**IIMT UNIVERSITY, MEERUT**

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**EVALUATION SCHEME & SYLLABUS**

**FOR**

**BACHELOR OF SCIENCE IN CBZ**

**(BIOLOGY)**

On Choice Based Credit System

(Effective from the Session: 2019-20)

**IIMT UNIVERSITY, MEERUT**

**STUDY & EVALUATION SCHEME**

**B. Sc. BIOLOGY I YEAR, I Semester**

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| **S. No.** | **Course Type** | **Course Code** | **Subject** | **Study Scheme** | **Credit** | **Evaluation Scheme** |
| **L** | **T** | **P** |  | **Internal** | **External** | **Total** |
| 1 | CBot-1 Theory | BSBC-111 | Biodiversity (Microbes, Algae, Fungi and Archegoniate)  | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| 2 | CZoo-1 Theory | BSZC-112 | Biodiversity- Animals | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| 3 | CChem-3 Theory | BSCC-113 | Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| 4. | AECC-1 Theory | NHU-111 | English Communication | 2 | 0 | 0 | 2 | 15 | 35 | 50 |
| 5. | USEC | NECC-111 | Industrial Visit/ Seminar/Presentation the report of visit | 0 | 0 | 0 | 0 | 25 | 0 | NC |
| 6. | USEC | NECC-112 | University Social Responsibility | 0 | 0 | 0 | 0 | 25 | 0 | NC |
| 7. | USEC | NECC-113 | Spoken Tutorial Certification | 1 | 0 | 0 | 1 | 25 | 0 | 25 |
| 8. | USEC | NECC-114 | MOOCs/ SWAYAM | 1 | 0 | 0 | 1 | 25 | 0 | 25 |
| **PRACTICALS** |
| 9. | CBot-1 Lab | BSBC-111P | Biodiversity (Microbes, Algae, Fungi and Archegoniate) Lab  | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
| 10 | CZoo-1 Lab | BSZC-112P | Biodiversity- Animals Lab  | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
| 11 | CChem-3 Lab | BSCC-113P | Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons Lab | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
|  |  |  | **TOTAL** | **16** |  | **6** | **22** | **215** | **335** | **550** |
|  |
| 12 | USEC | SPT-111 | Sports | 0 | 0 | 0 | 0 | 50 | 0 | NC |

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| **L= Lecture**  |  |  |  |  |  |  |  |  |  |  |
| **T= Tutorial**  |  |  |  |  |  |  |  |  |  |  |
| **P= Practical****B.Sc. BIOLOGY I SEMESTER****Core Course: Botany****Paper I (Code: BSBC-111)****Biodiversity (Microbes, Algae, Fungi and Archegoniate)** **(Credits: Theory-4, Practicals-2)** |  |  |  |  |  |  |  |  |  |  |

**Lectures: 60**

**Unit 1: Microbes (10 Lectures)**

Viruses – Discovery, general structure, replication (general account), Plant Virus (TMV), Animal Virus (HIV), Bacteriophage. Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

**Unit 2: Algae (12 Lectures)**

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*. Economic importance of algae

**Unit 3: Fungi (12 Lectures)**

Introduction- General characteristics, ecology and significance, range of thallus organization,

cell wall composition , nutrition, reproduction and classification, life cycle of *Rhizopus* (Zygomycota) *Penicillium,* (Ascomycota), *Agaricus* (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

 **Unit 4: Introduction to Archegoniate** (**2 Lectures)**

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

**Unit 5: Bryophytes (10 Lectures)**

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 6: Pteridophytes (8 Lectures)**

General characteristics, classification. 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.

**Unit 7: Gymnosperms (6 Lectures)**

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.

**Biodiversity (Microbes, Algae, Fungi and Archegoniate) Lab: (BSBC-111P)**

**(Credits: Practicals-2)**

**Practicals**

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.

2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary

Fission; Conjugation; Structure of root nodule.

3. Gram staining

4. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (electron

micrographs)*, Oedogonium, Vaucheria, Fucus\* and Polysiphonia* through temporary

preparations and permanent slides. (\* *Fucus* - Specimen and permanent slides)

5. *Rhizopus and Penicillium*: Asexual stage from temporary mounts and sexual structures

through permanent slides.

6. *Alternaria:* Specimens/photographs and tease mounts.

7. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry

leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.

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

*Agaricus*.

9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)

10. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)

11. ***Marchantia***- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through

gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore,

l.s. sporophyte (all permanent slides).

12. ***Funaria***- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores

(temporary slides); permanent slides showing antheridial and archegonial heads, l.s.

capsule and protonema.

13. ***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).

14. ***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).

15. ***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).

16. ***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).

17. ***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).

 **Suggested Readings**

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi.

12 2nd edition.

2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson

Benjamin Cummings, U.S.A. 10th edition.

3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan

Publishers Pvt. Ltd., Delhi.

4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John

Wiley and Sons (Asia), Singapore. 4th edition.

5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw

Hill, Delhi, India.

6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.

7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd

Publishers, New Delhi, India.

8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book

Depot, Allahabad.

**B.Sc. BIOLOGY I SEMESTER**

**Core Course: Zoology**

**Paper II (Code: BSZC-112)**

**ANIMAL DIVERSITY**

**(Credits: Theory-4, Practicals-2)**

**Unit 1: Kingdom Protista 4**

General characters and classification up to classes; Locomotory Organelles and locomotion in

Protozoa

**Unit 2: Phylum Porifera 3**

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

**Unit 3: Phylum Cnidaria 3**

General characters and classification up to classes; Polymorphism in Hydrozoa

**Unit 4: Phylum Platyhelminthes 3**

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

**Unit 5: Phylum Nemathelminthes 5**

General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations

**Unit 6: Phylum Annelida 3**

General characters and classification up to classes; Metamerism in Annelida

**Unit 7: Phylum Arthropoda 5**

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

Insects

**Unit 8: Phylum Mollusca 4**

General characters and classification up to classes; Torsion in gastropods

**Unit 9: Phylum Echinodermata 4**

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

**Unit 10: Protochordates 2**

General features and Phylogeny of Protochordata

**Unit 11: Agnatha 2**

General features of Agnatha and classification of cyclostomes up to classes

**Unit 12: Pisces 4**

General features and Classification up to orders; Osmoregulation in Fishes

**Unit 13: Amphibia 4**

General features and Classification up to orders; Parental care

**Unit 14: Reptiles 4**

General features and Classification up to orders; Poisonous and non-poisonous snakes, Biting

mechanism in snakes

**Unit 15: Aves 5**

General features and Classification up to orders; Flight adaptations in birds

**Unit 16: Mammals 5**

Classification up to orders; Origin of mammals

**Note:** Classification of Unit 1-9 to be followed from “Barnes, R.D. (1982). *Invertebrate*

*Zoology*, V Edition”

**ANIMAL DIVERSITY LAB: (BSZC-112P)**

 **(Credits: Practicals-2)**

**PRACTICALS**

**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 sixcommon 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.

**SUGGESTED READINGS**

Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders

International Edition.

Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The*

*Invertebrates: A New Synthesis*, III Edition, Blackwell Science

Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.

Pough H. *Vertebrate life,* VIII Edition, Pearson International.

Hall B.K. and Hallgrimsson B. (2008). *Strickberger’s Evolution*. IV Edition. Jones and

Bartlett Publishers Inc.

**B.Sc. BIOLOGY I SEMESTER**

**Core Course: Chemistry**

**Paper III (Code: BSCC-113)**

**ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS**

 **(Credits: Theory-4, Practicals-2)**

**Course Objectives:**

**Course Objectives:**

The course reviews the structure of the atom, which is a necessary pre-requisite in understanding the nature of chemical bonding in compounds. It provides basic knowledge about ionic, covalent and metallic bonding and explains that chemical bonding is best regarded as a continuum between the three cases. It discusses the Periodicity in properties with reference to the s and p block, which is necessary in understanding their group chemistry. The course is also infused with the recapitulation of fundamentals of organic are introduced. The constitution of the course strongly aids in the paramount learning of the concepts chemistry and the introduction of a new concept of visualizing the organic molecules in a three dimensional space. To establish the applications of these concepts, the clases of alkanes, alkenes, alkynes and aromatic hydrocarbons and their applications.

**Learning Outcomes:**

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

* Solve the conceptual questions using the knowledge gained by 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.
* Draw the plausible structures and geometries of molecules using radius ratio rules, VSEPR theory and MO diagrams (homo- & hetero-nuclear diatomic molecules).
* Understand and explain the differential behavior of organic compounds based on fundamental concepts learnt.
* Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
* Learn and identify many organic reaction mechanisms including free radical substitution,

electrophilic addition and electrophilic aromatic substitution.

***Section A: Inorganic Chemistry-1* (30 Periods)**

**Unit-1**

**Atomic Structure:** Review of: Bohr’s theory and its limitations, dual behaviour ofmatter and radiation, de Broglie’s relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

Significance of quantum numbers, orbital angular momentum and quantum numbers ml and ms . Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (ms).

Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomicorbitals, Anomalous electronic configurations. **(14 Lectures)**

**Unit-2**

**Chemical Bonding and Molecular Structure (16 Lectures)**

*Ionic Bonding:* General characteristics of ionic bonding*.* Energy considerations inionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. 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 onthe 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 and heteronuclear diatomic molecules such as CO, NO and NO+.

***Section B: Organic Chemistry-1* (30 Periods)**

**Unit-3**

**Fundamentals of Organic Chemistry (8 Lectures)**

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. 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.

**Unit-4**

**Stereochemistry (10 Lectures)**

Conformations with respect to 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-5**

**Aliphatic Hydrocarbons (12 Lectures)**

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 ofalkenes and dehydrohalogenation of alkyl halides (Saytzeff’s rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. KMnO4) and trans-addition (bromine), Addition of HX (Markownikoff’s and anti-Markownikoff’s addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

**Alkynes**: (Upto 5 Carbons)*Preparation:*Acetylene from CaC2and conversion intohigher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

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

**Reference Books:**

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in* *Inorganic Chemistry*, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry:* *Principles of Structure and Reactivity*, Pearson Education India, 2006.
5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry,* John Wiley & Sons (2014).
6. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
7. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi (1988).
8. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
9. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
10. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
11. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.

**B.Sc. BIOLOGY I SEMESTER**

**Chemistry Lab**

**Course Code: BSCC-113P**

**ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS LAB**

 **(Credits: 2)**

***Section A: Inorganic Chemistry - Volumetric Analysis***

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with KMnO4.
3. Estimation of water of crystallization in Mohr’s salt by titrating with KMnO4.
4. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator.
5. Estimation of Cu (II) ions iodometrically using Na2S2O3.

***Section B: Organic Chemistry***

1. Detection of extra elements (N, S, Cl, Br, I) and functional grop in organic compounds (containing upto two extra elements).
2. Detection of functional grop in organic compounds

**Reference Books:**

* Svehla, G. *Vogel’s Qualitative Inorganic Analysis*, Pearson Education, 2012.
* Mendham, J. *Vogel’s Quantitative Chemical Analysis*, Pearson, 2009.
* Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
* Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.

**B.Sc. BIOLOGY I SEMESTER**

**AbilityEnhancementCompulsoryCourses**

**Paper IV (Code: NHU-111)**

**English Communication**

 **(Credits: Theory-4)**

**Unit-1** **Introduction to Communication**

* Nature and Process of Communication
* Levels of Communication
* Language as a tool of Communication

**Unit-2 Language of Communication**

* Verbal and Non-Verbal
* Spoken and Written
* Personal, Social and Business
* Barriers to Communication (Intra-personal, Inter-personal and Organizational communication)

**Unit-3 Speaking Skills**

* + Monologue
* Dialogue
* Group Discussion (Methodology & Guidelines)
* Interview (Types & Frequently Asked Questions)
* Public Speaking (Dos & Don'ts)

 **Unit-4 Reading and Understanding**

* Reading Comprehension
* Difference between Abstract & Summary
* Paraphrasing
* Precis Writing

**Unit-5** **Writing Skills**

* Notices, Agenda , Minutes of Meeting
* Letter writing (Formal & Informal)
* Email Writing
* Report Writing (Kinds, Structure)

**Recommended Readings:**

1. Fluency in English- Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity,Orient Blackswan, 2013.
4. Language through Literature (forthcoming)ed.Dr.GauriMishra,Dr Ranjana Kaul, Dr Brati Biswas.
5. Oxford Guide to writing and speaking , John Seely, O.U.P
6. Effective Technical Communication, M.Asraf Rizvi, Tata McGraw Hill
7. English Grammar & composition,Wren & Martin
8. Technical Communication, Meenakshi Raman & Sangeeta Raman

**Pedagogy for content delivery:**

1. Lectures
2. Presentations
3. Group Discussions
4. Quizzes
5. A/V aids

**IIMT UNIVERSITY, MEERUT**

**STUDY & EVALUATION SCHEME**

**B. Sc. BIOLOGY I YEAR, II Semester**

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| --- | --- | --- | --- | --- | --- | --- |
| **S.No.** | **Course Type** | **Course Code** | **Subject** | **Study Scheme** | **Credit** | **Evaluation Scheme** |
| **L** | **T** | **P** |  | **Internal** | **External** | **Total** |
| 1 | CBot-2 Theory | BSBC-121 | Plant Ecology and Taxonomy  | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| 2 | CZoo-2 Theory | BSZC-122 | Comparative Anatomy and Developmental Biology of Vertebrates  | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| 3 | CChem-2 Theory | BSCC-123 | Molecules of Life | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| 4. | AECC-2 Theory | BSAEC-122 | Environmental Science | 2 | 0 | 0 | 2 | 15 | 35 | 50 |
| 5. | USEC | NECC-121 | Industrial Visit/ Seminar/Presentation the report of visit | 0 | 0 | 0 | 0 | 25 | 0 | NC |
| 6. | USEC | NECC-122 | University Social Responsibility | 0 | 0 | 0 | 0 | 25 | 0 | NC |
| 7. | USEC | NECC-123 | Spoken Tutorial Certification | 1 | 0 | 0 | 1 | 25 | 0 | 25 |
| 8. | USEC | NECC-124 | MOOCs/ SWAYAM | 1 | 0 | 0 | 1 | 25 | 0 | 25 |
| **PRACTICALS** |
| 9. | CBot-2 Lab | BSBC-121P | Plant ecology and Taxonomy Lab  | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
| 10. | CZoo-2 Lab | BSZC-122P | Comparative Anatomy and Developmental Biology of Vertebrates Lab  | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
| 11. | CChem-2 Lab | BSCC-123P | Molecules of Life Lab | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
|  |  |  | **TOTAL** | **16** |  | **6** | **22** | **215** | **335** | **550** |
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| 12. | USEC | SPT-121 | Sports | 0 | 0 | 0 | 0 | 50 | 0 | NC |

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| **L= Lecture**  |  |  |  |  |  |  |  |  |  |  |
| **T= Tutorial**  |  |  |  |  |  |  |  |  |  |  |
| **P= Practical** |  |  |  |  |  |  |  |  |  |  |

**B.Sc. BIOLOGY II SEMESTER**

**Core Course: Botany**

**Paper I (Code: BSBC-121)**

**Plant Ecology and Taxonomy**

 **(Credits: Theory-4, Practicals-2)**

**Lectures: 60**

**Unit 1: Introduction (2 Lectures)**

**Unit 2: Ecological factors (11 Lectures)**

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.

**Unit 3: Plant communities (6 Lectures)**

Characters; Ecotone and edge effect; Succession; Processes and types.

**Unit 4: Ecosystem (10 Lectures)**

Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids

production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and

Phosphorous

**Unit 5: Phytogeography (4 Lectures)**

Principle biogeographical zones; Endemism

**Unit 6 Introduction to plant taxonomy (3 Lectures)**

Identification, Classification, Nomenclature.

**Unit 7 Identification (4 Lectures)**

Functions of Herbarium, important herbaria and botanical gardens of the world and India;

Documentation: Flora, Keys: single access and multi-access.

**Unit 8 Taxonomic evidences from palynology, cytology, phytochemistry and molecular**

**data**. **(6 Lectures)**

**Unit 9 Taxonomic hierarchy (2 Lectures)**

Ranks, categories and taxonomic groups.

**Unit 10 Botanical nomenclature (6 Lectures)**

Principles and rules (ICN); ranks and names; binominal system, typification, author citation,

valid publication, rejection of names, principle of priority and its limitations.

**Unit 11 Classification (6 Lectures)**

Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series),

Engler and Prantl (upto series).

**Plant Ecology and Taxonomy Lab (Code: BSBC-121P)**

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 (Orobanche),

Epiphytes, Predation (Insectivorous plants)

5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college

campus by species area curve method. (species to be listed)

6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and

comparison with Raunkiaer’s frequency distribution law

7. Study of vegetative and floral characters of the following families (Description, V.S. flower,

section of ovary, floral diagram/s, floral formula/e and systematic position according to

Bentham & Hooker’s system of classification):Brassicaceae -*Brassica, Alyssum / Iberis;*

Asteraceae -*Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax;* Solanaceae -*Solanum*

*nigrum, Withania;* Lamiaceae -*Salvia, Ocimum*; Liliaceae - *Asphodelus / Lilium / Allium.*

*8.* Mounting of a properly dried and pressed specimen of any wild plant with herbarium

label (to be submitted in the record book).

**Suggested Readings**

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.

2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th

edition.

3. Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press, San Diego, CA, U.S.A.

4. Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New

Delhi. 3rd edition.

**B.Sc. BIOLOGY II SEMESTER**

**Core Course: Zoology**

**Paper II (Code: BSZC-122)**

**Comparative Anatomy and Developmental Biology of Vertebrates**

**(Credits: Theory-4, Practicals-2)**

**Unit 1: Integumentary System 4 Lectures**

Derivatives of integument w.r.t. glands and digital tips

**Unit 2: Skeletal System 3 Lectures**

Evolution of visceral arches

**Unit 3: Digestive System 4 Lectures**

Brief account of alimentary canal and digestive glands

**Unit 4: Respiratory System 5 Lectures**

Brief account of Gills, lungs, air sacs and swim bladder

**Unit 5: Circulatory System 4 Lectures**

Evolution of heart and aortic arches

**Unit 6: Urinogenital System 4 Lectures**

Succession of kidney, Evolution of urinogenital ducts

**Unit 7: Nervous System 3 Lectures**

Comparative account of brain

**Unit 8: Sense Organs 3 Lectures**

Types of receptors

**Unit 9: Early Embryonic Development 12 Lectures**

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 10: Late Embryonic Development 10 Lectures**

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.

**Unit 11: Control of Development 8 Lectures**

Fundamental processes in development (brief idea) – Gene activation, determination,

induction, Differentiation, morphogenesis, intercellular communication, cell movements and

cell death

**COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF**

**VERTEBRATES LAB (Code: BSZC-122)**

**(CREDITS 2)**

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. Frog - Study of developmental stages - whole mounts and sections through permanent

slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and

internal gill stages.

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.

**SUGGESTED READINGS**

1. Kardong, K.V. (2005) *Vertebrates’ Comparative Anatomy, Function and Evolution*. IV

Edition. McGraw-Hill Higher Education.

1. Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition.

The McGraw-Hill Companies.

1. Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons.
2. Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.
3. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc.,

Publishers, Sunderland, Massachusetts, USA.

1. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer

Press.

1. Carlson, Bruce M (1996). Patten’s Foundations of Embryology, McGraw Hill, Inc.

**B.Sc. BIOLOGY II SEMESTER**

**Core Course: Chemistry**

**Paper III (Code: BSCC-123)**

**MOLECULES OF LIFE**

**(Credits: Theory-4, Practicals-2)**

**THEORY: Lectures: 60**

**Unit 1: Carbohydrates (10 Lectures)**

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 disachharides (sucrose, maltose, lactose) and polysachharides (starch and cellulose) excluding their structure elucidation.

**Unit 2: Amino Acids, Peptides and Proteins (12 Lectures)**

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 3: Enzymes and correlation with drug action (12 Lectures)**

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 noncompetitive inhibition including allosteric inhibition). Drug action - receptor theory. Structure – activity relationships of drug molecules, binding role of –OH group, -NH2 group, double bond and aromatic ring.

**Unit 4: Nucleic Acids (10 Lectures)**

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.

**Unit 5: Lipids (8 Lectures)**

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 6: Concept of Energy in Biosystems (8 Lectures)**

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 Carbohydrates - Glycolysis,

Fermentation, Krebs Cycle. Overview of catabolic pathways of fats and proteins.

Interrelationships in the metabolic pathways of proteins, fats and carbohydrates.

**Recommended Texts:**

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd.

(Pearson Education).

2. Finar, I. L. *Organic Chemistry* (*Volume 1*), Dorling Kindersley (India) Pvt. Ltd.

(Pearson Education).

*3.* Finar, I. L. *Organic Chemistry* (*Volume 2)*, Dorling Kindersley (India) Pvt. Ltd.

(Pearson Education).

4. Nelson, D. L. & Cox, M. M. *Lehninger’s Principles of Bioch*emistry *7th Ed.,* W. H.

Freeman.

5. Berg, J. M., Tymoczko, J. L. & Stryer, L. *Biochemistry 7th Ed.,* W. H. Freeman.

**Molecules of Life Lab (Code: BSCC-123)**

1. Separation of amino acids by paper chromatography

2. To determine the concentration of glycine solution by formylation method.

3. Study of titration curve of glycine

4. Action of salivary amylase on starch

5. Effect of temperature on the action of salivary amylase on starch.

6. To determine the saponification value of an oil/fat.

7. To determine the iodine value of an oil/fat

8. Differentiate between a reducing/nonreducing sugar.

9. Extraction of DNA from onion/ cauliflower

10. To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient

of an aspirin tablet by TLC.

**Recommended Texts:**

1. Furniss, B.S.; Hannaford, A.J.; Rogers, V.; Smith, P.W.G.; Tatchell, A.R. *Vogel’s*

*Textbook of Practical Organic Chemistry*, ELBS.

2. Ahluwalia, V.K. & Aggarwal, R. *Comprehensive Practical Organic Chemistry,*

Universities Press.

**B.Sc. BIOLOGY II SEMESTER**

**Ability Enhancement Compulsory Course**

**Paper IV (Code: NHU-122)**

**Environmental Science**

**(Credits: Theory-2)**

**Unit I:** Introduction to environmental studies

• Multidisciplinary nature of environmental studies; components of environment –atmosphere, hydrosphere, lithosphere and biosphere.

• Scope and importance; Concept of sustainability and sustainable development.

**Unit II**: **Ecosystems**

• What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems:

a) Forest ecosystem

b) Grassland ecosystem

c) Desert ecosystem

d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

**Unit III: Natural Resources: Renewable and Non-renewable Resources**

• Land Resources and land use change; Land degradation, soil erosion and desertification.

• Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.

• Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).

• Heating of earth and circulation of air; air mass formation and precipitation.

• Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

**Unit IV: Biodiversity and Conservation**

• Levels of biological diversity :genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hotspots

• India as a mega-biodiversity nation; Endangered and endemic species of India

• Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

• Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

**Unit V: Environmental Pollution**

• Environmental pollution : types, causes, effects and controls; Air, water, soil, chemical and noise pollution

• Nuclear hazards and human health risks

• Solid waste management: Control measures of urban and industrial waste..

• Pollution case studies.

**Unit VI: Environmental Policies & Practices**

• Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture.

• Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC).

• Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context

**Unit VII: Human Communities and the Environment**

• Human population and growth: Impacts on environment, human health and welfares.

• Carbon foot-print.

• Resettlement and rehabilitation of project affected persons; case studies.

• Disaster management: floods, earthquakes, cyclones and landslides.

• Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan.

• Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.

• Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

**Unit VIII: Field work**

• Visit to an area to document environmental assets; river/forest/flora/fauna, etc.

• Visit to a local polluted site – Urban/Rural/Industrial/Agricultural.

• Study of common plants, insects, birds and basic principles of identification.

• Study of simple ecosystems-pond, river, Delhi Ridge, etc.

**Suggested Readings:**

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.

2. Gadgil, M., & Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.

3. Gleeson,B. and Low, N. (eds.) 1999. Global Ethics and Environment, London, Routledge.

4. Gleick, P.H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.

5. Groom, Martha J. Gary K. Meffe, and Carl Ronald carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.

6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India’s Himalaya dams. Science, 339: 36-37.

7. McCully, P.1996. Rivers no more: the environmental effects of dams(pp. 29-64). Zed Books.

8. McNeil, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.

9. Odum, E.P., Odum, h.T. & Andrews, J.1971. Fundamentals of Ecology. Philadelphia: Saunders.

10. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.

11. Rao, M.N. & Datta, A.K. 1987. Waste Water Treatement. Oxford and IBH Publishing Co. Pvt. Ltd.

12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons.

13. Rosencranz, A., Divan, S., & Noble, M.L. 2001. Environmental law and policy in India. Tripathi 1992.

14. Sengupta, R. 2003.Ecology and economics: An approach to sustainable development. OUP.

15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.

16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.

17. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.

18. Warren, C.E. 1971. Biology and Water Pollution Control. WB Saunders.

19. Wilson, E.O. 2006. The Creation: An appeal to save life on earth. New York: Norton.

20.World Commission on environment and Development. 1987. Our Common Future. Oxford University Press.

**IIMT UNIVERSITY, MEERUT**

**STUDY & EVALUATION SCHEME**

**B. Sc. BIOLOGY II YEAR III Semester**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Type** | **Course Code** | **Subject** | **Study Scheme** | **Credit** | **Evaluation Scheme** |
| **L** | **T** | **P** |  | **Internal** | **External** | **Total** |
| 1. | CBot-3 Theory | BSBC-231 | Anatomy and Embryology of Angiosperm  | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| 2. |  CZoo-3 Theory | BSZC-232 | Physiology and Biochemistry | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| 3. | CChem-1 Theory | BSCC-233 | Conceptual Organic Chemistry | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| 4. | SEC-1 Theory | BSSEC-234 | Biofertilizers | 2 | 0 | 0 | 2 | 30 | 70 | 100 |
| 5. | USEC | NECC-231 | Industrial Visit/ Seminar/Presentation the report of visit | 0 | 0 | 0 | 0 | 25 | 0 | NC |
| 6. | USEC | NECC-232 | University Social Responsibility | 0 | 0 | 0 | 0 | 25 | 0 | NC |
| 7. | USEC | NECC-233 | Spoken Tutorial Certification | 1 | 0 | 0 | 1 | 25 | 0 | 25 |
| 8. | USEC | NECC-234 | MOOCs/ SWAYAM | 1 | 0 | 0 | 1 | 25 | 0 | 25 |
| **PRACTICALS** |
| 9. | CBot-3 Lab | BSBC-231P | Anatomy and Embryology of Angiosperm Lab  | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
| 10. | CZoo-3 Lab | BSZC-232P | Physiology and Biochemistry Lab  | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
| 11. | CChem-1 Lab | BSCC-233P | Conceptual Organic Chemistry Lab | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
|  |  |  | **TOTAL** | **16** |  | **6** | **22** | **230** | **370** | **600** |
|  |
| 12. | USEC | SPT-231 | Sports | 0 | 0 | 0 | 0 | 50 | 0 | NC |

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| **L= Lecture**  |  |  |  |  |  |  |  |  |  |  |
| **T= Tutorial**  |  |  |  |  |  |  |  |  |  |  |
| **P= Practical** |  |  |  |  |  |  |  |  |  |  |

**B.Sc. BIOLOGY III SEMESTER**

**Core Course: Botany**

**Paper I (Code: BSBC-231)**

**Plant Anatomy and Embryology**

 **(Credits: Theory-4, Practicals-2)**

**Unit 1: Meristematic and permanent tissues (8 Lectures)**

Root and shoot apical meristems; Simple and complex tissues.

**Unit 2: Organs (4 Lectures)**

Structure of dicot and monocot root stem and leaf.

**Unit 3: Secondary Growth (8 Lectures)**

Vascular cambium – structure and function, seasonal activity. Secondary growth in root and

stem, Wood (heartwood and sapwood).

**Unit 4: Adaptive and protective systems (8 Lectures)**

Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

**Unit 5: Structural organization of flower (8 Lectures)**

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs,

organization and ultrastructure of mature embryo sac.

**Unit 6: Pollination and fertilization (8 Lectures)**

Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and

dispersal mechanisms.

**Unit 7: Embryo and endosperm (8 Lectures)**

Endosperm types, structure and functions; Dicot and monocot embryo; Embryoendosperm

relationship.

**Unit 8: Apomixis and polyembryony** (**8 Lectures)**

Definition, types and practical applications.

**Plant Anatomy and Embryology Lab (Code: BSBC-231P)**

1. Study of meristems through permanent slides and photographs.

2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)

3. Stem: Monocot: *Zea mays;* Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).

4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).

5. Leaf: Dicot and Monocot leaf (only Permanent slides).

6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).

7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).

8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.

9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).

10. Ultrastructure of mature egg apparatus cells through electron micrographs.

11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).

12. Dissection of embryo/endosperm from developing seeds.

13. Calculation of percentage of germinated pollen in a given medium.

**Suggested Readings**

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.

2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

**B.Sc. BIOLOGY III SEMESTER**

**Core Course: Zoology**

**Paper II (Code: BSZC-232)**

**Physiology and Biochemistry**

 **(Credits: Theory-4, Practicals-2)**

**Unit 1: Nerve and muscle 8 Lectures**

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 2: Digestion 5 Lectures**

Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids

**Unit 3: Respiration 5 Lectures**

Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon

dioxide in blood.

**Unit 4: Excretion 5 Lectures**

Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism

**Unit 5: Cardiovascular system 6 Lectures**

Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac

impulse, Cardiac cycle

**Unit 6: Reproduction and Endocrine Glands 7 Lectures**

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 7: Carbohydrate Metabolism 8 Lectures**

Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain

**Unit 8: Lipid Metabolism 5 Lectures**

Biosynthesis and β oxidation of palmitic acid

**Unit 9: Protein metabolism 5 Lectures**

Transamination, Deamination and Urea Cycle

**Unit 10: Enzymes 6 Lectures**

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

**PHYSIOLOGY AND BIOCHEMISTRY LAB (Code: BSZC-233)**

**(CREDITS 2)**

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 in given solutions (Glucose,

Fructose, Sucrose, Lactose)

5. Estimation of total protein in given solutions by Lowry’s method.

6. Study of activity of salivary amylase under optimum conditions

**SUGGESTED READINGS**

1. Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, XII

Edition, John Wiley & Sons, Inc.

1. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) *Vander’s Human Physiology*, XI

Edition., McGraw Hill

1. Guyton, A.C. and Hall, J.E. (2011). T*extbook of Medical Physiology*, XII Edition,

Harcourt Asia Pvt. Ltd/ W.B. Saunders Company

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). *Biochemistry*. VI Edition. W.H

Freeman and Co.

1. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). *Principles of Biochemistry*. IV

Edition. W.H. Freeman and Co.

1. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009).
2. *Harper’s Illustrated Biochemistry*. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.

**B.Sc. BIOLOGY III SEMESTER**

**Core Course: Chemistry**

**Paper III (Code: BSCC-233)**

**CHEMICAL BONDING, TRANSITION METAL & COORDINATION CHEMISTRY (Credits: Theory-4, Practicals-2)**

**THEORY Lectures: 60**

**Unit 1: The covalent bond and the structure of molecules (10 Lectures)**

Valence bond approach, Concept of resonance in various organic and inorganic compounds,

Hybridization and structure, equivalent and non-equivalent hybrid orbitals, Bent’s rule and its

applications, VSEPR model for predicting shapes of molecules and ions containing lone pairs,

sigma and pi bonds.

**Unit 2: Molecular Orbital Approach (10 Lectures)**

LCAO method, symmetry and overlap for s-s ,s-p and p-p combinations, MO treatment of

homonuclear diatomic molecules of 2nd period (B2, C2 ,N2, O2 , F2 ) and heteronuclear di-atomic molecules (CO, NO) and their ions.

**Unit 3: Intermolecular forces: (8 Lectures)**

van der Waals forces, Hydrogen bonding and its applications, effects of these forces on melting

point, boiling point and solubility.

**Unit 4: Transition Elements (3*d* series) (12 Lectures)**

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).

**Unit 5: Coordination Chemistry (10 Lectures)**

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.

Coordination compounds in biological systems: Fe, Cu, Co, Mn, Ni, Zn and heavy metal ions.

**Unit 6: Crystal Field Theory (10 Lectures)**

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.

**Suggested Texts:**

1. James E. Huheey, *“Inorganic Chemistry: Principles of structure and reactivity”*,

Prentice Hall, IV Edition.

2. D. S. Shriver and P.A. Atkins, *“Inorganic Chemistry”*, Oxford University Press, IV

Edition.

3. Alan G. Sharpe, “*Inorganic Chemistry”*, University of Cambridge, III Edition.

4. J. D. Lee, *“A New Concise Inorganic Chemistry”*, ELBS IV Edition

5. Grey L. Miessler and Donald A. Tarr, *“Inorganic Chemistry”*, Prentice Hall, III Edition.

6. B. Douglas, D. H. McDaniel and J. J. Alexander, *“Concepts and Models of Inorganic*

*Chemistry”, John Wiley and Sons, III Edition.*

7. Rodgers, G.E. *Inorganic & Solid State Chemistry,* Cengage Learning India Ltd., 2008.

**B.Sc. BIOLOGY III SEMESTER**

**Skill Enhancement Courses**

**Paper IV (Code: BSSEC-234)**

**BIOFERTILIZERS**

**(Credits: Theory-2)**

**Lectures: 30**

**Unit 1: (4 Lectures)**

General account about the microbes used as biofertilizer – Rhizobium – isolation,

identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.

**Unit 2: (8 Lectures)**

*Azospirillum:* isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. *Azotobacter*: classification, characteristics – crop

response to *Azotobacter* inoculum, maintenance and mass multiplication.

**Unit 3: (4 Lectures)**

Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation.

**Unit 4: (8 Lectures)**

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation

and inoculum production of VAM, and its influence on growth and yield of crop plants.

**Unit 5: (6 Lectures)**

Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods,

types and method of vermicomposting – field Application.

**Suggested Readings**

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.

2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.

3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, NewDelhi.

4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.

5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.

6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

**IIMT UNIVERSITY, MEERUT**

**STUDY & EVALUATION SCHEME**

**B. Sc. BIOLOGY II YEAR, IV Semester**

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| **S. No.** | **Course Type** | **Course Code** | **Subject** | **Study Scheme** | **Credit** | **Evaluation Scheme** |
| **L** | **T** | **P** |  | **Internal** | **External** | **Total** |
| 1. | CBot-4 Theory | BSBC-241 | Plant Physiology and Metabolism  | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| 2. | CZoo-4 Theory | BSZC-242 | Genetics and Evolutionary Biology  | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| 3. | CChem-4 Theory | BSCC-243 | Physical Chemistry for the Biosciences | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| 4. | SEC-2 Theory | BSSEC-244 | Herbal Technology | 2 | 0 | 0 | 2 | 30 | 70 | 100 |
| 5. | USEC | NECC-241 | Industrial Visit/ Seminar/Presentation the report of visit | 0 | 0 | 0 | 0 | 25 | 0 | NC |
| 6. | USEC | NECC-242 | University Social Responsibility | 0 | 0 | 0 | 0 | 25 | 0 | NC |
| 7. | USEC | NECC-243 | Spoken Tutorial Certification | 1 | 0 | 0 | 1 | 25 | 0 | 25 |
| 8. | USEC | NECC-244 | MOOCs/ SWAYAM | 1 | 0 | 0 | 1 | 25 | 0 | 25 |
| **PRACTICALS** |
| 9. | CBot-4 Lab | BSBC-241P | Plant Physiology and Metabolism Lab  | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
| 10. | CZoo-4 Lab | BSZC-242P | Genetics and Evolutionary Biology Lab  | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
| 11. | CChem-4 Lab | BSCC-243P | Physical Chemistry for the Biosciences Lab | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
|  |  |  | **TOTAL** | **16** |  | **6** | **22** | **230** | **370** | **600** |
|  |
| 12 | USEC | SPT-241 | Sports | 0 | 0 | 0 | 0 | 50 | 0 | NC |

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| **L= Lecture**  |  |  |  |  |  |  |  |  |  |  |
| **T= Tutorial**  |  |  |  |  |  |  |  |  |  |  |
| **P= Practical** |  |  |  |  |  |  |  |  |  |  |

**B.Sc. BIOLOGY IV SEMESTER**

**Core Course: Botany**

**Paper I (Code: BSBC-241)**

**Plant Physiology and Metabolism**

 **(Credits: Theory-4, Practicals-2)**

**Unit 1: Plant-water relations (8 Lectures)**

Importance of water, water potential and its components; Transpiration and its significance;

Factors affecting transpiration; Root pressure and guttation.

**Unit 2: Mineral nutrition (8 Lectures)**

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.

**Unit 3: Translocation in phloem (6 Lectures)**

Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

**Unit 4: Photosynthesis (12 Lectures)**

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction

center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and

CAM pathways of carbon fixation; Photorespiration.

**Unit 5: Respiration (6 Lectures)**

Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate,

Oxidative Pentose Phosphate Pathway.

**Unit 6: Enzymes (4 Lectures)**

Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

**Unit 7: Nitrogen metabolism (4 Lectures)**

Biological nitrogen fixation; Nitrate and ammonia assimilation.

**Unit 8: Plant growth regulators (6 Lectures)**

Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

**Unit 9: Plant response to light and temperature (6 Lectures)**

Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red

and far red light responses on photomorphogenesis; Vernalization.

**Plant Physiology and Metabolism Lab (Code: BSBC-241P)**

1. Determination of osmotic potential of plant cell sap by plasmolytic method.

2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.

3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.

4. Demonstration of Hill reaction.

5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.

6. To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.

7. Comparison of the rate of respiration in any two parts of a plant.

8. Separation of amino acids by paper chromatography.

**Demonstration experiments (any four)**

1. Bolting.

2. Effect of auxins on rooting.

3. Suction due to transpiration.

4. R.Q.

5. Respiration in roots.

**Suggested Readings**

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.

2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.

3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

**B.Sc. BIOLOGY IV SEMESTER**

**Core Course: Zoology**

**Paper II (Code: BSZC-242)**

**Genetics and Evolutionary Biology**

**(Credits: Theory-4, Practicals-2)**

**Unit 1: Introduction to Genetics 3 Lectures**

Mendel’s work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information.

**Unit 2: Mendelian Genetics and its Extension 8 Lectures**

Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and codominance,

Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance.

**Unit 3: Linkage, Crossing Over and Chromosomal Mapping 9 Lectures**

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.

**Unit 4: Mutations 7 Lectures**

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and

Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor

Mutations.

**Unit 5: Sex Determination 4 Lectures**

Chromosomal mechanisms, dosage compensation

**Unit 6: History of Life 2 Lectures**

Major Events in History of Life

**Unit 7: Introduction to Evolutionary Theories 5 Lectures**

Lamarckism, Darwinism, Neo-Darwinism

**Unit 8: Direct Evidences of Evolution 5 Lectures**

Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse

**Unit 9: Processes of Evolutionary Change 9 Lectures**

Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism);

Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

**Unit 10: Species Concept 6 Lectures**

Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric,

Sympatric)

**Unit 11: Macro-evolution 5 Lectures**

Macro-evolutionary Principles (example: Darwin’s Finches)

**Unit 12: Extinction 6 Lectures**

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

extinction in evolution

**GENETICS AND EVOLUTIONARY BIOLOGY LAB (Code: BSZC-242P)**

**(CREDITS 2)**

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

**SUGGESTED READINGS**

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings.
4. Russell, P. J. (2009). *Genetics- A Molecular Approach.* III Edition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.
6. Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
7. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
8. Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers
9. Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.
10. Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.

**B.Sc. BIOLOGY IV SEMESTER**

**Core Course: Chemistry**

**Paper III (Code: BSCC-243)**

**Physical Chemistry for the Biosciences**

 **(Credits: Theory-4, Practicals-2)**

**Unit 1: Chemical Energetics (10 Lectures)**

Review of the Laws of Thermodynamics.

Important principles and definitions of thermochemistry. Concept of standard state and standard

enthalpies of formation, integral and differential enthalpies of solution and dilution. Calculation

of bond energy, bond dissociation energy and resonance energy from thermochemical data.

Variation of enthalpy of a reaction with temperature – Kirchhoff’s equation.

Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

**Unit 2: Chemical Equilibrium (8 Lectures)**

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical

equilibrium. Distinction between Δ*G* and Δ*G*o, Le Chatelier’s principle. Relationships between

*Kp, Kc* and *Kx* for reactions involving ideal gases.

**Unit 3: Ionic Equilibria (12 Lectures)**

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. Solubility and solubility product of

sparingly soluble salts – applications of solubility product principle.

**Unit 4: Chemical Kinetics (8 Lectures)**

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 and first order reactions. Half–life of a reaction. General methods for determination of

order of a reaction. Concept of activation energy and its calculation from Arrhenius equation.

Enzyme kinetics.

**Unit 5: Spectroscopy (16 Lectures)**

Introduction to spectroscopy: Electromagnetic radiation, fundamental definitions,

electromagnetic spectrum, introduction to concepts of absorption and emission spectroscopy,

Beer-Lambert law.

IR Spectroscopy: Fundamental and non-fundamental molecular vibrations, IR spectrum,

fingerprint and group frequency regions and their significance, Hooke’s law and vibrational

frequency. Factors affecting vibrational frequency.

Characterization of functional groups: alkanes, alkenes, alkynes (only alicyclic systems),

aldehydes, ketones, carboxylic acids and their derivatives, hydroxy compounds and amines.

Study of hydrogen bonding.

Electronic Spectroscopy: Electronic transitions, singlet and triplet states, dissociation and

predissociation.

UV spectroscopy: Types of electronic transitions, UV spectrum, λmax, εmax, chromophores,

auxochromes, bathochromic shift, hypsochromic shift (definitions and elementary examples)

and solvent effect. Characteristic UV transitions in common functional groups.

General applications of UV spectroscopy including distinction between cis-trans isomers.

Woodward rules for calculating λmax in the following systems:

* Conjugated dienes: alicyclic, homoannular, heteroannular.
* α,β-Unsaturated aldehydes and ketones.
* Extended conjugated systems: dienes, aldehydes and ketones.

PMR spectroscopy: Basic principles of NMR spectroscopy, PMR scale, chemical shifts

(concept of shielding and deshielding), factors influencing chemical shifts, simple spin-spin

couplings, coupling constant, chemical shift equivalence, anisotropic effects in alkenes,

alkynes, aldehydes and aromatics. Interpretation of PMR spectra of simple compounds.

Application of UV, IR and PMR in solving structures of simple molecules.

**Unit 6: Photochemistry (6 Lectures)**

Laws of photochemistry. Fluorescence and phosphorescence. Quantum efficiency and reasons

for high and low quantum yields. Primary and secondary processes in photochemical reactions.

Photochemical and thermal reactions.

**Recommended Texts:**

1. Atkins, P. W. & Paula, J. de *Atkin’s Physical Chemistry 9*th Ed., Oxford University

Press (2011).

2. Ball, D. W. *Physical Chemistry* Thomson Press, India (2007).

3. Castellan, G. W. *Physical Chemistry* 4th Ed. Narosa (2004).

4. Mortimer, R. G. *Physical Chemistry* 3rd Ed. Elsevier: NOIDA, UP (2009).

5. Chang, R. *Physical Chemistry for the Biosciences.* University Science Books (2005).

**Physical Chemistry for the Biosciences Lab (Code: BSCC-243P )**

**PRACTICAL-4**

**(I) Thermochemistry**

1. Determination of heat capacity of a calorimeter for different volumes.

2. Determination of the enthalpy of neutralization of hydrochloric acid with sodium

hydroxide.

3. Determination of integral enthalpy of solution of salts (endothermic and exothermic).

**(II) pH-metric and potentiometric measurements**

4. Preparation of sodium acetate-acetic acid buffer solutions and measurement of their pH.

5. Potentiometric titrations of (i) strong acid *vs* strong base (ii) weak acid *vs* strong

base

6. Determination of dissociation constant of a weak acid.

**(III) Study the kinetics of the following reactions:**

7. Initial rate method: Iodide-persulphate reaction

8. Integrated rate method:

a. Acid hydrolysis of methyl acetate with hydrochloric acid.

b. Saponification of ethyl acetate

**(IV) Colourimetry**

9. Verification of Lambert-Beer's Law for potassium dichromate/ potassium permanganate

solution.

10. Determination of pK (indicator) for phenolphthalein.

11. Study the kinetics of interaction of crystal violet with sodium hydroxide colourimetrically.

**Recommended Texts:**

1. Khosla, B.D.; Garg, V.C.; Gulati, A. & Chand, R. *Senior Practical Physical Chemistry*,

New Delhi.

**B.Sc. BIOLOGY IV SEMESTER**

**Skill Enhancement Courses**

**Paper IV (Code: BSSEC-244)**

**Herbal Technology**

 **(Credits: Theory-2)**

**Lectures: 30**

**Unit 1: (6 Lectures)**

Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants.

**Unit 2: (6Lectures)**

Pharmacognosy - systematic position m edicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.

**Unit 3: (6 Lectures)**

Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella* *asiatica* (memory booster).

**Unit 4: (8 Lectures)**

Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation -

Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds)

**Unit 5: (4 Lectures)**

Medicinal plant banks micro propagation of important species (*Withania somnifera*, neem and tulsi- Herbal foods-future of pharmacognosy)

**Suggested Readings**

1. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956.

C.S.I.R, New Delhi.

2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984.

International Book Distributors.

3. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.

4. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994.

Oxford IBH publishing Co.

5. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.

6. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.

7. Pharmacognosy, Dr.C.K.Kokate et al. 1999. Nirali Prakashan.

**IIMT UNIVERSITY, MEERUT**

**STUDY & EVALUATION SCHEME**

**B. Sc. BIOLOGY III YEAR, V Semester**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Type** | **Course Code** | **Subject** | **Study Scheme** | **Credit** | **Evaluation Scheme** |
| **L** | **T** | **P** |  | **Internal** | **External** | **Total** |
| 1. | DSEBot-1 Theory | BSBDS-351 | Cell And Molecular Biology  | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| BSBDS-351a | Research Methodology |
| 2. | DSEZoo-1 Theory | BSZDS-352 | Applied Zoology | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| BSZDS-352a | Insect Vector & Disease |
| 3. | DSEChem-1 Theory | BSCDS-353 | Analytical Methods in Chemistry | 4 | 0 | 0 | 4 | 30 | 70 | 100 |
| BSCDS-353a | Green Chemistry |
| 4. | SEC-3 | BSSEC-354 | Public Health and Hygiene | 2 | 0 | 0 | 2 | 30 | 70 | 100 |
| 5. | USEC | NECC-351 | Industrial Visit/ Seminar/Presentation the report of visit | 0 | 0 | 0 | 0 | 25 | 0 | NC |
| 6. | USEC | NECC-352 | University Social Responsibility | 0 | 0 | 0 | 0 | 25 | 0 | NC |
| 7. | USEC | NECC-353 | Spoken Tutorial Certification | 1 | 0 | 0 | 1 | 25 | 0 | 25 |
| 8. | USEC | NECC-354 | MOOCs/ SWAYAM | 1 | 0 | 0 | 1 | 25 | 0 | 25 |
| **PRACTICALS** |
| 9. | DSEBot-1 Lab | BSBDE-351P | Cell And Molecular Biology Lab  | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
| BSBDE-351aP | Research Methodology Lab |
| 10. | DSEZoo-1 Lab | BSZDE-352P | Applied Zoology Lab | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
| BSZDE-352aP | Insect Vector & disease Lab |
| 11. | DSEChem-1 Lab | BSCDS-353P | Analytical Methods in Chemistry Lab | 0 | 0 | 2 | 2 | 20 | 30 | 50 |
| BSCDS-353aP | Green Chemistry Lab |
|  |  |  | **TOTAL** | **16** |  | **6** | **22** | **230** | **370** | **600** |
|  |
| 12. | USEC | SPT-351 | Sports | 0 | 0 | 0 | 0 | 50 | 0 | NC |

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**B.Sc. BIOLOGY V SEMESTER**

**Discipline Specific Elective Course**

**Paper I (Code: BSBDS-351)**

**CELL AND MOLECULAR BIOLOGY**

 **(Credits: Theory-4, Practicals-2)**

**Lectures: 60**

**Unit 1: Techniques in Biology** **(8 Lectures)**

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 2: Cell as a unit of Life** **(2 Lectures)**

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell

components.

**Unit 3: Cell Organelles** **(20 Lectures)**

Mitochondria: Structure, marker enzymes, composition; Semiautonomous nature; Symbiont

hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA.

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 4: Cell Membrane and Cell Wall** **(6 Lectures)**

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.

**Unit 5:** Cell Cycle, Overview of Cell cycle, Mitosis and Meiosis; Molecular controls.

**(6 Lectures)**

**Unit 6: Genetic material** **(6 Lectures)**

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, Ǿ (theta) mode of replication, replication of linear, ds-DNA,

replicating the 5 ́end of linear chromosome including replication enzymes.

**Unit 7:** Transcription (Prokaryotes and Eukaryotes) **(6 Lectures)**

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

**Unit 8: Regulation of gene expression** **(6 Lectures)**

Prokaryotes:Lac operon and Tryptophan operon ; and in Eukaryotes.

**CELL AND MOLECULAR BIOLOGY LAB (Code: BSBDS-351P)**

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.

10. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.

11. Measure the cell size (either length or breadth/diameter) by micrometry.

12. Study the structure of nuclear pore complex by photograph (from Gerald Karp)Study of special chromosomes (polytene & lampbrush) either by slides or photographs.

13. Study DNA packaging by micrographs.

14. Preparation of the karyotype and ideogram from given photograph of somatic metaphase

chromosome.

**Suggested Readings**

**1.** Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition.

John Wiley & Sons. Inc.

**2.** De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th

edition. Lippincott Williams and Wilkins, Philadelphia.

3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition.

ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the

Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

**B.Sc. BIOLOGY V SEMESTER**

**Discipline Specific Elective Course**

**Paper I (Code: BSBDS-351a)**

**RESEARCH METHODOLOGY**

 **(Credits: Theory-4, Practicals-2)**

**Lectures: 60**

**Unit 1:** **Basic concepts of research (10 Lectures)**

Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs emperical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.

 **Unit 2: General laboratory practices (12 Lectures)**

 Common calculations in botany laboratories. Understanding the details on the label of reagent bottles. Molarity and normality of common acids and bases. Preparation of solutions. Dilutions. Percentage solutions. Molar, molal and normal solutions. Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling.

**Unit 3: Data collection and documentation of observations (6 Lectures)**

Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissuespecimens and application of scale bars. The art of field photography.

**Unit 4: Overview of Biological Problems (6 Lectures)**

History; Key biology research areas, Model organisms in biology (A Brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, ProteomicsTranscriptional regulatory network. **Unit 5: Methods to study plant cell/tissue structure (6 Lectures)**

Whole mounts, peel mounts, squash preparations, clearing, maceration and sectioning; Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, non-coagulant fixatives; tissue dehydration using graded solvent series; Paraffin and plastic infiltration; Preparation of thin and ultrathin sections.

**Unit 6: Plant microtechniques (12 Lectures)**

Staining procedures, classification and chemistry of stains. Staining equipment. Reactive dyes and fluorochromes (including genetically engineered protein labeling with GFP and other tags). 32 Cytogenetic techniques with squashed plant materials.

**Unit 7: The art of scientific writing and its presentation (8 Lectures)**

Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Powerpoint presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

**Practical**

1. Experiments based on chemical calculations.

2. Plant microtechnique experiments.

3. The art of imaging of samples through microphotography and field photography.

4. Poster presentation on defined topics.

 5. Technical writing on topics assigned.

**Suggested Readings**

1. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.

2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.

 3. Ruzin, S.E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

**B.Sc. BIOLOGY V SEMESTER**

**Discipline Specific Elective Course**

**Paper II (Code: BSZDS-352)**

**APPLIED ZOOLOGY**

 **(Credits: Theory-4, Practicals-2)**

**Unit 1: Introduction to Host-parasite Relationship 3 Lectures**

Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis

**Unit 2: Epidemiology of Diseases 7 Lectures**

Transmission, Prevention and control of diseases: Tuberculosis, typhoid

**Unit 3: Rickettsiae and Spirochaetes 6 Lectures**

Brief account of *Rickettsia prowazekii, Borrelia recurrentis* and *Treponema pallidum*

**Unit 4: Parasitic Protozoa 8 Lectures**

Life history and pathogenicity of *Entamoeba histolytica, Plasmodium vivax* and *Trypanosoma gambiense*

**Unit 5: Parasitic Helminthes 5 Lectures**

Life history and pathogenicity of *Ancylostoma duodenale* and *Wuchereria bancrofti*

**Unit 6: Insects of Economic Importance 8 Lectures**

Biology, Control and damage caused by *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio demoleus, Callosobruchus chinensis, Sitophilus oryzae* and *Tribolium castaneum*

**Unit 7: Insects of Medical Importance 8 Lectures**

Medical importance and control of *Pediculus humanus corporis*, *Anopheles, Culex, Aedes,*

*Xenopsylla cheopis*

**Unit 8: Animal Husbandry 5 Lectures**

Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle

**Unit 9: Poultry Farming 5 Lectures**

Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs

**Unit 10: Fish Technology 5 Lectures**

Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed

**APPLIED ZOOLOGY LAB (Code: BSZDS-352P)**

**(CREDITS 2)**

1. Study of *Plasmodium vivax*, *Entamoeba histolytica, Trypanosoma gambiense, Ancylostoma duodenale* and *Wuchereria bancrofti* and their life stages throughpermanent 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*, *Papilio demoleus*, *Pyrilla perpusilla, Callosobruchus chinensis, Sitophilus oryzae* and *Tribolium castaneum*

5. Visit to poultry farm or animal breeding centre. Submission of visit report

6. Maintenance of freshwater aquarium

**SUGGESTED READINGS**

* Park, K. (2007). *Preventive and Social Medicine*. XVI Edition. B.B Publishers.
* Arora, D. R and Arora, B. (2001). *Medical Parasitology*. II Edition. CBS Publications

and Distributors.

* Kumar and Corton. *Pathological Basis of Diseases*.
* Atwal, A.S. (1986). *Agricultural Pests of India and South East Asia*, Kalyani Publishers.
* Dennis, H. (2009). *Agricultural Entomology.* Timber Press (OR).
* Hafez, E. S. E. (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
* Dunham R.A. (2004). *Aquaculture and Fisheries Biotechnology Genetic Approache*s.

CABI publications, U.K.

* Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.

**B.Sc. BIOLOGY V SEMESTER**

**Discipline Specific Elective Course**

**Paper II (Code: BSZDS-352a)**

**INSECT VECTOR AND DISEASE**

 **(Credits: Theory-4, Practicals-2)**

**Unit I: Introduction to Insects (6 Lectures)**

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

**Unit II: Concept of Vectors 6 Lectures**

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

**Unit III: Insects as Vectors 8** **Lectures**

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

**Unit IV: Dipteran as Disease Vectors 24 Lectures**

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 IV: Siphonaptera as Disease Vectors 6 Lectures**

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

**Unit V: Siphunculata as Disease Vectors 4 Lectures**

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 VI: Hempitera as Disease Vectors 6 Lectures**

Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures

**INSECT VECTOR AND DISEASE LAB (BSZDS-352aP)**

**PRACTICALS (CREDITS 2)**

1. Study of different kinds of mouth parts of insects

2. Study of following insect vectors through permanent slides/ photographs: Aedes, Culex, Anopheles, Pediculus humanus capitis, Pediculus humanus corporis, Phithirus pubis, Xenopsylla cheopis, Cimex lectularius, Phlebotomus argentipes, Musca domestica, through permanent slides/ photographs

3. Study of different diseases transmitted by above insect vectors Submission of a project report on any one of the insect vectors and disease transmitted

**SUGGESTED READINGS**

1. Imms, A.D. (1977). A General Text Book of Entomology.

2. Chapman & Hall, UK Chapman, R.F. (1998). The Insects: Structure and Function. IV Edition, Cambridge University Press, UK

3. Pedigo L.P. (2002). Entomology and Pest Management. Prentice Hall Publication

4. Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell

**B.Sc. BIOLOGY V SEMESTER**

**Discipline Specific Elective Course**

**Paper III (Code: BSCDS-353)**

**ANALYTICAL METHODS IN CHEMISTRY**

**(Credits: Theory-4, Practicals-2)**

**Theory: 60 Lectures**

**UNIT 1 (5 Lectures)**

**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.

**UNIT 2**

**Optical methods of analysis: (25 Lectures)**

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.

*Infrared Spectrometry:* Basic principles of instrumentation (choice of source, monochromator

& 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 3 (5 Lectures)**

**Thermal methods of analysis:**

Theory of thermogravimetry (TG), basic principle of instrumentation.

Techniques for quantitative estimation of Ca and Mg from their mixture.

**UNIT 4 (10 Lectures)**

**Electroanalytical methods:**

Classification of electroanalytical methods, basic principle of pH metric, potentiometric and

conductometric titrations. Techniques used for the determination of equivalence points.

Techniques used for the determination of pKa values.

**UNIT 5 (15 Lectures)**

**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 nonaqueous 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.

Stereoisomeric separation and analysis: Measurement of optical rotation, calculation of

Enantiomeric excess (ee)/ diastereomeric excess (de) ratios and determination of enantiomeric

composition using NMR, Chiral solvents and chiral shift reagents. Chiral chromatographic

techniques using chiral columns (GC and HPLC).

Role of computers in instrumental methods of analysis.

**Reference Books:**

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel’s Textbook of*

*Quantitative Chemical Analysis*, John Wiley & Sons, 1989.

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*,

7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

1. Christian, G.D; *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004.
2. Harris, D. C. *Exploring Chemical Analysis*, Ed. New York, W.H. Freeman, 2001.
3. Khopkar, S.M. *Basic Concepts of Analytical Chemistry*. New Age, International

Publisher, 2009.

1. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage

Learning India Ed.

1. Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles

Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.

1. Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.

**ANALYTICAL METHODS IN CHEMISTRY LAB (Code: BSCDS-353P)**

**60 Lectures**

**I. Separation Techniques**

1. Chromatography:

(a) Separation of mixtures

(i) Paper chromatographic separation of Fe3+, Al3+, and Cr3+.

(ii) Separation and identification of the monosaccharides present in the given mixture (glucose

& fructose) by paper chromatography. Reporting the Rf values.

(b) Separate a mixture of Sudan yellow and Sudan Red by TLC technique and identify them on

the basis of their Rf values.

(c) Chromatographic separation of the active ingredients of plants, flowers and juices by TLC

**II. Solvent Extractions:**

(i) To separate a mixture of Ni2+ & Fe2+ by complexation with DMG and extracting the Ni2+-

DMG complex in chloroform, and determine its concentration by spectrophotometry.

(ii) Solvent extraction of zisconium with amberliti LA-1, separation from a mixture of irons and

gallium.

3. Determine the pH of the given aerated drinks fruit juices, shampoos and soaps.

4. Determination of Na, Ca, Li in cola drinks and fruit juices using flame photometric

techniques.

5. Analysis of soil:

(i) Determination of pH of soil.

(ii) Total soluble salt

(iii) Estimation of calcium, magnesium, phosphate, nitrate

6. 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.

**III Spectrophotometr**y

1. Determination of pKa values of indicator using spectrophotometry.

2 Structural characterization of compounds by infrared spectroscopy.

3 Determination of dissolved oxygen in water.

4 Determination of chemical oxygen demand (COD).

5 Determination of Biological oxygen demand (BOD).

6 Determine the composition of the ferric-salicylate/ ferric-thiocyanate complex by Job’s

method.

**Reference Books:**

1. Jeffery, G.H., Bassett, J., Mendham, J. & Denney, R.C. *Vogel’s Textbook of*

*Quantitative Chemical Analysis*, John Wiley & Sons, 1989.

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*,

7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA, 1988.

1. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
2. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
3. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International

Publisher, 2009.

1. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage

Learning India Ed.

1. Mikes, O. *Laboratory Hand Book of Chromatographic & Allied Methods*, Elles
2. Harwood Series on Analytical Chemistry, John Wiley & Sons, 1979.
3. Ditts, R.V. *Analytical Chemistry; Methods of Separation*, van Nostrand, 1974.

**B.Sc. BIOLOGY V SEMESTER**

**Discipline Specific Elective Course**

**Paper III (Code: BSCDS-352a)**

**GREEN CHEMISTSTRY**

**(Credits: Theory-4, Practicals-2)**

**Introduction to Green Chemistry**

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/ Obstacles in the pursuit of the goals of Green Chemistry**. (4 Lectures)**

 **Principles of Green Chemistry and Designing a Chemical synthesis**

Twelve principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products (Atom Economy); prevention/ minimization of hazardous/ toxic products; designing safer chemicals – different basic approaches to do so; selection of appropriate auxiliary substances (solvents, separation agents), green solvents, solventless processes, immobilized solvents and ionic liquids; energy requirements for reactions - use of microwaves, ultrasonic energy; selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups; use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; designing of biodegradable products; prevention of chemical accidents; strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. **(24 Lectures)**

**Examples of Green Synthesis/ Reactions**

1. Green Synthesis of the following compounds: adipic acid, catechol, BHT, methyl methacrylate, urethane, aromatic amines (4-aminodiphenylamine), benzyl bromide, acetaldehyde, disodium iminodiacetate (alternative to Strecker synthesis), citral, ibuprofen, paracetamol, furfural.

2. Microwave assisted reactions in water: Hofmann Elimination, Hydrolysis (of benzyl chloride, benzamide, n-phenyl benzamide, methylbenzoate to benzole acid), Oxidation (of toluene, alcohols). Microwave assisted reactions in organic solvents: Esterification, Fries rearrangement, Orthoester Claisen Rearrangement, Diels-Alder Reaction, Decarboxylation. Microwave assisted solid state reactions: Deacetylation, Deprotection. Saponification of esters, Alkylation of reactive methylene compounds, reductions, synthesis of nitriles from aldehydes; anhydrides from dicarboxylic acid; pyrimidine and pyridine derivatives; 1,2- dihydrotriazine derivatives; benzimidazoles.

3. Ultrasound assisted reactions: Esterification, saponification, substitution reactions, Alkylations, oxidation, reduction, coupling reaction, Cannizaro reaction, Strecker synthesis, Reformatsky reaction.

4. Selective methylation of active methylene group using dimethylcarbonate: Solid-state polymerization of amorphous polymers using diphenylcarbonate; Use of “Clayan”, a nonmetallic oxidative reagent for various reactions; Free Radical Bromination; Role of Tellurium in organic syntheses; Biocatalysis in organic syntheses. **(24 Lectures)**

**Future Trends in Green Chemistry**

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; oncovalent derivatization; Green chemistry in sustainable development. **(8 Lectures)**

**Reference Books:**

• V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry,

 • Anamalaya Publishers (2005).

• P.T. Anastas & J.K. Warner: Oxford Green Chemistry- Theory and Practical, University Press (1998).

• A.S. Matlack: Introduction to Green Chemistry, Marcel Dekker (2001).

• M.C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).

• M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).

**CHEMISTRY PRACTICAL - DSE LAB: GREEN CHEMISTRY 60 Lectures**

 1. Safer starting materials The Vitamin C clock reaction using Vitamin C tablets, tincture of iodine, hydrogen peroxide and liquid laundry starch. ! Effect of concentration on clock reaction ! Effect of temperature on clock reaction. (if possible) 2. Using renewable resources Preparation of biodiesel from vegetable oil. 3. Avoiding waste Principle of atom economy. Use of molecular model kit to stimulate the reaction to investigate how the atom economy can illustrate Green Chemistry. Preparation of propene by two methods can be studied (I) Triethylamine ion + OH- → propene + trimethylpropene + water (II) 1-propanol H2SO4/Δ propene + water The other types of reactions, like addition, elimination, substitution and rearrangement should also be studied for the calculation of atom economy. 4. Use of enzymes as catalysts Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide Alternative Green solvents 5. Diels Alder reaction in water Reaction between furan and maleic acid in water and at room temperature rather than in benzene and reflux. 6. Extraction of D-limonene from orange peel using liquid CO2 prepared form dry ice. 7. Mechanochemical solvent free synthesis of azomethines 8. Co-crystal controlled solid state synthesis (C2 S3 ) of N-organophthalimide using phthalic anhydride and 3-aminobenzoic acid. 65 Alternative sources of energy 9. Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II). 10. Photoreduction of benzophenone to benzopinacol in the presence of sunlight. Reference Books: • Anastas, P.T & Warner, J.C. Green Chemistry: Theory and Practice, Oxford University Press (1998). • Kirchoff, M. & Ryan, M.A. Greener approaches to undergraduate chemistry experiment. American Chemical Society, Washington DC (2002). • Ryan, M.A. Introduction to Green Chemistry, Tinnesand; (Ed), American Chemical Society, Washington DC (2002). • Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. Green Chemistry Experiment: A monograph International Publishing House Pvt Ltd. New Delhi. Bangalore CISBN 978-93-81141-55-7 (2013). • Cann, M.C. & Connelly, M. E. Real world cases in Green Chemistry, American Chemical Society (2008). • Cann, M. C. & Thomas, P. Real world cases in Green Chemistry, American Chemical Society (2008). • Pavia, D. L. Lamponan, G. H. &Kriz, G.S. W B Introduction to organic laboratory

**B.Sc. BIOLOGY V SEMESTER**

**Skill Enhancement Courses**

**Paper IV (Code: BSSEC-354)**

**PUBLIC HEALTH AND HYGIENE**

**(Credits: Theory-2)**

**UNIT – I Nutrition, Environment and Health (15 Periods)**

1.1 Classification of foods - Carbohydrates, proteins, lipids, vitamins and minerals

1.2 Balanced diet and malnutrition.

1.3 Nutritional deficiencies and disorders- Carbohydrates, proteins, lipids, vitamins and minerals.

1.4 Environment and health Impact assessment: concept, steps and applications.

 1.5 Occupational, Industrial, agricultural and urban Health-Exposure at work place, urban areas, industrial workers, farmers and agricultural labourers, Health workers and health disorders and diseases. 1.6 Environmental pollution and associated Health hazards

**UNIT-II Communicable and Non-Communicable diseases (15 Periods)**

2.1 Causes, Symptoms, Diagnosis, Treatment and Prevention of Communicable diseases - Malaria, Filaria, Measles, Polio, Chicken pox, Rabies, Plague, Leprosy, Tuberculosis and AIDS.

2.2 Causes, Symptoms, Diagnosis, Treatment and Prevention of Non-Communicable diseases - Hypertension, Coronary Heart diseases, Stroke, Diabetes, Obesity and Mental ill-health.

2.3 Water borne diseases: Cholera, E. coli , Hepatitis and Polio; Air borne diseases: Chickenpox, Influenza, Measles and Tuberculosis

**UNIT-III Health Education in India (15 periods)**

3.1 Health care legislation in India – termination of pregnancy act, Maternity benefit act, Transplantation of human organs act, Child Labour act, Biomedical waste act, ESI act. 3.2 WHO Programmes – Government and Voluntary Organizations and their health services 3.3 First Aid and Health awareness, personal health care record maintenance.

**Suggested Readings**

1. Park and Park, 1995: Text Book of Preventive and Social Medicine – Banarsidas Bhanot Publ. Jodhpur – India.

2. Public Health at the Crossroads Achievements and Prospects. Robert Beaglehole and Ruth

3. Bonita 2nd Edition Cambridge University Press 3. Maxcy Rosenau Last Public Health &

4. Preventive Medicine, Fourteenth Edition Ed RobertWallace, MD, et al. 4.

5. Epidemiology and Management for Health Care: Sathe, P.V. Sathe, A.P., PopularPrakashan, Mumbai, 1991. 5.

6. International Public Health: Diseases, Programs, Systems, and Policies by 8. MichaelMerson, Robert E Black, Anne J Mills Jones and Bartlett Publishers. 6

**IIMT UNIVERSITY, MEERUT**

**STUDY & EVALUATION SCHEME**

**B.SC BIOLOGY III YEAR, SIXTH SEMESTER (NON-CBCS)**

|  |
| --- |
| **BOTANY** |
| **S.No.** | **Course Code** | **Subject** | **Study Scheme** | **Evaluation Scheme** |
| **L** | **T** | **P** | **Internal** | **External** | **Total** |
| 1 | BSB-601 | Analytical Techniques in Plant Sciences | 3 | 0 | 0 | 30 | 70 | 100 |
| 2 | BSB-602 | Economic Botany and Biotechnology | 2 | 0 | 0 | 30 | 70 | 100 |
| 3 | BSB-611P | Botany Lab-VI | 0 | 0 | 2 | 25 | 50 | 75 |
|  | **Total** |  | **5** | **0** | **2** | **85** | **190** | **275** |
| **ZOOLOGY** |
| 4. | BSZ-601 | Evolutionary Biology | 3 | 0 | 0 | 30 | 70 | 100 |
| 5. | BSZ-602 | Ecology and Ethology | 2 | 0 | 0 | 30 | 70 | 100 |
| 6. | BSZ-611P | Zoology Lab-VI  | 0 | 0 | 2 | 25 | 50 | 75 |
|  | **Total** |  | **5** | **0** | **2** | **85** | **190** | **275** |
| **CHEMISTRY** |
| 7. | BSC-601 | Organic Chemistry – III | 3 | 0 | 0 | 30 | 70 | 100 |
| 8. | BSC-602 | Physical Chemistry – III | 2 | 0 | 0 | 25 | 50 | 75 |
| 9. | BSC-611P | Chemistry Lab-VI | 0 | 0 | 2 | 20 | 30 | 50 |
|  | **Total** |  | **5** | **0** | **2** | **75** | **150** | **225** |
| 10. | ECC-631 | Industrial Visit/ Seminar/ Presentation on the report of Visit | 0 | 0 | 0 | 25 | 0 | 25 |
| 11. | ECC-632 | University Social Responsibility | 1 | 0 | 0 | 25 | 0 | 25 |
| 12. | ECC-633 | Spoken Tutorial Certification | 1 | 0 | 0 | 25 | 0 | 25 |
| 13. | ECC-634 | MOOCS/ SWAYAM | 1 | 0 | 0 | 25 | 0 | 25 |
|  | **Total** |  | **19** | **0** | **6** | **345** | **530** | **875** |
| 14 | SPT-361 | Sport | 0 | 0 | 0 | 50 | 0 | 50 |

|  |
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|  |
| **L=Lecture P= Practical****T= Tutorial** |  |  |  |  |  |  |  |  |  |  |
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**B.Sc. BIOLOGY**

**SIXTH SEMESTER**

**BSB-601: Analytical Techniques in Plant Sciences**

**Unit 1: 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:

**Unit 2: Cell fractionation**

Centrifugation: Differential and density gradient centrifugation, ultracentrifugation, marker enzymes.

**Unit 3: Radioisotopes and Spectrophotometry**

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

**Unit 4: Chromatography and Electrophoresis**

Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange

chromatography; Molecular sieve chromatography; Affinity chromatography. Electrophoresis: AGE, PAGE, SDS-PAGE

**Unit 5: 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.

**PRACTICALS:**

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).

**Suggested Readings**

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill

Publishing Co. Ltd. New Delhi. 3rd edition.

2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.

3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.

4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.

**B.Sc. BIOLOGY**

**SIXTH SEMESTER**

**BSB-602: ECONOMIC BOTANY AND BIOTECHNOLOGY**

**Unit 1: Origin of Cultivated Plants**

Concept of centres of origin, their importance with reference to Vavilov’s work

**Unit 2: Cereals**

Wheat -Origin, morphology, uses

**Unit 3: Legumes**

General account with special reference to Gram and soybean

**Unit 4: Spices**

General account with special reference to clove and black pepper (Botanical name, family, part

used, morphology and uses)

**Unit 5: Beverages**

Tea (morphology, processing, uses)

**Unit 6: Oils and Fats**

General description with special reference to groundnut

**Unit 7: Fibre Yielding Plants**

General description with special reference to Cotton (Botanical name, family, part used,

morphology and uses)

**Unit 8: Introduction to biotechnology**

**Unit 9: Plant tissue culture**

Micropropagation ; haploid production through androgenesis and gynogenesis; brief account of

embryo & endosperm culture with their applications

**Unit 10: 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 Immunodetection. Molecular

diagnosis of human disease, Human gene Therapy.

**Practicals**

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.

**Suggested Readings**

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India

Ltd., New Delhi. 4th edition.

2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice.

Elsevier Science Amsterdam. The Netherlands.

3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and

Applications of recombinant DNA. ASM Press, Washington.

**B.Sc. BIOLOGY**

**SIXTH SEMESTER**

**BSZ-601: EVOLUTIONARY BIOLOGY**

**Unit 1: History of Life and Introduction to Evolutionary Theories**

Major Events in History of Life, Lamarckism, Darwinism, Neo-Darwinism

**Unit 2: Direct Evidences of Evolution**

Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse

**Unit 3: Processes of Evolutionary Change**

Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism);

Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

**Unit 4: Species Concept and Macro-evolution.**

Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric,

Sympatric). Macro-evolutionary Principles (example: Darwin’s Finches)

**Unit 5 : Extinction**

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

extinction in evolution.

**PRACTICALS OF EVOLUTIONARY BIOLOGY**

1. Study of fossil evidences from plaster cast models and pictures

2. Study of homology and analogy from suitable specimens/ pictures

3. 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.

4. Visit to Natural History Museum and submission of report.

**SUGGESTED READINGS**

1.Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing.

2.Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.

3..Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers.

4. Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.

5. Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.

**B.Sc. BIOLOGY**

**SIXTH SEMESTER**

**BSZ-602: ECOLOGY AND ETHOLOGY**

**Unit 1**: **INTRODUCTION TO ECOLOGY**

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors

**UNIT 2: ECOSYSTEM**

Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies Nutrient and biogeochemical cycle with one example of Nitrogen cycle Human modified ecosystem.

**UNIT 3:** **COMMUNITY**

Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example Theories pertaining to climax community

**UNIT 4:** Introduction to Animal Behaviour Origin and history of Ethology; Brief profiles of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen,

**UNIT 5:** Biological Rhythm Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms; Concept of synchronization and masking; Photic and non-photic zeitgebers; Circannual rhythms; Photoperiod and regulation seasonal reproduction of vertebrates; Role of melatonin.

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**PRACTICALS**

1. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community.
2. Study of an aquatic ecosystem
3. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary
4. To study nests and nesting habits of the birds and social insects.
5. To study geotaxis behaviour in earthworm.
6. To study the phototaxis behaviour in insect larvae.
7. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.
8. Study and actogram construction of locomotor activity of suitable animal models.
9. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

**SUGGESTED READINGS**

1. David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.
2. Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour, Cambridge,University Press, UK.
3. John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
4. Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
5. Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
6. Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.)R.D. Lewis. (3rdEd) 2002 Barens and Noble Inc. New York, USA
7. The Clock that times us. 1982. Moore Ed et al.
8. Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.
9. Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
10. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
11. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole Robert Leo Smith Ecology and field biology Harper and Row publisher.
12. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press.

**B.Sc. BIOLOGY**

**SIXTH SEMESTER**

**BSC- 601 : ORGANIC CHEMISTRY – III**

**1. Heterocyclic Compounds 8 Hrs**

Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan thiophene

and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the

mechanism of electrophilic substitution. Mechanism of nucleophilic substitution reactions in

pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five and. six-membered heterocycles. Preparation and reaction of

indole, quinoline and isoquinoline.

**2. Organic Synthesis via Enolates 6 Hrs**

Acidity of α-hydrogens. Synthetic applications of diethyl malonate and ethyl acetoacetate.

Synthesis of ethyl acetoacetate: the Claisen condensation, Keto-enol tautomerism of ethyl

acetoacetate.

**3. Carbohydrates 8 Hrs**

Classification and nomenclature. Monosaccharides, mechanism of osazone formation, Inter

conversion of glucose and fructose, Configuration of monoSaccharides. Erythro and threo

diastereomers. Conversion of glucose into mannose. Formation of glycosiders, ethers and esters.

Determination of ring size of monosaccharides. Cydic structure of D (+)-glucose. Mechanism of

mutarotation. An introduction to disaccharides (maltose, sucrose and lactose) and

polysaccharides (starch and cellulose) without involving structure determination.

**4. Amino Acids, Peptides, Proteins and Nucleic Acids 6 Hrs.**

Classification, structure and stereochemistry of amino acids, Acid-base behaviour, isoelectric

point and electrophoresis. Preparation and reactions of (α-amino acids).

Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure

determination. solid-phase peptide synthesis. Structures of peptides and proteins. Protein

denaturation/ renaturation.

Nucleic acids: Introduction. Constituents of&#39; nucleic acids. Ribonucleosides and ribonucleotides.

The double helical structure of DNA.

**5. Sulphadrugs 4 Hrs.**

Sulphacetamide, Sulphaguinidine, Sulphapyridine, Sulphadizine, Sulphathiozoles and

sulphamethazine, mechanisms and action of sulpha drugs.

**6. Synthetic Polymers 4 Hrs**

Addition or chain-growth polymerization. Free radical vinyl polymerization. Ionic vinyl

polymerization, Ziegler-Natta polymerization and vinyl polymers. 19

Condensation or step growth polymerization. Polyesters, polyamides, phenol formaldehyde

resins, urea formaldehyde resins epoxy resins and polyurethanes, natural and synthetic rubbers.

Synthetic Dyes: colour and constitution, classification of dyes, chemistry and synthetic of methyl

orange, cango red, malachite green, phenolphthalein, fluorescein, alizarin and indigo.

**7. Polynuclear Hydrocarbons 8Hrs**

Naphthalene and its constitution, Naphthols, Naphthylamines, Preparation properties and uses.

Anthracene, phenanthrene and carcinogenic hydrocarbons synthesis, properties and structure.

**B.Sc. BIOLOGY**

**SIXTH SEMESTER**

**BSC- 602 : PHYSICAL CHEMISTRY – III**

**1. Spectroscopy 20 Hrs.**

Introduction: electromagnetic radiation. regions of the spectrum, basic features of different

spectrometers, statement of the Born-Oppenheimer approximation, degrees of freedom.

Vibrational Spectrum

Infrared spectrum: Energy levels of simple harmonic oscillator, selection rules, pure vibrational

spectrum, intensity, determination of force constant and qualitative relation of force constant and

bond energies. idea of vibrational frequencies of different functional groups.

Raman Spectrum: concept of polarizability, pure rotational and pure vibrational Raman spectra

of diatomic molecules, selection rules.

Rotational Spectrum

Diatomic molecules. Energy level of a rigid rotor (semi-classical principles), selection rules,

spectral intensity, distribution using population distribution (Maxwell- Boltzmann distribution),

determination of bond length, qualitative description of non-rigid rotor, isotope effect.

Electronic Spectrum:

Concept of potential energy curves for bonding and antibonding molecular orbitals, qualitative

description of selection rules and Franck - Condon principle. Qualitative description of , π- and

n M.O., their energy levels and the respective transitions.

**2. Photochemistry 8 Hrs.**

Interaction of radiation with matter, difference between thermal and photochemical processes.

Laws of photochemistry: Grothus - Drapper law, Stark -Einstein law, Jabolonski diagram

depicting various processes occurring in the excited state , qualitative description of intersystem

crossing, quantum yield, photosensitized reactions - energy transfer processes (simple examples).

**3. Physical Properties and Molecular Structure 5 Hrs.**

Optical activity, polarization – (Clausius – Mossotti equation), orientation of dipoles in an

electric field, dipole moment, induced dipole moment, measurement of diploe moment –

temperature method and refractivity method, dipole moments and structure of molecules,

magnetic properties: paramagnetism, diamagnetism and ferromagnetics.

Solutions, Dilute Solutions and Colllgative Properties 7 Hrs.

Ideal and non-Ideal solutions, methods of expressing concentrations of solutions, activity and

activity coefficient.

Dilute solution, colligative properties, Raoult’s law, relative lowering of vapour pressure,

molecular weight determination. Osmosis, law of osmotic pressure and its measurement,

determination of molecular weight from osmotic pressure. Elevation of boiling point and

depression of freezing point. Thermodynamic derivation of relation between molecular weight

and elevation in boiling point and depression in freezing point. Experimental method for

determining various colligative properties.

Abnormal molar mass, degree of dissociation and association of solutes.

**B.Sc. BIOLOGY**

**SIXTH SEMESTER**

**BSC- 611P : CHEMISTRY LAB – VI**

**Gravimetric Analysis:**

i. Estimation of nickel (II) using Dimethylglyoxime (DMG).

ii. Estimation of copper as CuSCN

iii. Estimation of iron as Fe 2 O 3 by precipitating iron as Fe(OH) 3 .

iv. Estimation of Al(III) by precipitating with oxine and weighing as Al(oxine) 3

(aluminium oxinate).

**Inorganic Preparations:**

i. Tetraamminecopper (II) sulphate, [Cu(NH 3 ) 4 ]SO 4 .H 2 O

ii. Acetylacetonate complexes of Cu 2+ /Fe 3+

iii. Tetraamminecarbonatocobalt (III) nitrate

iv. Potassium tri(oxalato)ferrate(III)

**Organic Chemistry**

**Chromatography: Separation of mixtures by Chromatography: Measure the Rf value in each case**

(combination of two compounds to be given).

1. Separation of a mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or

any other amino acid) by ascending and horizontal paper chromatography.

2. Separation of a mixture of two sugars by ascending paper chromatography.

3. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer

chromatography (TLC).

**Organic Preparations**

(i) Bromination of acetanilide / aniline / phenol.

(ii) Nitration of nitrobenzene / toluene.

Colorimetry

1. To verify Beer – Lambert’s Law for KMnO 4 /K 2 Cr 2 O 7 and determine the concentration of

the given solution of the substance.

**Books Suggested (Theory Courses):**

1. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson and P.L. Gaus, Wiley.

2. Concise Inorganic Chemistry, J.D. Lee, ELBS.

3. Concepts of Models of Inorganic Chemistry, B. Douglas, D. McDaniel and J. Alexander,

John Wiley.

4. Inorganic Chemistry, D.E. Shriver, P.W. Atkins and C.H. Langford, Oxford.

5. Inorganic Chemistry, W.W. Porterfield, Addison–Wesley.

6. Inorganic Chemistry, A.G. Sharpe, ELBS.

7. Organic Chemistry, Morrison and Boyd, Prentice Hall.

8. Organic Chemistry, L.G. Wade jr., Prentice Hall.

9. Fundamentals of Organic Chemistry, Solomons, John–Wiley.

10. Organic Chemistry Vol. I, II &amp; III, S.M. Mukherji, S.P. Singh and R.P. Kapoor, Wiley

Eastern Ltd., (New Age International).

11. Organic Chemistry, F.A. Carey, McGraw Hill, Inc.

12. Physical Chemistry, G.M. Barrow, International Student Edition, McGraw Hill.

13. Basic Programming with Application, V.K. Jain, Tata McGraw Hill.

14. Computers and Common Sense, R. Hunt and Shelly, Prentice Hall.

15. University General Chemistry, C.N.R. Rao, McMillan.

16. Physical Chemistry, R.A. Alberty, Wiley Eastern Ltd.

17. The Elements of Physical Chemistry, P.W. Atkins, Oxford.

18. Physical Chemistry Through Problems, S.K. Dogra and S. Dogra, Wiley Eastern Ltd.

Books Suggested (Laboratory Courses):

1. Vogel’s Qualitative Inorganic Analysis, revised, svehla, Orient Longman.

2. Vogel’s Textbook of Quantitative Inorganic Analysis (revised), J. Bassett, R.C. Denney,

G.H. Jeffery and J. Mendham, ELBS.

3. Standard Methods of Chemical Analysis, W.W. Scott, The Technical Press.

4. Experimental Inorganic Chemistry, W.G. Palmer, Cambridge.

5. Handbook of Preparative Inorganic Chemistry, Vol. I &amp; II, Brauer, Academic Press.

6. Inorganic Synthesis, McGraw hill.

7. Experimental Organic Chemistry Vol. I &amp; II, P.R. Singh, D.S. Gupta and K.S. Bajpai.

Tata McGraw Hill.

8. Laboratory Manuel in Organic Chemistry, R.K. Bansal, Wiley Eastern.

9. Experiments in General Chemistry, C.N.R. Rao and U.C. Agarwal, East-West Press.

10. Experiments in Physical Chemistry, R.C. Dass and D. Behra, Tata McGraw Hill.

11. Advanced Practical Physical Chemistry, J.B. Yadav, Goel Publishing house.

12. Advanced Experimental Chemistry, Vol. I – Physical, J.N. Gurtu and R. Kapoor, S.

Chand &amp; Co.

13. Experiments in Physical Chemistry, J.C. Ghosh, Bharti Bhavan.

14. Practical Organic Chemistry, F.G. Mann and B.C. Saunders, Pearson Education.

15. Practical Organic Chemistry, 5th Ed., B.S Furniss, A.J. Hannaford, P.W.G. Smith and

A.R. Tatchell, Pearson.