Course Objective (CO)</b>	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>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.</li> <li>2. Learn about silicates, fertilizers, surface coatings, batteries, engineering materials for mechanical construction as well as the emerging area of nano-sized materials.</li> <li>3. Develop the interest in the frontier areas of inorganic and material chemistry.</li> </ol>
<b>Course Outcomes (CO)</b>	<p><b>By the end of the course, the students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. To perform qualitative and quantitative analysis of industrially important chemicals.</li> <li>2. To analyse composition of alloy, cement and fertilizers</li> <li>3. To prepare industrially significant pigments.</li> </ol>

#### 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 Publishers, New Delhi.
3. Svehla, G. (1996), Vogel's Qualitative Inorganic Analysis, Prentice Hall.
4. Banewicz, J. J.; Kenner, C.T. Determination of Calcium and Magnesium in Limestones and Dolomites, *Anal. Chem.*, 1952, 24 (7), 1186–1187.



## BASIC ANALYTICAL CHEMISTRY

<b>Semester</b>	<b>III</b>
<b>Course Code</b>	<b>CHM 205</b>
<b>Course Title</b>	<b>Basic Analytical Chemistry</b>
<b>Type of course</b>	<b>Skill Enhancement Course</b>
<b>L T P</b>	2:0:0
<b>Credits</b>	2
<b>Course prerequisite</b>	B.sc. Ist, IInd year with Chemistry as core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Aware about concepts of analytical Chemistry various spectrophotometric, electroanalytical methods of analysis. 2. Exposed to important separation methods like solvent extraction and chromatography.
<b>Course outcome (CO)</b>	<b>By the end of this course, students will be able to:</b> 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 adulterants & cosmetics 4. Estimate macro nutrients using Flame photometry & Separate mixtures using 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 ( $\text{Fe}^{3+}$  and  $\text{Al}^{3+}$ )
- 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:

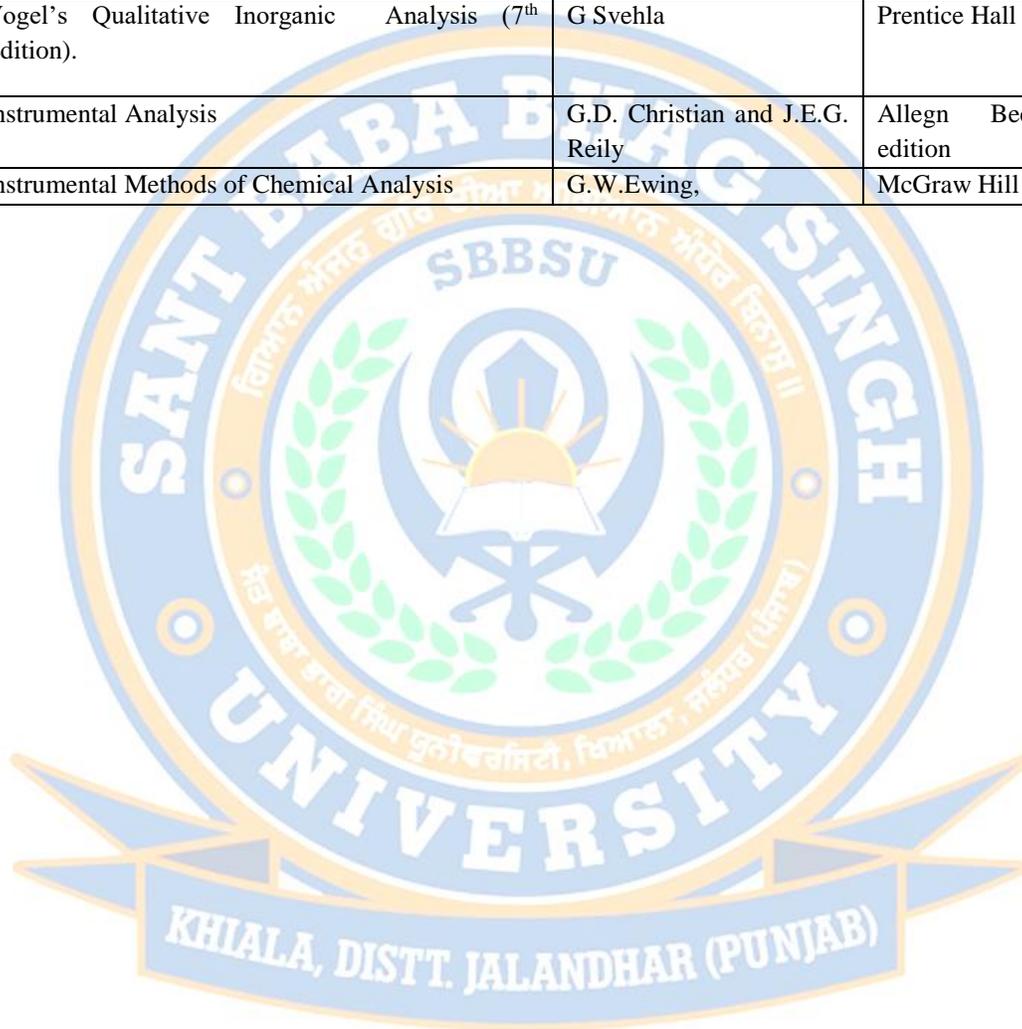
a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry.

b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets.

c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft drink

#### Text and Reference Books

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.; Nieman, T.A. (2005),	Thomson Asia Pvt. Ltd.
3	Vogel's Qualitative Inorganic Analysis (7 <sup>th</sup> Edition).	G Svehla	Prentice Hall
4	Instrumental Analysis	G.D. Christian and J.E.G. Reily	Allegn Becon, Latest edition
5	Instrumental Methods of Chemical Analysis	G.W.Ewing,	McGraw Hill Pub, 1975.



## GREEN METHODS IN CHEMISTRY

Semester	IV
Course Code	CHM 210
Course Title	Green Methods in Chemistry
Type of course	Skill Enhancement Course
L T P	2:0:0
Credits	2
Course prerequisite	Bsc. Ist, IInd year with Chemistry as core subject
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 1. Impart Coherent knowledge about principles of green chemistry. 2. Study scope of Green chemistry and applications of green chemistry in current scenario.
Course Outcome (CO)	<b>By the end of this course, students will be able to:</b> 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).

**Text and Reference Books**

S. No	Name	Author(S)	Publisher
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 315
Course Title	Fuel chemistry
Type of course	Skill enhancement Course
L T P	2:0:0
Credits	2
Course prerequisite	Bsc. Ist, IInd year with CHEMISTRY as core subject
Course Objective (CO)	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>1. Know about basic scientific and technical understanding of the production, behaviour and handling of hydrocarbon fuels and lubricants.</li> <li>2. Study emerging alternative &amp; renewable fuels.</li> <li>3. Be industry ready to contribute effectively in the field of petroleum chemistry and technology.</li> </ol>
Course Outcome (CO)	<p><b>By the end of this course, students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Understanding of both conventional petroleum-based fuels, and alternative &amp; renewable fuels, including gaseous fuels.</li> <li>2. understand the refining processes used to produce fuels and lubricants and their usage in different applications.</li> <li>3. Analyze origin of petroleum, crude oil, composition, different refining processes employed industrially to obtain different fractions of petroleum.</li> <li>4. Categorize alternative and renewable fuels like Biofuels (Different generations), Gaseous Fuels (e.g. CNG, LNG, CBG, Hydrogen etc.).</li> <li>5. Apply various test methods used to qualify different types of fuels as well characterization methods.</li> </ol>

#### 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, pour point) and determination.

#### Text and Reference Books

S. No	Name	Author(S)	Publisher
1	Principles of Instrumental Methods of analysis	D. A. Skoog and D.M.West	Saunders' College Publ. Latest edition.
2	Engineering Chemistry	Jain, P.C. & Jain, M.	Dhanpat Rai & Sons, Delhi
3	Instrumental methods of chemical analysis	B.K.sharma	Krishna prakashan media LTD
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

<b>Semester</b>	<b>VI</b>
<b>Course Code</b>	<b>CHM 314</b>
<b>Course Title</b>	<b>Basic Pharmaceutical Chemistry</b>
<b>Type of course</b>	Skill enhancement course
<b>L T P</b>	2:0:0
<b>Credits</b>	2
<b>Course prerequisite</b>	Bsc. Ist, IInd year with CHEMISTRY as core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 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.
<b>Course outcome (CO)</b>	<b>By the end of this course, students will be able to:</b> 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, bentonite, 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), antilprosy (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.

**Text and Reference Books**

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., Lemke, David A. William	B.I. Waverly Pvt. Ltd. New Delhi
4	Medicinal Chemistry-the role of organic chemistry in drug, 1993	C. R. Ganellin, and S. M. Roberts	Academic Press
5	Medicinal Chemistry-principles and practice, 1994	F. D. King	Royal Society of Chemistry

### CHEMISTRY OF COSMETICS AND PERFUMES

<b>Semester</b>	<b>VI</b>
<b>Course Code</b>	<b>CHM 316</b>
<b>Course Title</b>	Chemistry of Cosmetics and Perfumes
<b>Type of course</b>	Skill enhancement course
<b>L T P</b>	2:0:0
<b>Credits</b>	2
<b>Course prerequisite</b>	Bsc. Ist, IInd year with CHEMISTRY as core subject
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 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.
<b>Course Outcome (CO)</b>	<b>By the end of this course, students will be able to:</b> 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

#### Text and Reference Books

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

*(AEC)*

*Ability Enhancement  
Courses*

*Semester I - VI*



## COMMUNICATION SKILLS-I

<b>Semester</b>	<b>I</b>
<b>Course Code</b>	<b>ENG121</b>
<b>Course Title</b>	<b>Communication skills-I</b>
<b>Type of course</b>	Theory
<b>L T P</b>	2 0 0
<b>Credits</b>	2
<b>Course prerequisite</b>	+2 with any stream
<b>Course Objective (CO)</b>	<b>Objectives of the course is to:</b> <ol style="list-style-type: none"> <li>1. Equip the learner with proficiency in reading comprehension..</li> <li>2. Enable the learner with improved writing skills and command over official/ corporate communication.</li> <li>3. Enhance the learners' range of vocabulary and knowledge of the essentials of grammar.</li> </ol>
<b>Course Outcome (CO)</b>	<b>At the conclusion of the course the learner will be able to:</b> <ol style="list-style-type: none"> <li>1. Have fairly good proficiency in reading comprehension.</li> <li>2. Have enhanced writing skills and command in official/ corporate communication.</li> <li>3. Develop confidence in making presentation: oral or documentary.</li> </ol>

**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:**

<b>Sr No</b>	<b>Author(s)</b>	<b>Title</b>	<b>Publisher</b>
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-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)	<b>Objectives of the course is to:</b> 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)	<b>At the conclusion of the course the learner will be able to:</b> 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**

**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.

**UNIT-II**

**Listening Skills:** Listening to any recorded 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	2 0 0
Credits	2
Course pre-requisite	NA
Course Objectives (CO)	<b>Objectives of the course is to:</b> <ol style="list-style-type: none"> <li>1. Equip the learner with proficiency in reading comprehension..</li> <li>2. Enable the learner with improved writing skills and command over official/ corporate communication.</li> <li>3. Enhance the learners' range of vocabulary and knowledge of the essentials of grammar.</li> </ol>
Course Outcome (CO)	<b>At the conclusion of the course the learner will be able to:</b> <ol style="list-style-type: none"> <li>1. Have fairly good proficiency in reading comprehension.</li> <li>2. Have enhanced writing skills and have command in official/ corporate communication.</li> <li>3. Develop confidence in making presentation; oral or documentary.</li> </ol>

**UNIT-I**

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

**UNIT-II**

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

**UNIT-III**

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

**UNIT-IV****Oral Communication and its Application:**

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

**Recommended Books**

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

## COMMUNICATION SKILLS-II LAB

<b>Semester</b>	<b>II</b>
<b>Course Code</b>	<b>ENG116</b>
<b>Course Title</b>	<b>Communication Skills-II Lab</b>
<b>Type of Course</b>	Practical
<b>L T P</b>	0:0:2
<b>Credits</b>	1
<b>Course pre-requisite</b>	+ 2 with any stream
<b>Course Objectives</b>	<b>Objectives of the course is to:</b> <ol style="list-style-type: none"> <li>1. Equip the learner with proficiency in reading comprehension..</li> <li>2. Enable the learner with improved writing skills and command over official/ corporate communication.</li> <li>3. Enhance the learners' range of vocabulary and knowledge of the essentials of grammar.</li> </ol>
<b>Course Outcome</b>	<b>At the conclusion of the course the learner will be able to:</b> <ol style="list-style-type: none"> <li>1. Have fairly good proficiency in reading comprehension.</li> <li>2. Have enhanced writing skills and have command in official/ corporate communication.</li> <li>3. Develop confidence in making presentation; oral or documentary.</li> </ol>

**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 Publishing Company,
2	MediaandCommunication Management	C. S. Rayudu	Himalaya Publishing House,
3	Essentials of Business Communication	Rajendra Pal and J. S. Korlahalli	Sultan Chand & Sons, New Delhi

## ENVIRONMENTAL SCIENCE

Semester	III
Course Code	EVSO01
Course Title	Environmental Science
Type of course	Theory
L T P	3 0 0
Credits	3
Course prerequisite	NA
Course Objective (CO)	<b>The aim of this course is to enable the students to</b> 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)	<b>By the end of this course, students will be able to:</b> 1. Gain understanding of environment and ecosystem.. 2. Study environmental pollutions and natural resources. 3. Study social issues related to environment.

**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 resources 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 environmental assets: river/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

<b>Semester</b>	<b>IV</b>
<b>Course Code</b>	<b>SSC001</b>
<b>Course Title</b>	<b>Gender Equity</b>
<b>Type of course</b>	ID
<b>L T P</b>	3:0:0
<b>Credits</b>	3
<b>Course prerequisite</b>	NA
<b>Course Objectives (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Acquire knowledge and understanding of theory and concepts related to gender and gender relations 2. Critically reflect how gender is a development issue.
<b>Course Outcome (CO)</b>	<b>By the end of this course, students will be able to:</b> 1. Know important mathematical concepts in abstract algebrasuch 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.

**Text and Reference Books:**

S.No.	Author(S)	Year	Title	Publisher
1	Jayachandran, Seema	2014	The Roots of Gender Inequality in Developing Countries	NBER Working Paper No.20380. Issued in August 2014
2	Duflo, Esther	2012	Women's Empowerment and Economic Development	<i>Journal of Economic Literature</i> , 50(4): 1051-79.

### HUMAN VALUES & PROFESSIONAL ETHICS

<b>Semester</b>	<b>V</b>
<b>Course Code</b>	<b>SSC006</b>
<b>Course Title</b>	<b>Human values &amp; Professional Ethics</b>
<b>Type of Course</b>	ID
<b>L T P</b>	3:0:0
<b>Credits</b>	3
<b>Course Prerequisites</b>	None
<b>Course Objectives (CO)</b>	<p><b>The aim of this course is to enable the students to</b></p> <ol style="list-style-type: none"> <li>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.</li> <li>2. Discover what they consider valuable. Accordingly, they should be able to discriminate between valuable and the superficial in real situations in their life.</li> </ol>
<b>Course Outcome (CO)</b>	<p><b>By the end of this course, students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Behave ethically, professionally and promote human values in society.</li> <li>2. Understand about global issues.</li> <li>3. Learn the rights and responsibilities as an employee, team member and a global citizen.</li> </ol>

#### 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

## BASICS OF COMPUTER SCIENCES

Semester	VI
Course Code	CSE014
Course Title	Basics of Computer Sciences
Type of Course	Theory
L T P	2 00
Credits	2
Course Prerequisites	Basic of Computer
Course Objectives (CO)	<b>The aim of this course is to enable the students to</b> 1. Understand the basic concepts of computer, office automation, information technology and internet. 2. Familiarize with computing problems and apply principles of computing.
Course Outcomes (CO)	<b>By the end of this course, students will be able to:</b> 1. 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 its applications.

**Introduction of internet-** Definition, Applications of internet, Impact of Internet on Society Crime on/through the Internet, E-mail, WWW.

**Text and Reference Books**

Sr.no.	Name	Author(s)	Publisher
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
4	MS Office for Windows XP	Sagman S	Pearson Education

## BASICS OF COMPUTER SCIENCES LAB

<b>Semester</b>	<b>VI</b>
<b>Course Code</b>	<b>CSE016</b>
<b>Course Title</b>	<b>Basics of Computer Sciences Lab</b>
<b>Type of course</b>	Practical
<b>L T P</b>	002
<b>Credits</b>	1
<b>Course prerequisite</b>	NA
<b>Course Objective (CO)</b>	<b>The aim of this course is to enable the students to</b> 1. Familiarize with basic concepts of computers including office automation and internet concepts. 2. Familiarize with computing problems and apply principles of computing.
<b>Course Outcomes (CO)</b>	<b>By the end of this course, students will be able to:</b> 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 a file
- Creating and operating on a folder
- Changing setting like, date, time, colour (background and foreground)
- 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 Setup:

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, endnote, 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 setup, printing options Using Find, Replace options

f) Using Tools like:

Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printing envelopes and labels

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, formula to calculate values, format data, create chart, print chart, save worksheet, switching between different spread sheets

b) Menu commands:

Create, format charts, organize, manage data, solving problem by analyzing data, exchange with other 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, slides 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
  - l. Changing slide layout
  - m. Changing slide colour scheme
  - n. Changing background
  - o. Applying design template
- How to view the slideshow?

