Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar

(Autonomous)

(Affiliated to Savitribai Phule Pune University, Pune)

Choice Based Credit System (CBCS)

Bachelor of Science (B.Sc.)

Syllabus of

F.Y.B.Sc. (Zoology)

Implemented from

Academic year 2021 -22

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Board of Studies in Zoology

Sr. No.	Name	Designation
1.	Hon. Prof. A. K. Pandarkar	Chairman
2.	Hon. Dr. L. U. Kunjir	Member
3.	Hon. Prof. S. N. Pokale	Member
4.	Hon. Dr. A. D. Harkal	Member
5.	Hon. Prof. R. J. Chavan	Academic Council Nominee
6.	Hon. Prof. S. S. Nanware	Academic Council Nominee
7.	Hon. Dr. S. S. Teradalkar	Vice-Chancellor Nominee
8.	Hon. Prof. B. A. Pawar	Alumni
9.	Hon. Mrs. Manjushree Tadvalkar	Industry Expert
10.	Hon. Shri. M. S. Kasture	Member (co-opt)
11.	Hon. Mrs. S. P. Salve	Member (co-opt)

1. Prologue

Zoology is one of the major subjects of Basic Sciences and deals with all aspects of animal biology. It includes an interesting range of highly diverse topics. A zoology student needs to understand many areas of the subject to keep pace with advancements in Life Sciences. The Board of Studies has designed this under-graduate degree program in Zoology of New Arts, Commerce and Science College, Ahmednagar (Autonomous) with a substantial component of zoologists' needs as a skilled career zoologists need to pursue 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 in Zoology and the advanced and more specialized areas. This degree offers Discipline Specific Core Courses [CC] in Animal Systematics and Diversity, Animal Ecology, Cell Biology, Genetics and Techniques in Biology. 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 DSEC courses are Animal Biology, Mammalian Histology, Applied Zoology, Biochemistry, Developmental Biology, Parasitology, Animal Physiology, Molecular Biology, Evolutionary Biology and Entomology. The SEC courses are Computer Applications in Biology, Recombinant DNA Technology and Project. In Semester VI, the students also have a course dedicated to Project work.

The syllabus has been framed so that the student gains each year a broader perspective of the subject as he/ she progresses towards completion of the degree program. Field trips, educational visits and Project work have been included to experience the applications of the theory learned in the classroom. After completing the program, it is expected that students will understand and appreciate: animal diversity, few applications of Zoology, the Structure, functions and life processes at cellular, tissue, organ and system level, the significance of evolution, and basic concepts of human health. The students would also gain an insight into laboratory and fieldwork through the practical course, fieldwork and the project. Presenting this new syllabus to the teachers and students of F.Y.B.Sc. Zoology, we are delighted to state that efforts have been made to seek the inputs of all the stakeholders to make it more relevant. The new course will be effective from 2021-2022 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 CGPA credits and 08 non CGPA credits. 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 Academic council. 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 skill in handling scientific instruments, planning and performing in the laboratory and exercising critical judgment, independent thinking and problem-solving skills.

2. Programme Outcomes (POs)

- **Disciplinary knowledge and skills**: Capable of demonstrating comprehensive knowledge and understanding of major concepts, theoretical principles and experimental findings in Zoology and its different subfields and other related fields of study, including broader interdisciplinary subfields.
- **Skilled communicator**: Ability to impart complex technical knowledge relating to Zoology clearly and concisely in writing and oral skills.
- **Critical thinker and problem solver**: Ability to have critical thinking and efficient problem-solving skills in the basic areas of Zoology
- **Sense of inquiry**: Capability for asking relevant/appropriate questions relating to issues and problems in the field of Zoology, and planning, executing and reporting the results of an experiment or investigation.
- **Team player/worker**: Capable of working effectively in a diverse classroom, laboratory, industry, and field-based situations.
- **Skilled project manager**: Capable of identifying/mobilizing appropriate resources required for a project and manage a project to completion while observing responsible and ethical scientific conduct; and safety and chemical hygiene regulations and practices.
- **Digitally literate**: Capable of using computers for Bioinformatics and computation and appropriate software for analysis of genomics and proteomics data, and employing modern bioinformatics search tools to locate, retrieve, and evaluate the location and biological annotation genes of different species.

- **Ethical awareness/reasoning**: Capable of conducting their work with honesty and precision, thus avoiding unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, and appreciating environmental and sustainability issues.
- **Lifelong learners**: Capable of self-paced and self-directed learning aimed at personal development and improving knowledge/skill development and reskilling.

Programme Structure and Course Titles

Sr. No.	Class	Semester	Course Code	Course Title	Credits
1.	F. Y. B.Sc.	I	BSC-ZO-101 T	Animal Systematics & Diversity- I	02
2.	F. Y. B.Sc.	I	BSC-ZO-102 T	Animal Ecology	02
3.	F. Y. B.Sc.	I	BSC-ZO-103 P	Zoology Practical Paper-I	1.5
4.	F. Y. B.Sc.	II	BSC-ZO-201 T	Animal Systematics & Diversity- II	02
5.	F. Y. B.Sc.	II	BSC-ZO-202 T	Cell Biology	02
6.	F. Y. B.Sc.	II	BSC-ZO-203 P	Zoology Practical Paper-II	1.5
7.	S. Y. B.Sc.	III	BSC-ZO-301 T	Animal Systematics & Diversity- III	02
8.	S. Y. B.Sc.	III	BSC-ZO-302 T	Genetics	02
9.	S. Y. B.Sc.	III	BSC-ZO-303 T	Zoology Practical Paper- III	02
10.	S. Y. B.Sc.	IV	BSC-ZO-401 T	Animal Systematics & Diversity- IV	02
11.	S. Y. B.Sc.	IV	BSC-ZO-402 T	Biological Techniques	02
12.	S. Y. B.Sc.	IV	BSC-ZO-403 P	Zoology Practical Paper- IV	02
13.	T. Y. B.Sc.	V	BSC-ZO-501 T	Animal Biology- I	02
14.	T. Y. B.Sc.	V	BSC-ZO-502 T	Mammalian Histology	02
15.	T. Y. B.Sc.	V	BSC-ZO-503 T	Applied Zoology- I	02
16.	T. Y. B.Sc.	V	BSC-ZO-504 T	Biochemistry	02
17.	T. Y. B.Sc.	V	BSC-ZO-505 T	Developmental Biology	02
18.	T. Y. B.Sc.	V	BSC-ZO-506 T	Parasitology	02
19.	T. Y. B.Sc.	V	BSC-ZO-507 P	Zoology Practical Paper- V	02
20.	T. Y. B.Sc.	V	BSC-ZO-508 P	Zoology Practical Paper- VI	02

21.	T. Y. B.Sc.	V	BSC-ZO-509 P	Zoology Practical Paper- VII	02
22.	T. Y. B.Sc.	V	BSC-ZO-510 T	Computer Applications in Biology	02
23.	T. Y. B.Sc.	V	BSC-ZO-511 P	Zoology Practical Paper- VIII	02
24.	T. Y. B.Sc.	VI	BSC-ZO-601 T	Animal Biology- II	02
24.	T. Y. B.Sc.	VI	BSC-ZO-602 T	Animal Physiology	02
25.	T. Y. B.Sc.	VI	BSC-ZO-603 T	Applied Zoology- II	02
26.	T. Y. B.Sc.	VI	BSC-ZO-604 T	Molecular Biology	02
27.	T. Y. B.Sc.	VI	BSC-ZO-605 T	Evolutionary Biology	02
28.	T. Y. B.Sc.	VI	BSC-ZO-606 T	Entomology	02
29.	T. Y. B.Sc.	VI	BSC-ZO-607 P	Zoology Practical Paper- IX	02
30.	T. Y. B.Sc.	VI	BSC-ZO-608 P	Zoology Practical Paper- X	02
31.	T. Y. B.Sc.	VI	BSC-ZO-609 P	Zoology Practical Paper- XI	02
32.	T. Y. B.Sc.	VI	BSC-ZO-610 T	Recombinant DNA Technology	02
33.	T. Y. B.Sc.	VI	BSC-ZO-611 Pr	Project	02
	Total	**06**	**33**		**67**

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New Arts, Commerce and Science College, Ahmednagar

(Autonomous)

Syllabus of F.Y. B. Sc. Zoology (Semester-I)

under

Faculty of Science and Technology

Semester – I	**Paper – I**
Course Code: BSC-ZO 101 T	**Title of the Course: Animal Systematics and Diversity- I**
Credits: 02	**Total Lectures: 30 Hrs.**

Course Outcomes (COs)

1. Understand classification and identification of animals.
2. Understand the general physiological mechanism in the lower invertebrates.
3. Learn the economic importance of lower invertebrates.
4. Understand the peculiar characters lower invertebrates.

Detailed Syllabus

Unit	Name of Topic	Lectures Allotted
1.	**Animal Classification and Architecture**	**(06)**

Classification, Systematics, and Taxonomy.

Binomial and Trinomial Nomenclature.

Concept of Species.

Classifying Organisms (Hierarchies of classification).

Modern Classification Systems: Five Kingdom and Three Kingdom System.

Organization and Body Plan: Symmetry and Cephalisation, Germ Layers and Body Cavity, Grades of organizations, Developmental Patterns, Segmentation.

Outline Classification of Kingdom Animalia.

2. Animal Like Protists: Protozoans **(05)**

General Characters of Protista with particular emphasis on Protozoans.

Classification: Super Group Excavata, Super Group 'SAR' Clade, Super Group Unikonta.

Structural Organisation and Function in Protozoa.

Body Forms, Nutrition, Osmoregulation and Excretion, Respiration. The mechanism for Response, Reproduction in Protozoa.

Locomotion in Protozoans: Structure and Function of Cilia, Flagella and Pseudopodia.

Economic importance of Protozoa.

3. Introduction to Metazoa **(01)**

Origin and Diversification of Metazoa, Origin of Multicellularity, Diversification, and Phylogeny of Animals

4. Phylum Porifera **(05)**

Characteristic Features of Phylum Porifera.

Classification of Phylum Porifera: Calcaria, Hexactinellida, Demospongea, and Sclerospongea.

Types of Canal System: Asconoid, Syconoid, Leuconoid, and Rhagon Skeleton in Porifera.

External Morphology and Cell types in Sycon.

5. Phylum Cnidaria **(05)**

Characteristic Features of Phylum Cnidaria.

Classification of Phylum Cnidaria: Hydrozoa, Scyphozoa, and Anthozoa.

Polymorphism in Cnidaria.

External Morphology and Life Cycle of *Hydra* (Short Introduction)

Coral and coral reefs.

6. Phylum Platyhelminthes **(04)**

Characteristic Features of Phylum Platyhelminthes.

Classification of Phylum Platyhelminthes: Turbellaria, Trematoda,

and Cestoda.

External Morphology and Life Cycle of *Taenia solium* (Short Introduction).

Economic importance of Platyhelminthes.

7. Phylum Aschelminthes (04)

Characteristic Features of Phylum Aschelminthes.

Classification of Phylum Aschelminthes: Introduction to Psuedocoelomates with particular emphasis on Nematodes.

External Morphology and Life Cycle of *Ascaris lumbricoides* (Short Introduction).

Economic importance of Nematoda.

Suggested Reading:

1. **Barnes, R.D. (1982). Invertebrate Zoology,** V Edition. Holt Saunders International Edition.
2. **Hadzi, J (1963): The Evolution of Metazoa,** Macmillan Newyork.
3. **Hyman. L. H (1955): The Invertebrates** Vol: I-X, Mcgraw Hill, Newyork.
4. **Modern Text-Book of Zoology, Invertebrates.** By Kotpal, RL., Rastogi and Co., Meerut.
5. **Nigam H.C., Zoology of Nonhordates,** Vishal Publication, Jalandhar-144008.
6. **Kotpal, RL. Rastogi Phylum Protozoa to Echinodermata (series),** Meerut
7. **Parker T.J and W.A Haswell (1972): A textbook of Zoology,** Vol –I (7th edition by Marshall and Williams) Mcmillan Press ltd.
8. **Jordan, E.L. and P.S.Verma Invertebrate Zoology,** S. Chand and Co., Ltd. Ram Nagar, New Delhi.

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Syllabus of F.Y. B. Sc. Zoology (Semester-I)

under

Faculty of Science and Technology

Semester – I	**Paper – II**
Course Code: BSC-ZO 102 T	**Title of the Course: Animal Ecology**
Credits: 02	**Total Lectures: 30 Hrs.**

Course Outcomes (COs)

1. Understand the population and community structure.
2. Understand the structure and characteristics of ecosystem.
3. Understand the types of animal interaction.
4. Understand the applications of ecology.

Detailed Syllabus

Unit	Name of Topic	Lectures Allotted
1.	**Introduction to Ecology** Concepts of Ecology, Environment, Population, Community, Ecosystem, Biosphere, Autecology and Synecology.	**(02)**
2.	**Population** Characteristic of Population: Density, Natality, Mortality, Fecundity tables, Survivorship curves, Age ratio, Sex ratio, Dispersal and Dispersion. Exponential and logistic growth. Population regulation – density-dependent and independent factors. Population interactions, Gause's principle with laboratory and field interactions.	**(06)**

3. Community. **(06)**

Community characteristics: Species richness, Dominance, Diversity, Abundance, Vertical stratification, Ecotone and edge effect; Ecological Succession with one Example.

4. Ecosystem **(07)**

Types of ecosystems: Aquatic (Freshwater, Estuarine, Marine) and Terrestrial (Forest, Grassland and Desert).

Structure and Composition of Ecosystem (Abiotic components and biotic components).

Food chain: Detritus and grazing food chains, Food web, Energy flow through the Ecosystem, Ecological Pyramids: Number, Biomass, and Energy.

5. Animal Interactions **(04)**

Introduction Animal interactions.

Types of Animal interactions with at least two suitable examples of each.

Competition: Interspecific and Intraspecific.

Beneficial Associations: Commensalism, Mutualism (Any 2 Examples).

Antagonistic associations: Parasitism, Prey predation (Any 2 Examples).

6. Applied Ecology **(05)**

Ecology in wildlife conservation and management.

Biodiversity types, Importance & Threats.

Protected areas: National Parks, Bio reserves and Sanctuaries, Restoration ecology.

Global climate change and its mitigation.

Suggested Reading:

1. **Ahluwalia V.K. & Malhotra S. (2006) Environmental Science**, Ane books Pvt, Ltd.
2. **Arvind Kumar (2009) The textbook of the Environmental Science.**
3. **Chapman J.L. and M.J. (1999) Ecology**- Principles and Applications.
4. **Krebs, C.J. (2001) Ecology**, VI Edition.
5. **Odum E, P.(2008) Fundamentals of Ecology**, Indian edition, Natraj Publication.
6. **Ricklefs, R.E. (2000) Ecology** V Chiron Press.
7. **Smith R.L. (2000) Ecology and Field Biology**, Harper and Row Publisher.
8. **Verma P.S. and Agarwal V.K. (2003) Environmental Biology**.
9. **Agarwal K.C . (1989) Environmental Biology**, Agro botanical Publisher, Bikaner.

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New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Syllabus of F.Y.B.Sc. Zoology (Semester-I)

under

Faculty of Science and Technology

Semester – I	**Paper – III**
Course Code: BSC-ZO 103 P	**Title of the Course: Zoology Practical Paper- I**
Credits: 1.5	**Total Practical: 45 Hrs.**

Course Outcomes (COs)

1. Understand classification and identification of museum specimens/ slides of lower invertebrates.
2. Understanding characteristics of lower invertebrates with the help of slides and culturing.
3. Understand the characteristics of the population by quadrate method
4. Understand the physicochemical parameters of water and soil.

Detailed Syllabus: (Any 12)

Unit	Name of Topic	Practicals Allotted
1.	Museum Study of phylum Protista Protozoa: *Euglena*, *Paramecium*, *Amoeba*, *Plasmodium* sp.	**(01)**
2.	Observation and gross identification of freshwater protozoans from the given sample	**(01)**
3.	Museum study of Phylum Porifera: Sycon, Euplectella, Spongilla.	**(01)**
4.	Museum study of phylum Cnidaria: *Hydra*, Physalia, Obelia, Anyone coral	**(01)**
5.	Museum Study of phylum Platyhelminthes: Planaria, *Fasciola hepatica*, *Taenia solium*	**(01)**
6.	Museum Study of phylum Aschelminthes: *Ascaris lumbricoides*	**(01)**

7.	Study of *Paramecium*: External morphology, Culture, Conjugation, and Binary fission.	**(01)**
8.	Study of permanent slides: Spicules and Gemmules in Sponges, T. S. of Sycon, *Taenia solium*: Scolex, Gravid proglottid.	**(01)**
9.	Estimation of T.D.S. from the water sample.	**(01)**
10.	Estimation of dissolved oxygen from the water sample.	**(01)**
11.	Estimation of dissolved carbon-di-oxide from the water sample.	**(01)**
12.	Study of animal community structure by quadrat method (field or simulation)	**(01)**
13.	Determination of density, frequency and abundance of species by quadrat method.	**(01)**
14.	Estimation of water holding capacity of given soil sample.	**(01)**
15.	Study of microscopic fauna of freshwater ecosystem (from Pond)	**(01)**
16.	A visit to National Park / Bioreserves / Sancturies	**(01)**

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Syllabus of F.Y. B. Sc. Zoology (Semester- II)

under

Faculty of Science and Technology

Semester – II	**Paper - I**
Course Code: BSC-ZO 201 T	**Title of the Course: Animal Systematics and Diversity- II**
Credits: 02	**Total Lectures: 30 Hrs.**

Course Outcomes (COs)

1. Understand classification and identification of animals.
2. Understand the general physiological mechanism in the higher invertebrates.
3. Learn the economic importance of higher invertebrates.
4. Understand the peculiar characters higher invertebrates.

Detailed Syllabus

Unit	Name of Topic	Lectures Allotted
1.	**Phylum Annelida** Characteristic Features of PhylumAnnelida. Classification of Phylum Annelida. Concept of Coelom (Schizocoelom). Metamerism in Annelida. External morphology and excretion in Earthworm.	**(07)**
2.	**Phylum Arthropoda** Characteristic Features of Arthropoda. Outline classification of Phylum Arthropoda: Subphylum Trilobitomorpha, Chelicerata, Crustacea and Uniramia External morphology and Caste system in Honey Bee Life Cycle of Silkworm (In Short)	**(08)**

Ecdysis in Crustacea

Economic importance of Arthropoda

3. Phylum Mollusca (08)

Characteristics of Mollusca

A Generalised Molluscan structure

Outline classification of Phylum Mollusca: Class- Monoplacophora, Polyplacophora Aplacophora, Gastropoda, Bivalvia, Scaphopoda, and Cephalopoda

Torsion in Mollusca

Pearl formation in Mollusca

Economic Importance of Mollusca

4. Phylum Echinodermata (07)

Characteristic Features of Phylum Echinodermata

Outline classification of Phylum Echinodermata: Class- Asteroidea, Ophiuroidea, Echinoidea, Holothuroidea, Crinoidea

External Morphology of Sea Star

Water Vascular System in Sea Star

Larval forms in Echinodermata

Suggested Reading:

1. **Barnes, R.D. (1982). Invertebrate Zoology,** V Edition. Holt Saunders International Edition.
2. **Hyman. L. H (1955): The Invertebrates** Vol: I-X, Mcgraw Hill, Newyork.
3. **Modern Text-Book of Zoology, Invertebrates.** By Kotpal, RL., Rastogi and Co., Meerut.
4. **Nigam H.C., Zoology of NonChordates,** Vishal Publication, Jalandhar-144008.
5. **Kotpal, RL. Rastogi Phylum Protozoa to Echinodermata (series),** Meerut
6. **Parker T.J and W.A Haswell (1972): A textbook of Zoology,** Vol –I (7th edition by Marshall and Williams) Mcmillan Press ltd.
7. **Jordan, E.L. and P.S.Verma Invertebrate Zoology,** S. Chand and Co., Ltd. Ram Nagar, New Delhi.

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Syllabus of F.Y. B. Sc. Zoology (Semester- II)

under

Faculty of Science and Technology

Semester – II	**Paper - II**
Course Code: BSC-ZO 202 T	**Title of the Course: Cell Biology**
Credits: 02	**Total Lectures: 30 Hrs.**

Course Outcomes (COs)

1. Understand the structure and types of cells.
2. Understand the structure and function of various cell organelles.
3. Understand the concepts of the cell division and cell death.
4. Understand the basic techniques in cell biology.

Detailed Syllabus

Unit	Name of Topic	Lectures Allotted
1.	**Introduction to Cell Biology** Cell as a basic unit of life, Structure and function of prokaryotic cell (*E. coli*.) Structure of eukaryotic cell (Plant Cell and Animal Cell).	**(03)**
2.	**Plasma Membrane** Introduction, Structure of plasma membrane: Fluid mosaic model, Transport across membranes: Active and Passive transport, Facilitated transport, exocytosis, endocytosis, phagocytosis – vesicles and their importance in transport, Other functions of Cell membrane-Protection, cell recognition, shape, storage, cell signaling (in brief), Cell Junctions: Tight junctions, gap junctions, Desmosomes.	**(04)**
3.	**Endomembrane System** Introduction, Structure, location and functions: Endoplasmic	**(05)**

Reticulum, Golgi apparatus, Lysosomes and Ribosomes.

4. **Mitochondria and Peroxisomes** **(04)**

   Introduction, ultrastructure and function of the mitochondria

   Peroxisomes: Structure and function

5. **Nucleus: Structure and function** **(04)**

   Introduction to Nucleus, Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleoplasm, Nucleolus, Functions of nucleus and nucleolus.

   Chromatin: Eu-chromatin and Hetro-chromatin, nature and differences,

6. **Cell Division** **(04)**

   Introduction, Cell cycle (G_O, G_1, S, G_2, M phases), Mitosis, Meiosis.

7. **Cell Growth and Cell Death** **(03)**

   Cancer, Properties of cancer cell, Apoptosis and Necrosis.

8. **Methods in Cell Biology (in brief)** **(03)**

   Light Microscope

   Phase-contrast microscope

   Electron microscope

   Micro techniques (Microtomy), Fixation and Staining.

Suggested Readings:

1. **Powar C.B. Cell biology,** Himalaya Publication, Meerut.
2. **Dr. P.S.Verma and Dr. V. K. Agrawal, Cell Biology, Molecular Biology, Evolution and Ecology,** S. Chand Higher Academic, Publications.
3. **Karp, G. (2010) and Molecular Biology:** Concept and Experiments.VI Edition John Wiley and Sons. Inc.
4. **De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology**. VII Edition. Lippincott Williams and Wilkins, Philadelphia.
5. **Copper , G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach,** V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, M.A.

6. **Becker , W.M. Kleinsmith, L.J. Hardin. J. and Bertoni, G.P. (2009). The World of the Cell.** VII Edition. Person Benjamin-Cummings Publishing, San Francisco.
7. **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

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Syllabus of F.Y.B.Sc. Zoology (Semester-II)

under

Faculty of Science and Technology

Semester – II	**Paper – III**
Course Code: BSC-ZO 203 P	**Title of the Course: Zoology Practical Paper- II**
Credits: 1.5	**Total Practical: 45 Hrs.**

Course Outcomes (COs)

1. Understand classification and identification of museum specimens/ slides of higher invertebrates.
2. Understanding characteristics of higher invertebrates with the help of slides, models etc.
3. Understand the morphology and cell division.
4. Understand the techniques in cell biology.

Detailed Syllabus: (Any 12)

Unit	Name of Topic	Practicals Allotted
1.	Museum study of Phylum Annelida: Neries, Earthworm, Leech.	**(01)**
2.	Museum study of Phylum Arthropoda: Prawn, Honey bee, Centipede, Millipede, Crab	**(01)**
3.	Museum study of Phylum Mollusca: Pila, Chiton, Bivalve, Octopus.	**(01)**
4.	Museum study of Phylum Echinodermata: Sea Star, Sea urchin, Brittle Star, sea cucumber.	**(01)**
5.	Study of permanent slides: Nephridia in Annelida, larval forms in Echinodermata	**(01)**
6.	Types of Shells in Mollusca. Pila, Bivalve, Chiton, Sepia.	**(01)**
7.	Economic importance of honey bees, Lac insects silkworms, red cotton bug, Anopheles mosquito	**(01)**
8.	Earthworm: vermicomposting bin preparation and maintenance.	**(01)**

9.	Visit a vermicomposting unit/ field for insect pest collection and its identification	**(01)**
10.	Study of Microscope: Simple and Compound Microscope	**(01)**
12.	Study of cell: Preparation of temporary mount of human buccal epithelial cells.	**(01)**
13.	Preparation of blood smears to observe the blood cells.	**(01)**
14.	Study of permanent slides of various stages of mitosis and meiosis.	**(02)**
15.	Temporary preparation of mitotic cells from onion root tips.	**(01)**
16.	Study of Cell organelles (any three) by using microphotographs.	**(01)**
17.	Study of types of cells. (permanent slide) any three.	**(01)**