# Department of Zoology

B.Sc. Zoology

B.Sc. Zoology

## Four-Year Undergraduate Program

**FYUP (Eight-Semester Course) As per NEP**

# Course Contents &Syllabus

**(For students enrolled in 2025-26 academic session)**


## Hemvati Nandan Bahuguna Garhwal University

**(A Central University)**

**Srinagar Garhwal-246174 (Uttarakhand)**

## Course Structure and Credit Allocation

## (For Practical based Subjects)

| First Year (NHEQF Level-4.5) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Category** | **Semester-I** | | | | | **Semester-II** | | | |
| | **Subject** | **Paper** | **Credits** | | | **Subject** | **Paper** | **Credits** | |
| | | | **T** | **P** | | | | **T** | **P** |
| **Discipline Specific Core** | DSC Subject-I (Major) | Animal Diversity-I | 2 | 2 | | DSC Subject-I (Major) | Animal Diversity-II | 2 | 2 |
| | DSC Subject-II (Minor) | Animal Diversity-I | 2 | 2 | | DSC Subject-II (Minor) | Animal Diversity-II | 2 | 2 |
| **MD/ID Subject-1** | MD/ID-I | Laboratory Techniques in Biology | 2 | 2 | | MD/ID-II | Basic Instrumentation | 2 | 2 |
| **MD/ID Subject-2** | MD/ID-I | - | 2 | 2 | | MD/ID-II | - | 2 | 2 |
| **SEC/ AEC** | Field work/SEC/ Communication Skills **Or** AMSC/Field Work/SEC | Communication Skills | 2 | -- | | AMSC/Field Work/SEC **Or** Field work/ SEC/ Communication Skills | AMSC* | 2 | -- |
| **VAC** | Understanding and Connecting with Environment **Or** Life Skills & Personality development | Understanding and Connecting with Environment | 2 | -- | | Understanding and Connecting with Environment **Or** Life Skills & Personality Development | Life Skills & Personality Development | 2 | -- |
| **Total** | | | 12 | 8 | | | | 12 | 8 |
| **NHEQF Level-4.5** | Student on exit after successfully completing first year (i.e., securing minimum required 40 credits + 4 Credits in one Vocational Course/Skill-Enhancement Course of 4 credits) will be awarded "Undergraduate Certificate" of one year, in related field/discipline/subject. | | | | | | | | |

- The student may opt for any one course from Field Work/ Skill Enhancement Course (SEC)/ Communication Skills in one semester, and any one course from Additional Multidisciplinary Skill Course (AMSC)/ Field Work/ Skill Enhancement Course (SEC) in the other semester.
- Field Work/Discipline Specific Skill Enhancement Course (SEC): Studeny may opt SEC/Field Work related to any discipline subject opted by her/him as a DSC in the first year.
- **Field Work**: In addition to providing students with practical, experience-based learning, field work aims to expose them to real-world socio-economic and societal challenges, allowing them to bridge the gap between theory and practice and develop effective solutions to real-life problems.
- ***AMSC**: Additional Multidisciplinary Skill Course (is offered as SEC)
  Following courses are offered under AMSC, University may add new courses under AMSC in future:
  1. Plant Nursery Development and Management
  2. Basic Yoga Practices
  3. Physical Education and Sports Management
  4. Regional Folklores and their Cultural Context
  5. Indian Traditional Music
  6. Tour and Travel Operations
- **Communication Skills (AEC):** 'Communication Skills' course will be offered in Hindi, English and Sanskrit Languages, student may opt any one language for studying the course
- **Life Skill & Personality Development (VAC)** Compulsory Course [Common University Syllabus]
- **Understanding and Connecting with Environment (VAC)**Compulsory Course [Common University Syllabus]

**Note**: Student can opt Zoology subject as either Discipline Specific Major or Discipline Specific Minor or as Multidisciplinary/Interdisciplinary (MD/ID) Subject-1 or 2.

| Second Year (NHEQF Level-5) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Course Category** | **Semester-III** | | | | | **Semester-IV** | | | |
| | **Subject** | **Paper** | **Credits** | | | **Subject** | **Paper** | **Credits** | |
| | | | **T** | **P** | | | | **T** | **P** |
| **Major-I (One Subject)** | DSC Major-I | Elementary Cell Biology & Molecular Biology | 4 | 2 | | DSC Major-II | Physiology and Elementary Biochemistry | 4 | 2 |
| **Minor-I (One Subject)** | DSC Minor-I | Elementary Cell Biology & Molecular Biology | 2 | 2 | | DSC Minor-II | Physiology and Elementary Biochemistry | 2 | 2 |
| **SEC** | SEC Major-I | Aquaculture* | 2 | - | | SEC Major-II | Aquarium Fish Keeping* | 2 | - |
| **MD/ID** | MD/ID-III | Microscopy | 2 | 2 | | MD/ID-IV | Bio-techniques | 2 | 2 |
| **AEC (Language based courses)** | Indian, Modern, Regional Language-I | | 2 | | | Indian, Modern, Regional Language-II | | 2 | |
| **VAC/AEC** | IKS Or Culture, Traditions and Moral Values | | 2 | -- | | IKS Or Culture, Traditions and Moral Values | | 2 | -- |
| **Total** | | | 14 | 6 | | | | 14 | 6 |
| **NHEQF Level-4.5** | Student on exit after successfully completing Second year (i.e., securing minimum required 80 credits + 4 Credits in one vocational course/skills-enhancement course of 4 credits) will be awarded "Undergraduate Diploma" of two year, in related field/discipline/subject. | | | | | | | | |

- IKS-Indian Knowledge System (AEC)
- Culture, Traditions and Moral Values (VAC)
- Students are required to study both courses—Indian Knowledge System (IKS) and Culture, Traditions and Moral Values during the III and IV semesters. However, they will have the flexibility to study one course in each semester.
- Indian, Modern, Regional Language—Hindi, Sanskrit and English (Student have to study 2 different languages in the second year with one language in one semester and other language in another semester).
- *The department will offer a 2-credit SEC-Major course in a fully theory-based module.

**FOUR-YEAR BACHELOR'S DEGREE PROGRAMME WITH HONOURS/RESEARCH**
**(B.Sc. Zoology)**
**SYLLABUS (*w.e.f.* 2025-26)**

**B. Sc. First Year (I Semester)**

## MAJOR/CORE ZOOLOGY

**(Theory: 2 Credits; Practical: 2Credits)**

**SOLS/ZOO/DSC (Major)-1 Animal Diversity-I** **2 Credits [30hours]**

**Unit I.**

**Introduction to Non-Chordata :** General characters; Outline classification up to Classes.

**Protozoa:** Salient features; Study of structure, locomotion and nutrition.

Origin of Metazoa. [7 hours ]

**Porifera :** Salient features; Canal system in sponges.

**Unit II.**

**Coelenterata :** Salient features; Alternation of generation in Coelenterates, Coral and coral reefs.

**Helminthes:** Salient features; Study of *Taenia* and *Ascaris* with reference to morphology, reproduction (life-cycle). [8 hours]

**Unit III**

**Annelida:** Salient features; Types and significance of coelom; Metamerism and its significance; Study of *Hirudinaria* with reference to morphology and reproduction; Trochophore larva and its significance.

**Arthropoda:** Salient features; Zoological importance of *Peripatus* and *Limulus*; Economic importance of arthropods. [7 hours]

**Unit IV**

**Mollusca:** Salient features; Study of *Pila* with reference to morphology and respiration.

**Echinodermata:** Salient features; Study of *Asterias* with reference to morphology, locomotion, water vascular system. [8 hours]

## MINOR/CORE ZOOLOGY

**(Theory: 2Credits; Practical: 2Credits)**
**[For students with Major Subjects other than Zoology]**

**SOLS/ZOO/DSC (Minor)-1 Animal Diversity-I** **2 Credits [30 Hours]**

**Unit I.**

**Introduction to Non-Chordata:** General characters; Outline classification upto Classes.

**Protozoa:** Salient features; Study of locomotion and nutrition in Protozoa. [7 hours]

**Unit II.**

Origin of Metazoa.

**Porifera:** Salient features; Study of canal system in Sycanoid sponges.

**Coelenterata :**Salient features; Alternation of generation in Coelenterates. [8 hours]

**Unit III.**

**Helminthes:** Salient features; Parasitic adaptations in helminths.

**Annelida:** Salient features; Types and significance of coelom; Metamerism and its significance; Trochophore larva and its significance. [7 hours]

**Unit IV.**

**Arthropoda:** Salient features; Zoological importance of *Peripatus* and *Limulus*; Economic importance of arthropods.

**Mollusca:** Salient features; Torsion; Pearl formation.

**Echinodermata:** Salient features; Study of water vascular system in starfish.

[8 hours]

**Recommended Books:**


1. Barnes, RD: Invertebrate Zoology (4thed.), Holt-Saunders,1980.
2. Barrington, EJW: Invertebrate Structure and Function, Nelson,1987.
3. Hickman, Roberts & Hickman: Integrated Principles of Zoology (7thed) Times-Mirror, Mosby, 1984.
4. Iyer: A Manual of Zoology, PartI Viswanathan, 1973.
5. Kotpal, RL: Modern Text Book of Zoology: Invertebrates, Rastogi Publications, 12th edition, 2019
6. Marshall & William: Text Book of Zoology, Vol I (Parker & Haswell,7thed.)Macmillan, 1972.


| | |
|---|---|
| **SOLS/ZOO/DSC (Major)-1(P) Animal Diversity-I (Practical)** | **2 Credits** |
| **SOLS/ZOO/DSC (Minor)-1 (P) Animal Diversity-I(Practical)** | **2 Credits** |

**Study of museum specimens/slides:**

**Protozoa:** *Amoeba, Euglena, Plasmodium, Paramecium*, *Trichomonas, Trypanosoma, Monocystis, Vorticella*
**Porifera:** *Sycon* (including T.S. and L.S.), *Hyalonema*, *Euplectella*, *Euspongia*
**Coelenterata:** *Obelia, Physalia, Aurelia, Tubipora, Metridium*, *Hydra, Gorgonia, Pennatula* **Platyhelminthes:** *Taenia solium* and study of its life history stages, *Schistosoma, Fasciola* **Nemathelminthes:** Male and female *Ascaris lumbricoides*, *Wuchereria*, *Ancylostoma* **Annelida:** *Aphrodite, Nereis, Pheretima, Hirudinaria, Polygordias*
**Arthropoda:** *Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis*, *Musca*
**Mollusca:** *Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus*
**Echinodermata:** *Pentaceros, Ophiura, Echinus, Cucumaria, Antedon, Holothuria, Astreas*

## B.Sc. First Year (II Semester)

**SOLS/ZOO/Major-2 Animal Diversity-II** **2 Credits [30 Hours]**

**Unit I.**

**Introduction to Chordata:** General characters and outline classification of Chordates upto Classes.
Hemichordata: General characters; *Balanoglossus*: morphology and development.
**Urochordata:** General characters and classification; *Herdmania*: Morphology and Retrogressive metamorphosis.
**Cephalochordata:** Classification and salient features; *Branchiostoma* (=*Amphioxus*): Morphology and development.

[8 Hours]

**Unit II.**

**Cyclostomata:** General characters and classification; External features of *Petromyzon* and *Myxine*.
**Pisces:** General characters of cartilaginous and bony fish; Dipnoi: Distribution, General characters, and affinities; External features, Digestive system of *Scoliodon*; Scales and fins of fishes, respiratory organs in fish

[8 Hours]

**Unit III.**

**Amphibia:** General characters and classification, Elementary idea of parental care
**Reptilia:** General characters; Terrestrial Adaptations; Poisonous and non-poisonous snakes; Biting mechanism in snakes; Venom and Antivenom

[7 Hours]

**Unit IV.**

**Aves:** General characters; Digestive and Urinogenital System of *Columba*; Feathers in Birds; Aerial adaptations in birds.
**Mammalia:** General organization, salient features, and distribution of Prototheria, Metatheria and Eutheria

[7 Hours]

**SOLS/ZOO/Minor-2 Animal Diversity-II** **2 Credits [30 Hours]**

**Unit I.**

**Introduction to Chordata:** General characters and outline classification of Chordates upto Classes.

**Hemichordata:** General characters, classification and affinities.

**Urochordata:** General characters, classification and affinities; Retrogressive metamorphosis in *Herdmania*

**Cephalochordata:** General characters, classification and affinities. [8 Hours]

**Unit II.**

**Cyclostomata:** General characters, classification and affinities; Comparison between Lampreys and Hagfishes.

**Pisces:** General characters, classification, and affinities; Scales, fins, and respiratory organs of fishes;

**Dipnoi:** Distribution, General characters, and affinities [8Hours]

**Unit III.**

**Amphibia:** General characters and classification, Elementary idea of parental care.

**Reptilia:** Terrestrial Adaptations; General characters, distribution, and affinities; Poisonous and non-poisonous snakes; Biting mechanism in snakes; Venom and Antivenom. [7 Hours]

**Unit IV.**

**Aves:** General characters and classification; Feathers in Birds; Aerial adaptations in birds.

**Mammalia:** General characters,classification, and distribution of Prototheria, Metatheria and Eutheria [7Hours]

**Recommended Books:**


1. Kotpal, R.L.: Modern Text-book of Zoology,Vertebrates. Rastogi Publication,2007
2. Jordan, E.L.and P.S.Verma: Chordate Zoology. S.Chand & Co.Ltd.,2013
3. Hildebr and, M.Goslow,G. :Analysis of Vertebrate Structure,Wiley,1998
4. Romer,A.S.,T.S.Parsons: Vertebrate Body,Saunders(W.B.) Co Ltd; 5th Revisededition,1977
5. Pandey, B.N.,Mathur, V. Biology of Chordates. PHI Learning Pvt. Ltd., Delhi, 2019


**SOLS/ZOO/DSC (Major)-2 (P) Animal Diversity-II (Practical)** **2 Credits**
**SOLS/ZOO/DSC (Minor)-2 (P) Animal Diversity-II (Practical)** **2 Credits**

**Study of museum specimens/slides:**

**Protochordata:** *Balanoglossus, Herdmania, Branchiostoma*, Agnatha: *Petromyzon*, *Myxine*

**Pisces:** *Sphyrna, Pristis, Torpedo, Exocoetus, Anguilla*, *Acipenser*, *Latimaria*, *Chimaera* **Amphibia:** *Ichthyophis/ Ureotyphlus, Salamandra, Bufo, Hyla*

**Reptilia:***Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis*; Key for Identification of poisonous and non-poisonous snakes

**Aves:** Study of six common birds from different orders

**Mammalia:** *Sorex*, Bat, *Funambulus*, Loris, Platypus, Opossum, Kangaroo, Manis, Dolphin, Whale, Lutra, Camel, Polar Bear (Photographs)

An"animal album"containing photographs, cutouts with appropriate write up about the above mentioned taxa. Different taxa/topics may be given to different sets of students for this purpose. These need not be repeated as drawings by the album maker.

## MULTIDISCIPLINARYD/INTERDISCIPLINARY COURSE
## (Theory: 2 Credits; Practical: 2 Credits)

**SOLS/ZOO/MD/ID- 1 Laboratory Techniques in Biology 2 Credits [30 Hours]**

**Unit I.** Solutions Preparation: Solute, Solvent, Solution; Water-based or aqueous solution for biological application**,** Methods for dissolving the solute in purified water and adjusting the pH of the solution. Method for addition of the quantity sufficient (QS) to reach the desired volume; Buffer solution; Molarity, Normality [7 Hours]

**Unit II.** Concentration and Measuring Volumes: Serial dilution, Use of a serial dilution to prepare standards for generating a standard curve; Serological Pipettes, Pipettors use of pipet-aid, Measuring Mass: Analytical balance, Weighing, tarring [7 Hours]

**Unit III.** Study the parts of a compound microscope- eyepiece and objective lens, condenser lens, mirror, stage, coarse and fine adjustment knobs, and their basic functions. Micrometry- Measuring microscopic organism, measuring cell size in permanent slide viz. protozoan, microscopic invertebrates, egg diameter etc. Recording of microscopic images and videos using microscopic camera [8 Hours]

**Unit IV.** Museum preparation- Preserving macroscopic organisms (invertebrate and vertebrate specimen). Permanent slide preparation: basic histological and histochemical techniques,

Laboratory safety: Laboratory lay out, wet lab, storage of chemicals and glassware. Maintenance of Laboratory equipment (microscopes, centrifuge, incubators, analytical and electronic balances, electrophoretic units, pH meter, turbidity meter etc.); precautions while working in laboratory [8 Hours]

**Recommended Books:**


1. Charles R Cantor, PaulR. Schimmel (2008). Biophysical Chemistry (Techniques for the Study of Biological Structure and Function), Part II, W.H. Freeman and Company, ISBN-13: 978-0716711902
2. Plummer David T. (2004). Introduction to Practical Biochemistry, 3rd edition, Tata McGraw Hill, ISBN-9780070994874
3. Wester John G. (2008). Bio instrumentation,Wiley & Sons, ISBN-97881265136
4. Wilson Keith, John Walker (2010). Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, ISBN-978052173167


**SOLS/ZOO/MD/ID-1 (P) Laboratory Techniques in Biology (Practical) 2 Credits [30Hours]**

1. Preparation of an Aqueous Solution of a Given Molarity.
2. pH Adjustment of a Buffer Solution, demonstrating the use of a pH meter and safe handling of acids/bases.
3. Performing a serial dilution of a stock protein solution.
4. Use of Pipettes, Micropipettes and pipet-aid devices.
5. Measurement of mass: demonstration of tarring, weighing, and transferring.
6. Preparation of a Buffer Solution of Specific Normality.
7. Study and Identification of Compound Microscope Parts.
8. Demonstration of Micrometer for Measuring the Diameter of a Microscopic Organism.
9. Preparation of Permanent Slides

**SOLS/ZOO/MD/ID- 2 Basic Instrumentation 2 Credits [30 Hours]**

**Unit I. Principles and applications of Microscopy:** Light, phase contrast, confocal, transmission electron microscopy (TEM & SEM), Principle and application of Colorimeter. Principle of UV-Visible absorption spectrophotometry, instrumentation, and applications, Fluorimetry: Phenomena of fluorescence, intrinsic and extrinsic fluorescence, instrumentation and applications [8 Hours]

**Unit II.** Principle of centrifugation, basic rules of sedimentation, sedimentation coefficient, various types of centrifuges, different types of rotors, differential centrifugation, density gradient centrifugation

Basic principles of chromatography: Partition coefficient, concept of theoretical plates, various modes of chromatography (paper, thin layer, column), preparative and analytical applications, LPLC and HPLC. Principle and applications of: Paper Chromatography, Thin Layer Chromatography. Molecular Sieve Chromatography, Ion Exchange Chromatography, Affinity Chromatography [10 Hours]

**Unit III.** Basic Principle of electrophoresis, Paper electrophoresis, Gel electrophoresis, discontinuous gel electrophoresis, PAGE, SDS-PAGE. Agarose gel electrophoresis, buffer systems in electrophoresis. Electrophoresis of proteins and nucleic acids, protein and nucleic acid blotting, detection and identification [6 Hours]

**Unit VI.** Principle and applications of pH meter, autoclave, biosafety cabinets/practices; polymerase chain reaction; Water analysis kit; Principle and application of Turbidity meter, Conductivity meter, Flow meter; Types of Owen &

Incubators-BOD & COD Incubator [6 Hours]

**Recommended Books:**


1. Freifelder, D. (1982). Physical Biochemistry: Applications to Biochemistry and Molecular Biology, 2nd ed.,
2. W.H. Freeman and Company, New York
3. Plummer D.T. (1998). An Introduction to Practical Biochemistry, 3rd ed., Tata McGraw Hill Education Pvt. Ltd., New Delhi


**SOLS/ZOO/MD/ID- 2 (P) Basic Instrumentation (Practical) 2Credits**

1. Demonstration of Light Microscope – Parts and focusing.
2. Charts of optical paths of light, phase contrast, confocal microscopes, SEM and TEM.
3. Photographs of UV-Vis Spectrophotometer and Fluorimeter.
4. Charts: Types of rotors, sedimentation principle, density gradients.
5. Separation of plant pigments using Paper Chromatography.
6. Demonstration of steps in electrophoresis and pre-prepared gel image printouts.
7. Water sample analysis e.g. Dissolved Oxygen, pH and Conductivity
8. Charts: Working of PCR, Biosafety Cabinet Types.