

UNIVERSITY OF MUMBAI



Syllabus for the F.Y.B.Sc.

Program: B.Sc.

Course : Zoology

(Credit Based Semester and Grading System with
effect from the academic year 2011–2012)

F.Y.B.Sc. Zoology Syllabus
Restructured for Credit Based and Grading System
To be implemented from the Academic year 2010-2011

SEMESTER I

Course Code	UNIT	TOPICS	Credits	L / Week
USZO101	I	Diversity of Animal Kingdom I	2	1
	II	Life processes I		1
	III	Ecology		1
USZO102	I	Molecular basis of life I	2	1
	II	Biotechnology I		1
	III	Genetics		1
USZO P1	Practicals based on both courses in theory		2	6

SEMESTER II

Course Code	UNIT	TOPICS	Credits	L /Week
USZO201	I	Diversity of Animal Kingdom II	2	1
	II	Life processes II		1
	III	Ethology		1
USZOT202	I	Molecular basis of life II	2	1
	II	Biotechnology II		1
	III	Evolution and Biodiversity		1
USZO P2	Practicals based on both courses in theory		2	6

**F.Y.B.Sc. Zoology Syllabus modified for Credit System
To be implemented from the Academic year 2011-2012**

Semester I

Course Code : USZO101

Diversity of animal Kingdom I, Life processes I and Ecology (2 Credits)

Unit I: Diversity of animal Kingdom I (15 Lectures)

1.1: Levels of organization

1.1.1: Unicellularity vs multicellularity

Colonization and organization of germ layers
(diploblastic and triploblastic condition)

1.1.2: Division of labour and organization of tissues
(Brief fate of ectoderm, mesoderm and endoderm)

1.1.3: Development of coelome: Acoelomate, pseudocoelomate and
coelomate organization

1.1.4: Radial and bilateral symmetry

1.1.5: Segmentation and cephalization

1.2: Unicellular and multicellular organization

(Salient features with examples of phyla, subphyla and classes mentioned below)

1.2.1: Unicellular organization: Phylum Protozoa

1.2.2: Multicellular organization: Colonization level- Phylum Porifera

1.2.3: Multicellular organization: Division of labour (Cell differentiation)-
Phylum Coelenterata

1.3 Triploblastic acoelomate and pseudocoelomate organization

1.3.1: Acoelomate organization - Phylum Platyhelminthes

1.3.2: Pseudocoelomate organization – Phylum Nematelminthes

1.4: Triploblastic coelomate organization

1.4.1: Animals with metameric segmentation- Phylum Annelida

1.4.2: Animals with jointed appendages- Phylum Arthropoda

Unit II: Life processes I (15 Lectures)

2.1: Movement and locomotion

2.1.1: Amoeboid movement

2.1.2: Ultra-structure of cilia and ciliary movements

2.1.3: Action of muscles (Role of muscles in movement)

2.2: Nutrition

2.2.1: Types of nutrition: Autotrophic and heterotrophic.

Apparatus for nutrition: Food vacuole

Animals without alimentary canal, ex. *Amoeba*

Animals with incomplete alimentary canal, ex. *Hydra*

Animals with complete alimentary canal, ex. Bird

2.2.2: Brief account of physiology of digestion in vertebrates and symbiotic

digestion in Ruminants.

2.3: Respiration

2.3.1: Types of respiratory surfaces:

General body surface: Cell membrane - ex. *Amoeba*

Skin - ex. Earthworm and Frog

Specialized respiratory structures: Trachea and spiracles, Gills of fish,

Lungs of Frog and Human, Air sacs of Birds.

2.3.2: External respiration and cellular respiration with reference to human.

2.4: Circulation

2.4.1: Types of circulating fluids: Water, coelomic fluid, lymph and blood

2.4.2: Types of circulation: Protoplasmic streaming, open and closed circulation, single and double circulation

2.4.3: Hearts: Types, heart in *Daphnia*, cockroach and chordates
(1, 2, 3 and 4 chambered heart)

2.4.4: Structure of cardiac muscles.

Unit III: Ecology

(15 Lectures)

3.1: Concept of Ecosystem

3.2: Concepts of energy flow, food chain and food web

3.3: Concept of biogeochemical cycles:

(carbon, oxygen, nitrogen, phosphorus and water cycles)

3.4: Human activities affecting biogeochemical cycles.

3.5: Concepts of animal interactions:

Symbiosis: Mutualism, commensalism, parasitism, predation and Antibiosis

Course Code : USZO102

Biochemistry I, Biotechnology I and Genetics

(2 Credits)

Unit I: Molecular basis of life - I

(15 Lectures)

1.1: Biological micro- and macro-molecules

Monomeric constituents, polymers and significance of carbon

1.2: Proteins

1.2.1: Amino acids: Types based on carboxylic, amino and aromatic group.

1.2.2: Peptide bond

1.2.3: Structure of proteins: Primary, secondary, tertiary, and quaternary structure.

1.2.4: Biological role of proteins.

1.3: Carbohydrates

1.3.1: Nomenclature, isomerism and classification.

1.3.2: Glycosidic bond

1.3.3: Types of carbohydrates:

Monosaccharides: Glucose, fructose, galactose

Disaccharides: Maltose, sucrose, lactose

Polysaccharides: Starch, glycogen, cellulose, chitin, heparin

1.3.4: Biological role of carbohydrates

Unit II: Biotechnology – I

(15 Lectures)

2.1: Concept of Biotechnology

2.1.1: Definition

2.1.2: An overview of achievements and scope.

2.2: Fundamentals of laboratory techniques in biotechnology

2.2.1: Safe handling of equipments

2.2.2: Sterilization techniques

2.2.3: Molecular separation techniques

Principle and applications: Paper chromatography, TLC and

Electrophoresis- Agarose and PAGE

2.3: Food biotechnology

Applications of biotechnology in making bread, beer, wine, yogurt and cheese

2.4: Enzyme Technology

2.4.1: Enzymes as the meat tenderizer

2.4.2: Bio-detergents

2.4.3: Concept of enzyme immobilization

Unit III: Genetics

(15 Lectures)

3.1: Gene and gene concepts, definition of gene and gene expression

3.2: Mendelian inheritance:

- i) Monohybrid and dihybrid cross,
- ii) Concept of dominance,
- iii) Exception to Mendelian inheritance:
Incomplete dominance, co- dominance, interaction of genes: (Epistasis: recessive, dominant, double recessive and double dominant epistasis)
- iv) Lethal genes

3.3: Cytoplasmic inheritance: Kappa particles in *Paramecium*, sigma factor in *Drosophila* and shell coiling in *Limnaea*

3.4: Effect of environment on heredity

3.5: Introduction to Human genetics:

- i) Mendelian phenotypic traits in humans: Dominant recessive and X- linked characters (2 examples each)
- ii) Pedigree analysis: Dominant, recessive and X-linked traits
- iii) Genetic counseling
Risk of recurrence of hereditary diseases in a family
Risk of inheriting a disease from consanguineous marriage
Risk of acquiring common hereditary diseases

1. Levels of organization in Animal kingdom

- A) Symmetry: i) Asymmetric organization: *Amoeba*
ii) Radial symmetry: Sea anemone, *Aurelia*
iii) Bilateral symmetry: Planaria / liver fluke
- B) Acoelomate: T.S. of Planaria / liver fluke
- C) Pseudocoelomate: T.S. of *Ascaris*
- D) Coelomate : T.S. of Earthworm
- E) Segmentation i) Pseudosegmentation: Tapeworm
ii) Metamerism: Earthworm
iii) Specialization of body parts for division of labour: Head, thorax and abdomen - Insect
- F) Cephalization i) Cockroach – Head
ii) Prawn/ crab – Cephalothorax

2. Animal Diversity

- Protozoa : *Amoeba, Paramecium, Euglena, Plasmodium*
- Porifera: *Leucosolenia*, bath sponge
- Coelenterate: *Hydra, obelia colony, Aurelia*, sea anemone and any one coral
- Platyhelminthes: Planaria, liver fluke and tapeworm
- Nemathelminthes: *Ascaris*- male and female
- Annelida: *Nereis*, earthworm and leech
- Arthropoda: Crab, lobster, *Lepisma*, beetle, dragonfly, butterfly, moth, spider, centipede, millipede

3. Study of *Paramoecium* culture to observe food vacuole, contractile vacuole and ciliary movement.
4. Study of nutritional apparatus: *Amoeba*, L.S. of *Hydra*, Planaria, digestive system of cockroach and earthworm (both for demonstration only), Detection of activity of digestive enzymes (invertase, amylase, protease and lipase) from the gut of cockroach.
5. Study of effect of pH and temperature on amylase/ trypsin activity.
6. Mounting of trachea and spiracles from cockroach, study of gills of fish, lung of frog and mammal, rate of oxygen consumption by cockroach (demonstration only)
7. Study of heart of cockroach, determination of the rate of heart beat in *Daphnia*, study of whole mount and L.S. of following hearts: fish (2-chambered), Frog (3-chambered), mammal (4-Chambered).
Study of permanent slides of blood smear of frog and mammal.
8. Study of animal interaction:
Commensalism: Hermit crab and sea anemone, *Echinus* and shark
Mutualism: Termite and *Trichonympha*
Antibiosis: Effect of antibiotic on bacterial growth on a petri plate
Parasitism: Ectoparasite – head louse and bed bug
Endoparasite: *Trichinella spiralis*
Predation: Praying mantis and spider
9. Determination of population density (*Daphnia* or any suitable organism) by sub sampling method.

PRACTICAL – II

1. Introduction to basic laboratory safety practices, precautions and safety rules. Handling of common laboratory equipment (instrument and glassware): Burner, autoclave, centrifuge, colorimeter, balance, homogenizer, electrophoresis apparatus, Study of Microscope: Use care and functions of its components.
2. Aseptic techniques: Autoclaving and Packaging of test tubes, pipettes, petriplates, conical flask.
Aseptic transfer of liquids between burners.
3. Paper chromatography for separation of amino acids.
4. Qualitative tests for proteins and carbohydrates.
5. Preparation of beads of calcium alginate for immobilization of enzyme amylase or yeast cells.
6. Assay of immobilized amylase or invertase from immobilised yeast cells by DNSA method (visual observation for comparative colour intensity in test tube)
7. Demonstration of agarose gel electrophoresis for the separation of egg white proteins.
8. To demonstrate fermentation of grape juice/sugar cane juice or any fruit juice – (Detection of alcohol generated during fermentation by benzoic acid).
9. Effect of Papain (raw papaya extract) as a meat tenderizer
10. Human pedigree analysis: Dominant, recessive and X-linked characters.

SEMESTER II

Course Code : USZO201

Diversity of animal Kingdom II, Life processes II and Ethology

Unit I: Diversity of animal Kingdom II

(15 Lectures)

- 1.1: Triploblastic coelomate organization:
 - 1.1.1: Animals with mantle: Phylum Mollusca
 - 1.1.2: Animals with enterocoel: Phylum Echinodermata
- 1.2: Phylum Hemichordata
- 1.3: Phylum Chordata
 - 1.3.1: Subphylum Urochordata
 - 1.3.2: Subphylum Cephalochordata
- 1.4: Subphylum Vertebrata
 - 1.4.1: Super class: Agnatha- Class Cyclostomata
 - 1.4.2: Super class: Gnathostomata
 - 1.4.2.1: Class Pisces (Cartilaginous and bony fish)
 - 1.4.2.2: Class Amphibia
 - 1.4.2.3: Class Reptilia
 - 1.4.2.4: Class Aves
 - 1.4.2.5: Class Mammalia

Unit II: Life processes II

(15 Lectures)

- 2.1: Excretion and osmoregulation
 - 2.1.5: Concepts of osmoregulation and excretion.
 - 2.1.2: Categorization of animals on the basis of principle nitrogenous excretory products.
 - 2.1.3: Ornithine cycle, formation of urea, determination and detoxification.
- 2.2: Control and Coordination
 - 2.2.1: Irritability
 - 2.2.2: Structure of neuron, sense organs- human eye and ear.
 - 2.2.3: Conduction of nerve impulse: Resting potential, action potential and refractory period.
 - 2.2.4: Synaptic transmission
 - 2.2.5: Endocrine regulation: Hormones as chemical messengers, feedback mechanisms.
- 2.3: Reproduction
 - 2.3.1: Gametogenesis, structures of egg and sperm of mammal
 - 2.3.2: Fertilization and *In vitro* fertilization
 - 2.3.3: Oviparity, viviparity and ovo-viviparity

Unit III: Ethology

(15 Lectures)

3.1: Development of behaviour:

Ontogeny of behaviour,
Environmental influence on behaviour,
Sensitive periods during development,
Juvenile behaviour, Innate behaviour.

3.2: Animal learning:

Conditioning and learning:

Classical conditioning, acquisition, extinction,
habituation and generalization.

Instrument learning,

Reinforcement, operant behaviour.

Biological aspects of learning:

Constraints of learning,
learning to avoid enemies, mimicry,
learning to avoid sickness,
stimulus relevance.

Cognitive aspects of learning:

Hidden aspects of conditioning,
nature of cognitive process,
insight learning,
associative learning and representation.

Biochemistry II, Biotechnology II and Evolution and Biodiversity

Unit I: Molecular basis of life – II

(15 Lectures)

1.1: Lipids

- 1.1.1: Fatty acids: Structure, types and properties
- 1.1.2: Mono-, di- and tri-glycerides
- 1.1.3: Phospholipids and sphingolipids
- 1.1.4: Sterols and waxes
- 1.1.5: Biological role of lipids

1.2: Nucleic acids

- 1.2.1: Chemical structure of nitrogenous bases, pentoses
- 1.2.2: Nucleosides and nucleotides
- 1.2.3: Polynucleotides: 3' → 5' phosphodiester linkage
- 1.2.4: Watson - Crick Model of DNA
- 1.2.5: Types of RNA: mRNA, t-RNA and r-RNA
- 1.2.6: Cloverleaf model of t-RNA
- 1.2.7: Differences between DNA and RNA

Unit II: Biotechnology II

(15 Lectures)

2.1: Transgenic animals and animal cloning

- 2.1.1: Transgenic animals for production of pharmaceuticals:
α-1-antitrypsin, tissue plasminogen activator (tPA)
- 2.1.2: Animal cloning experiments for “Dolly”

2.2: Biotechnology and gene therapy

- 2.2.1: Biotechnology in production of insulin and hGH
- 2.2.2: Gene therapy: *Ex vivo* and *In vitro* approach,
Gene therapy for SCID (severe combined immune deficiency) and
cystic fibrosis
- 2.2.3: Ethical issues with reference to gene therapy

2.3: Environmental Biotechnology

- 2.3.1: Bioremediation: Concepts and applications
- 2.3.2: Biodegradation of polycyclic aromatic hydrocarbons (PAHs) and
Petrochemicals.

Unit III: Evolution and Biodiversity

(15 Lectures)

3.1: Evolution

3.1.1: Origin of life: Emergence of life on primitive earth

3.1.2: Evolution and adaptations:

Microevolution, Role of natural selection in microevolution,
Co-evolution.

3.1.3: Ecological niches and adaptations.

3.2: Biodiversity

3.2.1: Definition, Biodiversity hotspots, Benefits of Biodiversity, Biodiversity conservation, Bio-wealth of India.

3.2.2: Human activities affecting biodiversity.

3.2.3: Future of evolution

Course Code : USZOP2 Semester II; PRACTICAL – I

1. Animal Diversity

Mollusca:	<i>Chiton, Dentalium, Pila</i> , bivalve, <i>Sepia</i> and <i>Nautilus</i>
Echinodermata:	Starfish, brittle star, sea urchin, sea cucumber, feather star
Hemichordata:	<i>Balanoglossus</i>
Urochordata:	<i>Herdmania</i>
Cephalochordata:	<i>Amphioxus</i>
Cyclostomata:	<i>Petromyzone/Myxine</i>
Pisces:	<u>Chondrichthyes</u> : Shark, skates, sting ray/electric ray <u>Osteichthyes</u> : <i>Sciaena</i> , flying fish
Amphibia:	Frog, toad, caecilian, salamander
Reptalia:	Chameleon, <i>Calotes</i> , turtle/tortoise, snake, alligator/crocodile.
Aves:	Kite, kingfisher, duck
Mammalia:	Shrew, hedgehog, guinea pig, bat

2. Wheel organ of *Amphioxus*, scroll valve of Shark, digestive system of Pigeon, ruminant stomach.
3. Mounting of septal nephridium of earthworm, observation of sagittal section of mammalian kidney, Bowman's capsule (under high power), Urine analysis for detection of normal and abnormal constituents. Detection of uric acid from the excreta of bird or cockroach.
4. Study of irritability of paramecium by demonstration of release of trichocysts. Study of mammalian brain (entire and sagittal section with the help of specimen/model), observation of T.S. of mammalian spinal cord.
5. Observation of permanent slide of: Sponge gemmules, Hydra budding, mammalian sperm, T.S. mammalian testis, T.S. mammalian ovary showing graffian follicle, Observation of hens egg with developing embryo at any stage of development.
6. Mimicry: Leaf insect, stick insect, stick worm (caterpillar), Kallima butterfly, Monarch butterfly and common tiger butterfly (Danids)

PRACTICAL – II

1. Thin layer chromatography of lipids and adsorption chromatography using chalk to separate plant pigments or other pigments (Food colours)
2. Qualitative tests for lipids.
3. Extraction and qualitative detection of nucleic acids:
DNA (SDS-NaCl extraction), RNA (Phenol extraction)
4. Identification through photographs: Methodology for transgenesis –
i) By microinjection into egg ii) Transgenesis of embryonic stem cell
iii) Methodology for gene therapy for SCID or any human diseases
5. Study of bacteria using Gram stain.
6. To evaluate the quality of milk by methylene blue reduction method
7. Study of evidences of evolution:
A) Analogy – Leg of grasshopper and leg of mammal Wing of insect, wing of bird, wing of bat
B) Homology - Fore limb of amphibian/a reptilian, and wing of bird / bat. Any two fossils

REFERENCES:

1. Biological science, 3rd edition – D.J. Taylor, N. P. O. Green, G. W. Stout. Cambridge University press, Low priced edition.
2. Zoology – S. A. Miller and J. B. Harley, Tata McGraw hill
3. Principles of ecology – Odum
4. Ecology – Principle and application – J. L. Chapman and M. J. Reiss, Cambridge University press, Low priced edition.
5. Animal behaviour – David Mc Farland
6. An introduction to animal behaviour, 4th edition - Aubrey Manning and M. S. Dawkins. Cambridge University press, Low priced edition.
7. Animal behaviour – Mohan Arora. Himalaya publication.
8. Genetics – Winchester Oxford IBH publication
9. Principle of genetics - W. Sinnott, L.C. Dunn and Theodosius Dobzhansky, Mc Graw hill publication.
10. Basic human genetics – E. J. mange and A. P. Mange, Rastogi publications
11. Biology – Silvia S. Maddor, W.C.B. Publications
12. Biology – Investigating life on earth, Vernon Avila, Book mark publications
13. Biology of Cell – An evolutionary approach – Dewitt, Saunders publications
14. The cell, Alberts Panima Publications.
15. National Geographic Vol. 193 (3) March 1998: Rise of life on Earth p. 54-81
16. Scientific American Oct. 1994: Origin of life on Earth p. 53-61
17. Essentials of human genetics – S. M. Bhatnagar, M.L. Kothari, L.A. Mehta, Orient Longman publications
18. Essentials of Ecology, 3rd edition – G. Tyler and Miller Jr. Thompson Books
19. Biodiversity: S.V.S. Rana, Prentice Hall Publications
20. Evolution: Strickberger, C.B.S. Publication.

F. Y. B. Sc. Zoology Credit pattern: Distribution of Lectures						
	Unit I	Unit II	Unit III	Unit I	Unit II	Unit III
	USZO101			USZO201		
Diversity of animal Kingdom, Life processes, Ecology and Ethology	Diversity of Animal Kingdom I 1L/Week	Life processes I 1L/Week	Ecology 1L/Week	Diversity of Animal Kingdom II 1L/Week	Life processes II 1L/Week	Ethology 1L/Week
	USZO102			USZO202		
Biochemistry, Biotechnology, Genetics, Evolution and Biodiversity	Molecular basis of life I 1L/Week	Biotechnology I 1L/Week	Genetics 1L/Week	Molecular basis of life II 1L/Week	Biotechnology II 1L/Week	Evolution 1L/Week

Scheme of Examination:

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40% marks in the first part & by conducting the Semester End Examinations with 60% marks in the second part.

The Course having Practical training will have Practical Examination for 50 marks at the end of Semester, out of which 30 marks for the Practical task assigned at the time of examination. The 20 marks are allotted as Internal Assessment.

The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below:-

Internal Assessment: It is defined as the assessment of the learners on the basis of continuous evaluation as envisaged in the Credit based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.

Semester End Assessment : It is defined as the assessment of the learners on the basis of Performance in the semester end Theory/ written/ Practical examination.

Modality of Assessment :

Internal Assessment - 40%

40 marks.

a) Theory

40 marks

Sr No	Evaluation type	Marks
1	Two Assignments/Case study/Project	20
2	One class Test (multiple choice questions objective)	10
3	Active participation in routine class instructional deliveries(case studies/ seminars//presentation)	05
4	Overall conduct as a responsible student, manners, skill in articulation, leadership qualities demonstrated through organizing co-curricular activities, etc.	05

b) Practicals

20 marks

Sr No	Evaluation type	Marks
1	Two best practicals	10
2	Journal	05
3	Viva	05

B) External examination - 60 %

Semester End Theory Assessment - 60%

60 marks

- i. Duration - These examinations shall be of two hours duration.
- ii. Theory question paper pattern :-
 1. There shall be four questions each of 15 marks. On each unit there will be one question & fourth one will be based on entire syllabus.
 2. All questions shall be compulsory with internal choice within the questions. Each question will be of 20 to 23 marks with options.
 3. Questions may be sub divided into sub questions a, b, c, d & e only & the allocation of marks depends on the weightage of the topic.

Practical External Assessment

30 marks

Note:

- Two short field excursions for habitat studies are compulsory. Field work of not less than eight hours duration is equivalent to one period per week for a batch of 15 students.
- A candidate will be allowed to appear for the practical examinations only if he/she submits a certified journal of F.Y.B.Sc. Zoology or a certificate from the Head of the department / Institute to the effect that the candidate has completed the practical course of F.Y.B.Sc. Zoology as per the minimum requirements. In case of loss of journal a candidate must produce a certificate from the Head of the department /Institute that the practicals for the academic year were completed by the student. However such a candidate will be allowed to appear for the practical examination but the marks allotted for the journal will not be granted.