UNIVERSITY OF DELHI

COURSE NAME: B.Sc. in Life Sciences

(Semester-I)
Based on
Undergraduate Curriculum Framework 2022 (UGCF)
(Effective from Academic Year 2022-23)

University of Delhi

Course Title	Nature of the Course	Total Credits	Components			Eligibility Criteria/ Prerequisite	Contents of the course and reference is in -
			Lecture	Tutorial	Practical		
Plant Diversity & Systematics	DSC-Botany	04	02	-	02	Chemistry+Physics+Biology/ Biological studies/Biotechnology	**Annexure-I**
Basic Concepts of Organic Chemistry	DSC-Chemistry	04	02	-	02		
Diversity of Animals	DSC-Zoology	04	02	-	02		

Syllabus for B.Sc. in Life Sciences
Semester I

DISCIPLINE SPECIFIC CORE COURSES (DSC)
SEMESTER-I

Course Code BOT-DSC-1
Course Title: Plant Diversity and Systematics
Total Credits: 04 (Credits: Theory 02, Practical 02)
Total Hours: Lectures- 30, Practical- 15 classes of 4 hours each

Objective:

To make students aware about the diversity of plants and microbes present on the planet and their evolutionary relationships.

Learning Outcomes:

This course will be able to impart basic knowledge and understanding of:

- the diversity of plants and microbes
- the possible relationships between each group
- their general characteristics
- approaches used for identification and classification of various groups of plants

Unit 1: Diversity of Life — Lectures: 01

Classifying the diversity of life: Domains of Life –Eubacteria, Archaea and Eukaryotes

Unit 2: Microbes — Lectures: 04

Viruses: General account; Replication, Lytic and Lysogenic cycle; Bacteria: structure, wall-less forms (L-forms, Mycoplasma), asexual reproduction and genetic recombination

Unit 3: Algae — Lectures: 03

Brief introduction of major classes: Blue-green, Green, Brown and Red algae. Diagnostic features of identification; morphology, reproduction and classification with special reference to *Nostoc*, *Volvox* and *Spirogyra*.

Unit 4: Fungi — Lectures: 03

Diagnostic features of identification; morphology, reproduction and classification with special reference to *Rhizopus, Penicillium and Agaricus*; Lichens (a general account).

Unit 5: Bryophytes, Pteridophytes and Gymnosperms **Lectures: 06**

Characteristic features of identification; morphology and reproduction of Bryophytes, Pteridophytes and Gymnosperms with special reference to *Marchantia*, *Funaria*, *Pteris* and *Pinus* (only morphology).

Unit 6: Angiosperms **Lectures: 02**

Diagnostic features, Structure of flower, types of inflorescence

Unit 7: Systematics **Lectures: 01**

Aims, fundamental components of systematics, description, identification, nomenclature, phylogeny, biosystematics**.**

Unit 8: Systematics in Practices **Lectures: 07**

Taxonomic Hierarchy- Concept of taxa and categories, Botanical Nomenclature- principles and rules; Type method; Author citation; Valid publication; Rejection of names, Principle of priority and its limitations, names of hybrids and cultivars.

Unit 9: Systems of classification **Lectures: 03**

Classification: Artificial, Natural and Phylogenetic. An outline of Bentham and Hooker's (up to series only) and Engler and Prantl's (up to Subclasses) systems of classification and their merits and Demerits. APG System.

Practicals:

1. **Viruses:** Electron Micrographs of TMV and Bacteriophage, Specimens of virus infected plants (any two).
2. **Bacteria:** Electron Micrographs of a bacterium, types through permanent slides/photographs, specimens of infected plants (any two).
3. **Algae:** Study of vegetative and reproductive structures of (a) *Nostoc* (b) *Volvox* (c) *Spirogyra* through temporary preparations and permanent slides.
4. **Fungi:** Study of vegetative and reproductive structures of (a) *Rhizopus,* (b) *Penicillium* and (c) *Agaricus* through temporary preparations and permanent slides/specimens/photographs.
5. **Lichens:** Crustose, Foliose and Fruticose (specimens/ digital resources)
6. **Bryophytes:** Study of (a) *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), (b) *Funaria*: detailed study and classification from W.M. rhizoids, operculum, peristome, spores and permanent slides of archegonia, antheridia and capsule.
7. **Pteridophytes:** Study of *Pteris:* T. S. of Rachis, V.S. of Sporophyll and W.M. of sporangium.
8. **Gymnosperms:** Study of *Pinus* morphology of long & dwarf shoot, male and female cones (specimens) and T.S. of needle (permanent slides only).

9. **Herbarium technique:** Mounting of a properly dried and pressed specimen of any wild plant on the herbarium sheet with complete herbarium label.
10. Taxonomic study of characters of one plant from each of the following families (any four): Malvaceae, Solanaceae, Asteraceae, Fabaceace, Liliaceae.

Suggested Readings:

1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, 4th edition. Singapore, John Wiley and Sons (Asia).
2. Kumar, H.D. (1999). Introductory Phycology, 2nd edition. Delhi, Delhi: Affiliated East-West. Press Pvt. Ltd.
3. Bhatnagar, S.P., Moitra, A. (1996). Gymnosperms. New Delhi, Delhi: New Age International (P) Ltd. Publishers.
4. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Prayagraj: U.P.: Central Book Depot.
5. Pelczar, M.J. (2001). Microbiology, 5th edition. New Delhi, Delhi: Tata McGraw-Hill Co.
6. Tortora, G.J., Funke, B.R., Case. C.L. (2007). Microbiology. San Francisco, U.S.A: Pearson Benjamin Cummings.
7. Raven, P.H., Evert, RF., Eichhorn, S.E. (2013). Biology of Plants, 8th edition, New York, NY: W.H. Freeman and Company.
8. Sethi, I.K., Walia, S.K. (2018). Text book of Fungi and Their Allies. (2nd Edition), Medtech Publishers, Delhi.
9. Vashishta, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. New Delhi, Delhi: S. Chand & Co Ltd.
10. Singh, G. (2020). Plant Systematics: Theory and Practice, 4th edition. CBS Publishers and Distributers, New Delhi.
11. Simpson, M.G. (2020). Plant Systematics, 3rd edition, Elsevier Academic Press, San Diego, CA, U.S.A.
12. Gupta R. 2011. Plant Taxonomy: past, present, and future. New Delhi: The Energy and resources Institute (TERI).
13. Judd W.S., Campbell C.S., Kellogg, E. A., Stevens, P.F., Donoghue M.J. (2015). Plant Systematics: A Phylogenetic Approach 4th Edition Sinauer Associates, Oxford University Press. USA.
14. http://www.mobot.org/MOBOT/research/APweb/. (for APG IV classification).

Keywords: Bacteria, Viruses, Bryophytes, Pteridophytes, Gymnosperms, Angiopserms, Classification

Course Code : CHEM-DSC-01
Course Title: Basic Concepts of Organic Chemistry
Total Credits: 04 (Credits: Theory-02, Practical-02)
Total Lectures: Theory- 30, Practical- 15 classes of 4 hours each

Objectives: The course is infused with the recapitulation of fundamentals of organic chemistry and the introduction of the concept of visualizing the organic molecules in a three-dimensional space. To establish the applications of these concepts, a study of diverse reactions through mechanisms is included. The constitution of the course strongly aids in the paramount learning of the basic concepts and their applications.

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

- Understand and explain the differential behavior of organic compounds based on fundamental concepts learnt.
- Understand the fundamental concepts of stereochemistry.
- Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
- Learn and identify many organic reactions and their mechanisms including electrophilic addition, nucleophilic addition, nucleophilic substitution, electrophilic substitution and rearrangement reactions.

Unit 1: Fundamentals of organic chemistry — Lectures: 05

Types of Electronic displacements: Inductive effect, Resonance effect, Hyperconjugation, Electromeric Effect. Reactive intermediates and their stability: carbocations, free radicals, carbanions, benzyne, carbenes.
Acidity and basicity in organic compounds (comparison of carboxylic acids, alcohols, phenols, primary, secondary and tertiary aliphatic amines, aniline and its derivatives)

UNIT 2: Stereochemistry — Lectures: 07

Types of projection formulae: Flying Wedge Formula, Newmann, Sawhorse and Fischer representations and their interconversion.
Stereoisomerism: Concept of chirality (upto two carbon atoms). Configurational isomerism: 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).
Conformational isomerism with respect to ethane, butane and cyclohexane.

UNIT 3: Types of Organic Reactions (Including reactions of alkenes, alkyl and aryl halides, alcohols, aldehydes, ketones)

Lectures: 18

Electrophilic addition reactions

Electrophilic addition reaction (with respect to propene, propyne, 3,3-dimethyl-1-butene): Hydration, Addition of HX in the absence and presence of peroxide, Hydroboration oxidation, Addition of bromine (with stereochemistry).

Nucleophilic addition reactions

Nucleophilic addition reaction of carbonyl compounds: Addition of HCN, ammonia derivatives (Hydroxylamine, Hydrazine, Semicarbazide and 2,4-DNP), the addition of carbanion (Aldol condensation, Claisen Schmidt, Benzoin condensation, Perkin reaction, reactions involving Grignard reagent).

Elimination and Nucleophilic substitution reactions

Nucleophilic substitution reaction (S_N1 and S_N2) in alkyl halides (mechanisms with stereochemical aspect), alcohols (with nucleophiles like ammonia, halides, thiols, ambident nucleophiles (cyanide and nitrite ion)), ethers (Williamson ether synthesis), Elimination reaction (E1 & E2), elimination *vs* substitution (*w.r.t.* potassium t-butoxide and KOH); Nucleophilic aromatic substitution in aryl halides-elimination addition reaction *w.r.t.* chlorobenzene, including the effect of nitro group (on the ring) on the reaction. relative reactivity and strength of C-X bond in alkyl, allyl, benzyl, vinyl and aryl halides towards substitution reactions

Electrophilic substitution reactions

Electrophilic Aromatic substitution with mechanism (benzene)- sulphonation, nitration, halogenation, Friedel craft acylation :*o*-, *m*- and *p*- directive influence giving examples of toluene/nitrobenzene/ phenol/ aniline/ chlorobenzene.

Reactive intermediates and Rearrangement Reactions

Free radicals (Birch Reduction); *Carbocations* (Pinacol-Pinacolone, Wagner-Meerwein, Rearrangement, and Beckmann rearrangement); *Carbanions (*Michael Addition); *Carbenes* (Reimer-Tiemann).

PRACTICALS: **Credits: 02**

(Laboratory periods: 15 classes of 4 hours each)

1. Purification of an organic compound by crystallization (from water and alcohol) and distillation, Criteria of purity: Determination of M.P.
2. Determination of boiling point of liquid compounds. (Boiling point lower than and more than 100 °C by distillation and capillary method)
3. Detection of extra element
4. Preparations: (Mechanism of various reactions involved to be discussed).

a. Bromination of phenol/aniline.
b. 2,4-Dinitrophenylhydrazone of aldehydes and ketones
c. Semicarbazone of aldehydes/ ketones
d. Aldol condensation reaction using green method.
e. Bromination of Stilbene.
f. Acetanilide to p-Bromoacetanilide.

The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples
must be collected and may be used for recrystallization and melting point.

References:

Theory:

1. Sykes, P.(2003), **A Guide Book to Mechanism in Organic Chemistry,** 6th Edition Pearson Education.
2. Eliel, E. L. (2001), **Stereochemistry of Carbon Compounds**, Tata McGraw Hill.
3. Morrison, R. N.; Boyd, R. N., Bhattacharjee, S.K. (2010), **Organic Chemistry**, 7th Edition, Pearson Education.
4. Bahl, A; Bahl, B. S. (2019), **Advanced Organic Chemistry**, 22nd Edition, S. Chand.

Practical:

1. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. (2012), **Vogel's Textbook of Practical Organic Chemistry**, Pearson.
2. Mann, F.G.; Saunders, B.C. (2009), **Practical Organic Chemistry**, Pearson Education.
3. Dhingra, S; Ahluwalia V.K., (2017), **Advanced Experimental Organic Chemistry**, Manakin Press.
4. Pasricha, S., Chaudhary, A. (2021), **Practical Organic Chemistry: Volume I**, I K International Publishing House Pvt. Ltd., New Delhi.

Teaching Learning Process:

- Blend of conventional blackboard teaching, modern teaching learning tools and
- Computational infrastructure- based instructions and Practical training.
- Problem solving and quizzes for enhanced understanding of the concepts.
- Explaining the handling and usage of the hardware and softwares required for solution to the given set of problems.

Assessment Methods:

- Presentations by individual student/ group of students
- Class Tests at periodic intervals.
- Written assignment(s)
- End semester University theory examination presentations by individual student/ group of students

Keywords: Chirality, Electrophilic addition, Nucleophilic addition, Nucleophilic substitution, Electrophilic substitution

Course Code : ZOO-DSC-01
Course Title: Diversity of Animals
Total Credits: 04 (Credits: Theory-02, Practical-02)
Total Lectures: Theory- 30 hrs., Practical- 15 classes of 4 hours each

Objectives: The objective of this course is to teach the students concepts of morpho-taxonomy aswell as understand the characteristics and physiological aspects of unicellular and metazoan animals. The course lays emphasis on creating awareness and concern towards significance of animal diversity for human survival and its socio- economic importance. In addition to this, the course is aimed at nurturing skills of conducting scientific inquiry and experimentation in the field of animal diversity to acquire knowledge of fundamental concepts and theories of animal diversity.

Learning Outcomes:

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

- Acquire knowledge of diversity of non-chordate and chordates.
- Learn characteristics, morphotaxonomy, structural organization and physiological life systemof diverse animal groups.
- Understand the economic importance of non-chordates and chordates and their importance inthe ecosystem.
- Learn evolutionary relationships and phylogeny of invertebrates and vertebrates to structuralas well as functional similarities.

Unit I– Introduction ***02 hrs.***

Introduction to five kingdom classification system, General characters of kingdom Animalia and basis of its classification (with special reference to coelom), Concept of Taxonomic Hierarchy (up to species level), significance of binomial nomenclature.

Unit II: Protista to Pseudocoelomates **09 hrs.**

Characteristics of acoelomates and pseudocoelomates. Locomotory organelles and locomotion inProtozoa, Canal system in Porifera, Polymorphism in Cnidaria (Hydrozoa), Life cycle of *Taenia solium* and its Parasitic adaptations, Life cycle of *Ascaris lumbricoides* and its Parasitic adaptations.

Unit III: Coelomates ***09 hrs.***

General features of coelomates, Metamerism in Annelida, Vision in Arthropoda, Metamorphosis in Insects. Torsion and detorsion in Gastropoda. Pearl Formation, Water-vascular system in Asteroidea

Unit IV: Chordates ***10 hrs.***

Salient features of protochordates and chordates, Retrogressive metamorphosis in protochordates, Osmoregulation, Migration, and Parental care in fishes, Parental care in Amphibians, Flight adaptations and Migration in birds, Biting mechanism in snakes, Origin of mammals.

PRACTICAL **[15 classes of 4 hours each]**

1. General Characteristics and Classification up to classes: Protista, Porifera, Cnidaria,Platyhelminthes, Nemathelminthes. Study of museum specimens: *Amoeba,Euglena, Paramecium, Sycon, Euplectella, Obelia, Physalia, Aurelia, Metridium,* larval stage of *Taenia solium,* Male and female *Ascaris lumbricoides.*

2. General Characteristics and Classification up to classes: Annelida, Arthropoda, Mollusca, Echinodermata. Study of museum specimens: *Aphrodite, Nereis, Chaetopterus, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Chiton, Dentalium, Pila, Unio, Octopus, Pentaceros, Echinus, Cucumaria, Antedon.*

3. Study of following specimens, general characteristics and classification: *Balanoglossus, Amphioxus, Herdmania.*

4. Study of following specimens, general characteristics and classification up to order: *Petromyzon, Pristis, Exocoetus, Hippocampus, Hyla, Salamander Ichthyophis/Uraeotyphlus, Naja, Viper,Hydrophis, Chameleon, Uromastix, Milvus, Anas, Psittacula, Loris, Pteropus, Sorex*

5. Submission of report on an excursion to a Sanctuary/ Biodiversity Park.

Note: Classification to be followed from Ruppert, E.E., Fox, R.S., Barnes R.D. "*Invertebrate Zoology*" 7th Edition., Cengage Leaning, India" & Young, J. Z. (2004) *The Life of Vertebrates*. III Edition. Oxford university press.

Recommended Books:

1. Ruppert, E.E., Fox, R.S., Barnes, R. D. *Invertebrate Zoology: A Functional EvolutionaryApproach*. 7th Edition, Cengage Learning, India.
2. Young, J. Z. (2004) *The Life of Vertebrates*. III Edition. Oxford university press.
3. Barrington, E.J.W. (2012) *Invertebrate Structure and Functions*. II Edition, EWP Publishers.
Pechenik, J. A. (2015) *Biology of the Invertebrates*. VII Edition, McGraw-Hill Education
4. Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.
5. Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. TataMcGraw Hill Publishing Company. New Delhi.
6. Pough H. *Vertebrate Life*, VIII Edition, Pearson International.

7. Lal, S.S. (2012), Practical Zoology Invertebrate.
8. Lal S.S. (2015-16), Practical Zoology Vertebrate.
9. P. S. Verma (2010), A Manual of Practical Zoology: Chordates.

Teaching Learning Process:

- Blend of conventional blackboard teaching, modern teaching learning tools and computational infrastructure- based instructions and Practical training.
- Problem solving and quizzes for enhanced understanding of the concepts.
- Explaining the handling and usage of the hardware and software required for solution to thegiven set of problems.

Assessment Methods:

- Presentations by Individual Student/ Group of Students
- Class Tests at Periodic Intervals.
- Written assignment(s)
- End semester University Theory Examination Presentations by Individual Student/ Group of Students