



**MODERN COLLEGE OF ARTS, SCIENCE AND  
COMMERCE GANESHKHIND, PUNE-16  
(AUTONOMOUS)**

**Three Year B.Sc. Degree Program in  
ZOOLOGY  
(Faculty of Science)**

**F. Y. B. Sc. Zoology Syllabus**

**Choice Based Credit System Syllabus**

**To be implemented from Academic Year 2022-2023**

**BOARD OF STUDIES IN ZOOLOGY**

**Progressive Education Society's  
MODERN COLLEGE OF ARTS, SCIENCE AND COMMERCE, GANESHKHIND, PUNE- 16  
(AUTONOMOUS)**

**Preamble:**

Zoology is one of the major subjects in Basic Sciences and deals with all aspects of animal biology. It includes an interesting range of highly diverse topics. A zoology student needs to gain an understanding of many areas of the subject to keep pace with advancements in the Life Sciences. This under-graduate degree program has been designed by the Board of Studies in Zoology of **Progressive Education Society's Modern College of Arts, Science and Commerce, Ganeshkhind, Pune- 16 (Autonomous)** with a substantial component of what is needed from zoologists as a skilled career and what zoologists need to pursue for post-graduation and further academic studies. It follows the guidelines laid down by the University Grants Commission, New Delhi. This newly designed curriculum is a perfect blend of the classical aspects of Zoology and the advanced and more specialized areas. This degree offers Discipline Specific Core Courses [CC] in Animal Systematics, Animal Ecology, Animal Cell Biology, Applied Zoology, Pest Management, Histology, Biological Chemistry, Genetics, Developmental Biology, Parasitology, Medical & Forensic Zoology, Animal Physiology, Molecular Biology, Entomology, Techniques in Biology and Evolutionary Biology.

In addition to the Core Courses, Ability Enhancement Compulsory Courses [AECC] have been added in the second year i.e. Semester III and Semester IV of the undergraduate course. In the third year i.e. Semester V and Semester VI, Discipline specific Elective Courses [DSEC] and Skill Enhancement Courses [SEC] have been offered. The students, therefore, have an opportunity to take courses in Environment Awareness, Language communication: English/Marathi, Aquarium Management, Poultry Management and Biodiversity Assessment. In Semester VI the students also have a course dedicated to Project work.

The syllabus has been framed in such a way that the student gains each year, a broader perspective of the subject as he progresses towards completion of the degree program. Field trips, Educational visits and the Project work have been included for the student to experience the applications of the theory learnt in the classroom.

After completion of the program, it is expected that students will understand and appreciate: animal diversity, few applications of Zoology, the structure, functions and life processes at the cellular, tissue, organ and system level, significance of evolution, and basic concepts of human health. The students would also gain an insight into laboratory and field work through the practical course, field work and the project. While presenting this new syllabus to the teachers and students of F.Y.B.Sc. Zoology, I am extremely happy to state that efforts have been made to seek inputs from all the stake holders to make it more relevant.

The new course that will be effective from the academic year 2019- 2020 and will follow the Choice Based Credit System in a Semester mode. It has been primed keeping in view the distinctive requirements of B.Sc. Zoology students. The contents have been drawn-up to accommodate the widening prospects of the discipline of Life Sciences. They reflect the changing prerequisites of the students. This program has been introduced with 132 credits

for the subject group while 08 credits to earn from any of the 08 groups offering a range of curricular, co-curricular and extracurricular activities. This pattern has been specially aimed towards the overall development of the students'. The calculation of credits and CGPA will be as per the guidelines of the University. The B.Sc. Zoology program provides an appropriate blend of classical and applied aspects of the subject. This newly designed curriculum will allow students to acquire the skills in handling scientific instruments planning and performing in the laboratory and exercising critical judgment, independent thinking and problem solving skills. The syllabus has been revised with the following aims

- To foster curiosity in the students for Zoology
- To create awareness amongst students for the basic and applied areas of Zoology
- To orient students about the importance of abiotic and biotic factors of environment and their conservation.
- To provide an insight to the aspects of animal diversity.
- To inculcate good laboratory practices in students and to train them about proper handling of lab instruments.

**I. Course Structure with Credit Distribution of the First year Zoology Syllabus**

Semester	Course	Course code	Name of the Course	Credits
<b>I</b>	CC	<b>22-ZO-111</b>	Animal Systematics and Diversity-I	2 Credits (30 L)
	CC	<b>22-ZO-112</b>	Ecosystem and its Dynamics	2 Credits (30 L)
	CC	<b>22-ZO-113</b> (Based on <b>22-ZO-111+22-ZO-112</b> )	Zoology Practical	1.5 Credits
<b>Semester II</b>	CC	<b>22-ZO-121</b>	Animal Systematics and Diversity-II	2 Credits (30 L)
	CC	<b>22-ZO-122</b>	Fundamentals of Cell Biology	2 Credits (30 L)
	CC	<b>22-ZO-123</b> (Based on <b>22-ZO-121+22-ZO-122</b> )	Zoology Practical	1.5 Credits
	Mandatory Credit Course	<b>22-12999</b>	Democracy, Election and Governance	2 Credits (30L)

**II. Course Structure with Credit Distribution of the Second year Zoology Syllabus**

Semester	Course	Course code	Name of the Course	Credits
<b>III</b>	CC	<b>23-ZO -231</b>	Animal Systematics and Diversity-III	2 Credits (30 L)
	CC	<b>23-ZO -232</b>	Industrial Zoology- I	2 Credits (30 L)
	CC	<b>23-ZO -233</b> (Based on <b>23-ZO -231+ 23-ZO -232</b> )	Zoology Practical	1.5 Credits
	AECC	<b>23-LA-231</b>	English / Marathi	2 Credits (30 L)
	AECC	<b>23-EVS-231</b>	Environmental Awareness	2 Credits (30 L)
<b>Semester IV</b>	CC	<b>23- ZO -241</b>	Animal Systematics and Diversity-IV	2 Credits (30 L)
	CC	<b>23-ZO -242</b>	Industrial Zoology- II	2 Credits (30 L)
	CC	<b>23-ZO -243</b> (Based on <b>23-</b>	Zoology Practical	1.5 Credits

		ZO -241+ 23- ZO -242)		
	AECC	23-LA-241	English / Marathi	2 Credits (30 L)
	AECC	23-EVS-241	Environmental Awareness	2 Credits (30 L)

### III. Course Structure with Credit Distribution of the Third year Zoology Syllabus

Semester	Course	Course code	Name of the Course	Credits
V	DSEC	24-ZO -351	Pest Management	2 Credits (30 L)
	DSEC	24-ZO-352	Histology and Histopathology	2 Credits (30 L)
	DSEC	24 -ZO -353	Biological Chemistry	2 Credits (30 L)
	DSEC	24 -ZO -354	Genetics	2 Credits (30 L)
	DSEC	24-ZO -355	Developmental Biology	2 Credits (30 L)
	DSEC	24 -ZO-356	Medical Parasitology	2 Credits (30 L)
	DSEC	24-ZO-357 (Based on 24- ZO -351+24- ZO-352)	Zoology Practical –I	2 Credits
	DSEC	24-ZO-358 (Based on 24 - ZO -353+24 – ZO -354)	Zoology Practical –II	2 Credits
	DSEC	24-ZO-359 (Based on 24- ZO -355+24 – ZO-356)	Zoology Practical –III	2 Credits
	SEC	24-ZO-3510	Fishery Management	2 Credits (30 L)
	SEC	24-ZO-3511	Basics in Biostatistics/Veterinary Management	2 Credits (30 L)
Semester VI	DSEC	24-ZO-361	Forensic Zoology	2 Credits (30 L)
	DSEC	24-ZO-362	Animal Physiology	2 Credits (30 L)
	DSEC	24-ZO-363	Molecular Biology	2 Credits (30 L)
	DSEC	24-ZO-364	Applied Entomology	2 Credits (30 L)
	DSEC	24-ZO-365	Tools and techniques in Biology	2 Credits (30 L)
	DSEC	24-ZO-366	Evolutionary Biology	2 Credits (30 L)
	DSEC	24-ZO-367 (Based on 24- ZO-361+24- ZO-362)	Zoology Practical –I	2 Credits
	DSEC	24-ZO-368	Zoology Practical –II	2 Credits

		(Based on <b>24-ZO-363+24-ZO-364</b> )		
	DSEC	<b>24-ZO-369</b> (Based on <b>24-ZO-365+24-ZO-366</b> )	Zoology Practical –III	2 Credits
	SEC	<b>24-ZO-3610</b>	Biodiversity Assessment	2 Credits (30 L)
	SEC	<b>24-ZO-3611</b>	Project/Internship/Hands on Training or Workshop	2 Credits (Minimum 1 week duration)

**CC**=Core Courses,

**DSEC**= Discipline specific Elective Courses

**AECC** =Ability Enhancement Compulsory Courses,

**SEC**= Skill Enhancement Courses

- 1. In addition to the compulsory credits of 132, the student has to earn additional 8 Credits from following groups by taking/participating/conducting respective activities.**
- 2. Courses in Group-I are compulsory.**
- 3. The student can earn maximum 04 credits from an individual group from Group 2 to Group-9. These extra credits will not be considered for GPA calculation; however, These are mandatory for the completion and award of B. Sc. Degree.**

**Group 1:** Physical Education (at F. Y.B. Sc. Sem. I)-01 credit

Physical Education (at F. Y.B. Sc. Sem. II)-01credit (Note: Group I is Compulsory for all the students as stated above.)

**Group 2:** Sport representation at Collegelevel-01 credit

Sport representation at University/Statelevel-02 credits

**Group 3:** National Social Service Scheme (participation in Camp): 01 credits

N.C.C. (with participation in annual camp)-01credit

N. C. C. (with B certificate/C certificate award)-02 credits

N.S.S./N.C.C. Republicdayparadeparticipation-04 credits

**Group 4:** Avishkar participation; Extension activity participation, Cultural activity

Participation-01 credit, Avishkar selection at University level-02 credits.

Avishkar winner at state level-04credits

**Group 5:** Research paper presentation at State/National level-01 credits.

Research paper presentation at international level-02 credits

**Group 6:** Participation in Summer school/programme; Short term course (not less than 1-Week duration) -03 credit.

**Group 7:** Scientific Survey, Societal survey, -02 credits.

**Group 8:** Field Visits; Study Tours; Industrial Visits; Participation in curricular/Co-curricular competitions - 01 Credit.

**Group 9:** Online certificate Courses /MOOC Courses/ Career Advancement Course up to 04 credits (Minimum10 Hrs. / credit)

#### **Completion of Degree Course:**

- A student who earns 140 credits, shall be considered to have completed the requirements of the B. Sc. degree program and CGPA will be calculated for such student.

**Course Title: Animal Systematics & Diversity I**  
**Course Code-22-ZO-111**  
**Semester I (2 credits-30 lectures)**

Sr. no.	Unit	Required Lectures
1.	<p><b>Principles of Classification:</b>            Taxonomy &amp; Systematics            1.1 Taxonomy : Basic terminology and Introduction</p> <ul style="list-style-type: none"> <li>• Alpha, Beta and Gamma levels of taxonomy, Microtaxonomy</li> <li>• Macro taxonomy: Phenetics (numerical taxonomy, Cladistics (Phylogenetic systematics), Evolutionary taxonomy (evolutionary systematics)</li> <li>• Classical taxonomy and experimental or neo taxonomy (biochemical taxonomy and Cytotaxonomy)</li> <li>• Significance of Taxonomy</li> </ul> <p>1.2. Systematics: Definition and introduction            1.3. Linnaean system of classification (Six levels of classification: Phylum, class, order, family, genus, species)            1.4. Concept of Species: Biological &amp; Evolutionary            1.5. Nomenclature: Introduction to Binomial, Trinomial Nomenclature, <b>International Commission on Zoological Nomenclature (ICZN)</b> and rules of Zoological nomenclature</p>	05
2.	<p><b>Introduction to Five Kingdom System</b>            2.1 Introduction and <b>basis for</b> Five Kingdom classification System            2.2. General characters of Kingdom Animalia            2.3. Classification- Protozoa and Metazoa</p>	03
3	<p><b>Kingdom Protista (Phylum: Protozoa)</b>            3.1. Salient features of Phylum Protozoa            3.2. Classification of Phylum Protozoa up to class level with one example of each class</p> <ul style="list-style-type: none"> <li>• Class Rhizopoda</li> <li>• Class Mastigophora</li> <li>• Class Ciliata</li> <li>• Class Protozoa</li> </ul> <p>3.4. Locomotion in Protozoa: Amoeboid, Ciliary and Flagellar with examples            3.5. Economic importance of Protozoa – Harmful and Useful</p>	04
4	<p><b>Type Study of Paramecium</b>            4.1. <i>Paramecium caudatum</i>: Classification, Habit and Habitat, External Morphology            4.2, Feeding and digestion            4.3 Excretion            4.4 Reproduction (binary fission and conjugation)</p>	04
5	<p><b>Phylum Porifera</b>            5.1. Salient features of Phylum Porifera            5.2. Classification of Phylum Porifera up to class level with any One example of each class</p>	06



	<ul style="list-style-type: none"> <li>• Class Calcarea</li> <li>• Class Hexactinellida</li> <li>• Class Demospongiae</li> </ul> <p>5.3. Canal system in sponges: Ascend, Sycon, Leucon and Reagan type.</p> <p>5.4. Regeneration in sponges.</p> <p>5.5. Economic importance of Phylum Porifera.</p>	
<b>6</b>	<p><b>Phylum: Cnidaria</b></p> <p>6.1. Salient features of Phylum Cnidaria</p> <p>6.2. Classification of Phylum Cnidaria up to class level with any one given examples each class</p> <ul style="list-style-type: none"> <li>• Class Hydrozoa</li> <li>• Class Scyphozoa</li> <li>• Class Anthozoa</li> </ul> <p>6.3. Polymorphism in Hydrozoa</p> <p>6.4. Regeneration <i>Hydra</i></p> <p>6.5. Economic importance of Cnidarians</p>	<b>04</b>
<b>7</b>	<p><b>Phylum Platyhelminthes</b></p> <p>7.1. Salient features of Phylum Platyhelminthes</p> <p>7.2. Classification of Phylum Platyhelminthes up to class level with one example of each class</p> <ul style="list-style-type: none"> <li>• Class: Turbellaria</li> <li>• Class: Trematoda</li> <li>• Class Cestoda:</li> </ul> <p>7.3 Parasitic adaptations in Platyhelminthes</p> <p>7.4. Medical importance of Platyhelminthes</p>	<b>04</b>

**Course Title: Ecosystem and its Dynamics**  
**Course Code-22-ZO-112**  
**Semester I (2 credits-30 lectures)**

Sr. no.	Unit	Required Lectures
1.	<b>Introduction to Ecology</b> 1.1 Concepts of Ecology, Environment, Population, Community, Ecosystem, Biosphere, biomes, Autecology and synecology, <b>Niche</b>	<b>02</b>
2	<b>Population</b> 3.1 Characteristic of population: Density, Natality, Mortality, Age ratio, Sex ratio, 3.2 Exponential and logistic growth, 3.3 Gause's Principle <b>3.4 Sampling Methods- Quadrat and Line transect.</b>	<b>06</b>
3	<b>Community</b> 4.1 Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, 4.2 Eco tone and edge effect ; 4.3 Ecological succession with one example.	<b>06</b>
4	<b>Ecosystem</b> 2.1 Types of ecosystems: Aquatic (Freshwater, estuarine, Marine and terrestrial (Forest, Grassland and Desert) 2.2 Composition of Ecosystem (Abiotic components and biotic components). 2.3 Food chain: Detritus and grazing food chains, Food web 2.4 Ecological pyramids – Number, Biomass, Energy.	<b>07</b>
5	<b>Biogeochemical Cycles –</b> 5.1 Carbon Cycle 5.2 Nitrogen Cycle 5.3 Water Cycle	<b>04</b>
6	<b>Biodiversity and conservation</b> 6.1 Types and Hotspots of Biodiversity. 6.2 Loss of Biodiversity 6.3 Conservation Strategies- <b>Ex-Situ and In-situ conservation</b> 6.4 Application of ecology in wildlife conservation	<b>05</b>

**Course Title: Zoology Practical****Course Code- 22-ZO-113****Semester I (1.5 credits)**

Sr. no.	Unit of Animal Systematics & Diversity I
1.	Museum Study of phylum Protozoa: <i>Euglena</i> , <i>Paramecium</i> , <i>Amoeba</i> , <i>Plasmodium</i> sp.
2.	Museum study of Phylum Porifera: <i>Sycon</i> , <i>Euplectella</i> , <i>Chalina</i> , <i>Spongilla</i> .
3	Museum study of phylum Cnidaria: <i>Hydra</i> , <i>Physalia</i> , <i>Aurelia</i> , <i>Metridium</i> .
4	Museum Study of phylum Platyhelminthes: <i>Planaria</i> , <i>Faciola hepatica</i> , <i>Taenia solium</i>
5	Study of <i>Paramecium</i> : Culture, External morphology,
6	Study of <i>Paramecium</i> : Conjugation and Binary fission and Cyclosis
7	Study of permanent slides: Spicules and Gemmules in Sponges, <i>Taenia solium</i> : Scolex, Gravid proglottid.
8	Identification of any three museum specimen with help of taxonomic identification key.
9	Visit to Zoological survey of India/ Museum/National Park.
Sr. No.	Unit of Ecosystem and its Dynamics
1.	Estimation of Dissolved oxygen from given water sample <b>using wrinkler's Method.</b>
2.	Study of animal community structure by quadrat method (Field or Simulation).Determination of density, frequency and abundance of species by quadrat method.
3.	Study of any five microscopic zooplanktons of freshwater ecosystem (from pond).
4.	Study of Physicochemical properties of given soil sample. Any 2 Physical and Any 2 Chemical
5.	Estimation of dissolved and free carbon dioxide from water sample.
6.	Study of Eutrophication in lake/river.
7.	Study of diversity indices – Shannon and Simpson.

**Course Title: Animal Systematics and Diversity II**  
**Course Code-22-ZO-121**  
**Semester II (2 credits-30 lectures)**

Sr. no.	Unit	Required Lectures
1.	<b>Phylum Aschelminthes</b> 1.1 Salient features of Phylum Aschelminthes 1.2 Classification of Phylum Aschelminthes upto class level with any one example of each class. 1.3 Economic importance of Aschelminthes	03
2.	<b>Phylum Annelida</b> 2.1 Salient features of Phylum Annelida. 2.2 Classification of Phylum Annelida up to class level with any one example of each class Class Polychaeta • Class Oligochaeta • Class Hirudinea • <b>Class Archiannelida</b> 2.3 Economic importance of Annelida	05
3	<b>Phylum Arthropoda</b> 3.1 Salient features of Phylum Arthropoda • Classification of Phylum Arthropoda upto class level with any one example of each class • Class: Crustacea • Class: Chilopoda • Class: Diplopoda • Class Insecta • Class: Arachnida 3.2 Economic importance of Arthropoda	06
4	<b>Phylum Mollusca</b> 4.1 Salient features of Phylum Mollusca 4.2 Classification of Phylum Mollusca upto class level with any one example of each class. • Class Gastropoda • Class Pelecypoda • Class Polyplacophora • Class: Cephalopoda 4.4 Economic importance of Mollusca.	05

<b>5</b>	<b>Study of Phylum Echinodermata</b> 5.1 Salient features of Phylum Echinodermata. 5.2 Classification of Phylum Echinodermata upto class level with any one example from each class <ul style="list-style-type: none"><li>• Class Asteroidea</li><li>• Class: Holothuroidea.</li><li>• Class: Echinoidea</li><li>• Class: Crinoidea</li></ul> 5.3 Pedicellaria in Echinodermata: straight, crossed, valvate, tridactylous, globigerous. 5.4 Economic importance of Echinodermata	<b>06</b>
<b>6</b>	Type study: <i>Asterias rubens</i> (Sea Star): 6.1 Classification, Habit, Habitat, External Morphology, 6.2 Digestive system, Food and feeding mechanism. 6.3 Water vascular System 6.4 Autotomy and regeneration	<b>05</b>

**Course Title: Fundamentals of Cell biology**  
**Course Code-22-ZO-122**  
**Semester II (2 credits-30 lectures)**

Sr. no.	Unit	Required Lectures
1.	<b>Introduction:</b> 1.1 Cell as Basic unit of Life 1.2 Introduction to Prokaryotic and Eukaryotic cells. 1.3 Structure of Prokaryotic ( <i>E. coli</i> ) 1.4 Structure Eukaryotic cells (Animal and Plant cell)	03
2	<b>Plasma Membrane:</b> 2.1 Structure of plasma membrane: Fluid mosaic model. 2.2 Transport across membranes: Active and Passive transport, Facilitated transport, exocytosis, endocytosis, phagocytosis – vesicles and their importance in transport. 2.3 Functions of Cell membrane in brief	06
3	<b>Nucleus: Structure and function</b> 3.1 Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleoplasm, Nucleolus 3.2 Chromatin: Euchromatin and Heterochromatin, nature and differences. 3.3 Functions of nucleus	05
4	<b>Mitochondria</b> 4.1 Endosymbiont theory of mitochondrial biogenesis 4.2 Ultrastructure of mitochondria and its functions 4.3 Mitochondrial DNA and importance	03
5	<b>Endoplasmic reticulum(ER), Golgi complex and Lysosomes</b> 5.1 Structure and functions of E.R. 5.2 Structure and functions of Golgi complex 5.3 Structure and functions of Lysosome	06
6	<b>Cell Division</b> 6.1 Cell cycle 6.2 Mitosis. 6.3 Meiosis.	05
7	<b>Importance of Cell Biology and its industrial applications</b>	02

**Course Title: Zoology Practical**  
**Course Code- 22-ZO-123**  
**Semester II (1.5 credits)**

Sr. no.	Unit of Animal Systematics and Diversity II
1.	Museum study of Phylum Aschelminthes: <i>Ascaris lumbricoides</i> ,
2.	Museum study of phylum Annelida: <i>Nereis</i> , Earthworm, Leech.
3	Museum study of phylum Arthropoda: Prawn, Cockroach, Centipede, Millipede, Crab
4	Museum study of phylum Mollusca: <i>Pila</i> , <i>Chiton</i> , Bivalve, Octopus.
5	Museum study of phylum Echinodermata: Sea Star, Sea urchin, Brittle Star, Sea cucumber.
6	Study of permanent slides: Mouthparts of Insects -Mandibulate, Piercing and sucking, Chewing and Lapping.
7	Types of shell in Mollusca. <i>Pila</i> , Bivalve, Chiton, Sepia.
8	Economic importance of honey bees, Lac insects silk worms, red cotton bug, Anopheles mosquito.
9	Visit to vermicomposting unit/Field/ <b>Entomology museum of agricultural college</b>
10	Submission of Geotagged Photographs of any five invertebrates <b>with detailed Classification report.</b>
Sr. no.	Unit of Fundamentals of Cell biology
1.	Study of Microscope: Simple and Compound electron microscope
2.	Micrometry: Measurement of microscopic objects
3.	Preparation of temporary mount of human buccal epithelial cells
4.	Preparation of blood smears to observe the blood cells
5.	Temporary preparation of mitotic cell from onion roots
6.	Detection of Mitochondria by Janus Green B
7.	Visit to NCCS/IISER/SPPU for study of Cytotechniques.

### Recommended Reference Books

#### Animal Systematics and Diversity – I and II

1. Anderson, D.T (Ed) 1988: Invertebrate Zoology, Oxford University Press.
2. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
3. 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
4. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
5. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home.
6. Brusca, R.C and Brusca, G. J (2003): Invertebrate (2<sup>nd</sup> ed.) Sinauer Associates Inc., Publishers Sunderland.
7. Hadzi, J (1963): The Evolution of Metazoa, Macmillan Newyork.
8. Hyman, L. H (1940): Invertebrates Vol I, Protozoa through ctenophore.
9. Hyman. L. H (1955): The Invertebrates Vol: IV, Echinodermata, the coelomate bilateria, Mcgraw Hill, Newyork.
10. Modern Text-Book of zoology, Vertebrates. By Kotpal, RL., Rastogi and Co., Meerut.
11. Nigam H.C., Zoology of Chordates, Vishal Publication, Jalandhar-144008.
12. Phylum Protozoa to Echinodermata (series) by Kotpal, RL. Rastogi and Co., Meerut
13. Parker T.J and W.A Haswell (1972): A text book of Zoology, Vol –I (7<sup>th</sup> edition by Marshall and Williams) Mcmillan Press ltd.
14. Jordan, E.L. and P.s.Verma Invertebrate Zoology, S. Chand and Co., Ltd. Ram Nagar, New Delhi.
15. Russel Hunter: - A Biology of higher invertebrates, MacMillon Co. Ltd. London



**Ecosystem and its Dynamics**

1. Colinvaux, P. A. (1993). Introduction to Ecology. II Edition. Wiley, John and Sons, Inc.
2. Krebs, C. J. (2001). Ecology: The Experimental Analysis of Distribution and Abundance, 6th Edition, ©2009, Pearson
3. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
4. Robert Leo Smith Ecology and field biology Harper and Row publisher
5. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press
6. Sharma P.D. (2002) Ecology and Environment, Himalaya Publication

**Fundamentals of Cell Biology**

1. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition John Wiley and Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VII Edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition. ASM Press and 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*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London
6. Inside the Cell (2005); US Department of Health Sciences, National Institute of Health, Natinal institute of General Medicine Sciences.
7. Lodish, H., D. Baltimore, A. Berk, L. Zipursky, M. Matsudaira and J. Darnell. (2010).
8. Molecular Cell Biology, Eds. 3, Scientific American & W. H. Freeman. New York.
9. Powar C B.: Cell Biology, Himalaya Publication, Meerut

*Note: Latest editions of the recommended books may be referred.*

Chairman, B.O.S.

Principal