



**RAJARSHI SHAHU MAHAVIDYALAYA, LATUR**  
**(Autonomous)**

**(BoS in ZOOLOGY)**

**NEP-2020**

**SEMESTER PATTERN**

**(W.e.f. Academic Year 2023-24)**

**SYLLABUS FOR B.Sc.-I (ZOOLOGY)**

**June-2023**

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester -I**

**Sub: Zoology**

**2022-23**



Course and Level	Sem	Major Zoology				Minor Zoology				GE/OE				Interen ship/ Mini Project
		T / P	Core Courses DSC/IKS	Hrs	Credit	T/ P	Paper Title	Hrs	Credit	T/ P	Title Paper	Hrs	Credit	
Certificate in Zoology (Level 4.5)	I	T	DSC-1 Life and Diversity of Non-chordates	03	3	T	Comparative Anatomy and Physiology of Non-chordates	03	3		Food, Nutrition and Health	03	3	Mini Project
		P	Lab Course-I	02	1									
		T	DSC-2 Life and Diversity of Chordates	03	3									
		P	Lab Course-II	02	1	P	Lab Course-I	02	1	P	Lab Course-I	02	1	
	II	T	DSC-3 Cell Biology	03	3	T	Comparative Anatomy and Physiology of Chordates	03	3		Vectors, Diseases and Control	03	3	
		P	Lab Course-III	02	1									
		T	IKS History of zoology and Present Status In India	03	3									
		P	Lab Course-IV	02	1	P	Lab Course-II	02	1	P	Lab Course-II	02	1	
				20				12				12		

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester –I**

**DSC-1: Life and Diversity of Nonchordates**

**Sub: Zoology**

**Credits: 03**

**Marks: 75**

**Periods: 45 Hr.**

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**Learning Objectives**

- This course has been designed to understand of systematic, taxonomy and structural organization of animals.
- To understand evolutionary history and relationships of different non-chordates through functional and structural affinities.
- To understand Relationship between these Phylum Onychophora, Arthropod and Mollusk
- To understand Relationship between these Phylum Echinodermata and Hemichordata

**Learning Outcomes:**

After completion of the course the students will:

- Learn about the systematic, taxonomy and structural organization of animals.
  - Learn diversity of non-chordates living in varied habit and habitats.
  - Learn Critical analysis of the organization, complexity and characteristic features of non-chordates.
  - Comprehend the economic importance of non-chordates, their interaction with the environment and role in the ecosystem.
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**UNIT –I Basis of Classification and Lower Invertebrates**

- Basis of animal classification, Zoological nomenclature, concepts of taxonomy & systematics
- **Phylum Protozoa:** General characters and classification upto classes; Structure, life cycle and clinical significance of human Plasmodium Parasites and their diseases.
- **Phylum Cnidaria:** General characters and classification upto classes: Polymorphism in Coelenterates; Corals and Coral reef formation with their significance.
- **Phylum Porifera:** General characters and classification upto classes: Canal system in Sponges; Integumentary system in sponges.

**UNIT –II Phylum Platyhelminthes to Annelida**

- **Phylum Platyhelminthes:** General characters and classification upto classes; life cycle of Fasciola hepatica, and Taenia solium
- **Phylum Nematohelminthes:** General characters and classification up to classes; Life history of Ascaris lumbricoides and its parasitic adaptations
- **Phylum Annelida:** General characters and classification up to classes; Metamerism in Annelida; Significance of Hirudin of Leech

### **UNIT –III Phylum Onychophora, Arthropoda and Mollusca**

- **Phylum Onychophora:** General characters and classification upto classes: Taxonomic position of Peripatus and its affinities with Annelida and Arthropoda.
- **Phylum Arthropoda:** General characters and classification upto classes: Vision in Arthropoda, Metamorphosis in Insects; economically and medically important Arthropods. Gregarious behavior of insects.
- **Phylum Mollusca:** General characters and classification upto classes; important Arthropods. Gregarious behavior of insects. up to classes; Torsion in gastropods

### **UNIT –IV Phylum Echinodermata and Hemichordata**

- **Phylum Echinodermata:** General characters and classification up to classes; Water-vascular system in Asteroidea; Affinities of Echinoderm with Hemichordata and chordates
- **Hemichordates and chordates.** Affinities of Balanoglossus with chordates and non- chordates.

### **Text Books and References:**

1. Kotpal Volumes Protozoa through Echinodermata, Rastogi Publications
2. Jordan & Verma (revised editions) Invertebrate Zoology, S. Chand and Co. Ltd., New Delhi.
3. Jan Pechenik (2014). Biology of the Invertebrates, McGraw-Hill Science, 2014
4. Non-Chordate Zoology by Dhabhi and Dhami Pradeep Publication, Opposite Sitla Mandir, Jalndhar-144008

### **Links of Book References:**

1. Invertebrate Zoology (Multicolor Edition) By P.S. Verma  
[https://www.google.co.in/books/edition/Invertebrate\\_Zoology\\_Multicolour\\_Edition/TAKrDAAAQBAJ?hl=en&gbpv=1&dq=invertebrate+zoology&printsec=frontcover](https://www.google.co.in/books/edition/Invertebrate_Zoology_Multicolour_Edition/TAKrDAAAQBAJ?hl=en&gbpv=1&dq=invertebrate+zoology&printsec=frontcover)
2. Handbook of Invertebrate Zoology for Laboratories and Seaside Work By William Keith Brooks ·  
[https://www.google.co.in/books/edition/Handbook\\_of\\_Invertebrate\\_Zoology/pkUAAAAQAAJ?hl=en&gbpv=1&dq=invertebrate+zoology&printsec=frontcover](https://www.google.co.in/books/edition/Handbook_of_Invertebrate_Zoology/pkUAAAAQAAJ?hl=en&gbpv=1&dq=invertebrate+zoology&printsec=frontcover)

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester -I**

**Sub: Zoology Lab Course-I**

**Credits: 01**

**Marks: 50**

**Periods: 30 Hr.**

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**Learning Objectives**

- To designed this course to understand practical approach of Life and Diversity of Non-chordate
- To understand evolutionary history of Life and Diversity of Non-chordate.
- To enhance collaborative learning and communication skills through practical sessions, team work, group discussions, assignments and projects.

**Learning Outcomes:**

After successful completion of the course the students will:

- Learn about the importance of systematic, taxonomy and structural organization of animals.
  - Learn evolutionary history of life and diversity of Non-chordates
  - Learn Critical analysis of the organization, complexity and characteristic features of non-chordates.
  - Comprehend the economic importance of non-chordates, their interaction with the environment and role in the ecosystem.
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**Practicals:**

1) Theoretical and practical knowledge of simple and compound microscope.

2) Identification, Classification and comments on the slides/specimens of;

- Protozoa: Amoeba, Euglena, Plasmodium, Paramecium, Trypanosoma, Elphidium, Vorticella,
- Porifera: Sycon, Hyalonema, and Euplectella
- Cnideria: Hydra, Obelia, Physalia, Aurelia, Tubipora
- Aschelminthes: Ascaris, Ancylostoma, Wuchereria,
- Platyhelminthes: Fasciola, Taenia and their larvae,
- Arthropoda: Palaemon (Prawn), Crab, Palamnaeus
- Annelida: Pheretima, Hirudinaria (Leech), Nereis, (Scorpion)
- Mollusca: Pila (Apple snail), Lamellidens (Unio), Sepia, Octopus
- Echinodermata: Asterias (Sea Star), Echinus (Sea urchin)
- Hemichordata: Balanoglossus

3) Demonstration of earthworm Nerve ring and Ovaries; appendages of arthropod

**1. Links of Book References:**

**A Manual of Practical Zoology: INVERTEBRATES**

<https://www.google.co.in/books/edition/A Manual of Practical Zoology INVERTEBRA/mqi-QZp28sEC?hl=en&gbpv=1&dq=invertebrate+zoology&printsec=frontcover>

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester -I**

**DSC-2: Life and Diversity of Chordates**

**Sub: Zoology**

**Credits: 03**

**Marks: 75**

**Periods: 45 Hr.**

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**Learning Objectives**

- This course has been designed to understand of systematic, taxonomy and structural organization of chordates
- To understand evolutionary history and relationships of different chordates through functional and structural affinities.
- To understand Relationship between Pisces and Amphibians
- To understand Relationship between Reptile, Aves and Mammals (Type study: Rat)

**Learning Outcomes:**

After completion of the course the students will:

- Learn about the systematic, taxonomy and structural organization of animals.
  - Learn diversity of chordates living in varied habit and habitats.
  - Learn Critical analysis of the organization, complexity and characteristic features of chordates.
  - Comprehend the economic importance of chordates, their interaction with the environment and role in the ecosystem.
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**UNIT -I Chordates: Introduction and origin; Protochordates**

- **Protochordates** - General features and Phylogeny of Urochordates and Cephalochordates. Retrogressive metamorphosis;
- **Agnatha** - General features of Agnatha and classification of cyclostomes up to classes;

**UNIT -II Pisces and Amphibians**

- **Pisces** - General features and Classification up to orders; Osmoregulation in Fishes; Migration and Parental care in fishes
- **Amphibian** Classification upto orders, Parental care;

**UNIT -III Reptiles and Aves**

- **Reptiles** - Classification upto orders. Poisonous and non- poisonous snakes in India, Biting mechanism in snakes;
- **Aves** - Classification upto orders, flight adaptations, Mechanism of flight and Migration. Mammals - Classification upto orders. Origin of Mammals.

**UNIT -IV Classification of Mammals and Type study: Rat**

- Morphology, Digestive system
- Respiratory system, Circulatory, Brain and Reproductive system
- Sense organs: - Ear and Eye.

**Text Books and References:**

1. Vertebrate Zoology by Jordan E.L. and P.S.Verma S.Chand Publication, and Co., Ltd. Ram Nager New Delhi
2. Chordate Zoology by Dhami and Dhami- Pradeep Publication, Opposite Sitla Mandir, Jalndhar-144008
3. Rat a mammalian type By G.R. Kshirsagar., G.Y.-Rane Prakashan, Tilak Road, Poona 30.
4. Kotpal (2015). Modern Textbook of Zoology Vertebrates, Rastogi publishers, New Delhi

**Links of Book References:**

1. Vertebrate Zoology an Experimental Field Approach  
By Nelson G. Hairston · 1994

[https://www.google.co.in/books/edition/Vertebrate Zoology/gqM8AAAAIAAI?hl=n&gbpv=1&dq=vertebrate+zoology&printsec=frontcover](https://www.google.co.in/books/edition/Vertebrate_Zoology/gqM8AAAAIAAI?hl=n&gbpv=1&dq=vertebrate+zoology&printsec=frontcover)

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester -I**

**Sub: Zoology Lab Course-II**

**Credits: 01**

**Marks: 50**

**Periods: 30 Hr.**

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**Learning Objectives**

- To designed this course to understand practical approach of Life and Diversity of chordate
- To understand evolutionary history of Life and Diversity of chordate.
- To enhance collaborative learning and communication skills through practical sessions, team work, group discussions, assignments and projects.

**Learning Outcomes:**

After successful completion of the course the students will:

- Learn about the importance of systematic, taxonomy and structural organization of animals.
  - Learn evolutionary history of life and diversity of chordates
  - Learn Practical analysis of the organization, complexity and characteristic features of chordates.
  - Comprehend the economic importance of chordates, their interaction with the environment and role in the ecosystem.
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**Practicals:**

**Identification, Classification and comments on the specimens of:**

1. **Protochordates:**
  - Herdmania; Amphioxus
2. **Pisces:**
  - Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla
  - Estimation of age of fishes through Scales
3. **Amphibia:**
  - Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla
4. **Reptiles:**
  - Cobra; Viper
  - Calotis; Varanus; Chameleon; Rock Python, Draco, Crocodiles, Gharial, turtle, tortoise
  - Distinction between Poisonous and Non-poisonous snake
5. **Aves;**
  - Sparrow; Parrot; Columba; Myna
  - Owl; Duck; Woodpecker, penguin
  - Collection of different types of feathers from birds
6. **Mammals:**
  - Mole; Playtypus, Guinea pig; Bat, Whale
7. **Mountings:**



- Spicules and gemmules of sycon, Obelia colony, Jaws of leech & Nephridia, Nereis Parapodia
- Scales: Ctenoid, Cycloid and Placoid.

**Links of Book References:****1. A Course in Vertebrate Zoology**

A Guide to the Dissection and Comparative Study of Vertebrate Animals

<https://www.google.co.in/books/edition/A Course in Vertebrate Zo%C3%B6logy/vCgaA AAAyAAJ?hl=en&gbpv=1&dq=vertebrate+zoology&printsec=frontcover>

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester –I**

**Minor: Comparative Anatomy and Physiology of Non-chordates**

**Sub: Zoology**

**Credits: 03**

**Marks: 75**

**Periods: 45 Hr.**

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**Learning Objectives**

- This course has been designed to understand Diversity of Integument in non-chordates and Digestive system
- To understand Diversity of Locomotors, Respiratory, Circulatory and Excretory systems
- To understand Diversity of Nervous and Reproductive systems
- To understand Evolution and characteristics of important Non Chordate taxa

**Learning Outcomes:**

After completion of the course the students will:

- Understand about Diversity of Integument in non-chordates and Digestive system
  - Learn Diversity of Locomotors, Respiratory, Circulatory and Excretory systems
  - Learn Diversity of Nervous and Reproductive systems
  - Comprehend the Evolution and characteristics of important Non Chordate taxa
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**UNIT –I Diversity of Integument in non-chordates and Digestive system**

- Basic affinities and differences between prokaryotes and eukaryotes; protists and the non-chordate animals.
- Symmetry, Coelom development and diversity.
- Cell membrane in protists and its derivatives.
- Integument in non-chordates and its derivatives.
- Nutrition and feeding modes in protists.
- Digestive system & feeding mechanism in non-chordates
- Process of digestion from food vacuoles to complex digestive organs.

**UNIT – II Diversity of Locomotory, Respiratory, Circulatory and Excretory systems**

- Locomotion and diversity of locomotory organs in protists and non-chordates, muscle and locomotion, Structure and diversity of skeletal elements in protists and non-chordates.
- Respiration: diversity of respiratory organs, modes of respiration.
- Respiratory pigments and oxygen consumption rates of different organisms.
- Circulation and the diversity of circulatory system.
- Excretion (protists): endocytosis, exocytosis;
- Excretion and diversity of excretory organs in non chordates.

### **UNIT –III Diversity of Nervous and Reproductive systems**

- Nervous system with special reference to diversity in brain and nerve chord.
- Neuroendocrine systems, pheromones. Sense organs: Mechanoreceptors and their diversity in different taxa.
- Sense organs: photoreceptors, chemoreceptors, thigmoreceptors, rheoreceptors and proprioceptors in different taxa.
- Olfaction and sound perception in insects, etc. Diversity of the reproductive organs and accessory sex organs;
- Modes of reproduction- asexual and sexual reproduction. Metamorphosis. Diversity of larval forms in non-chordates

### **UNIT –IV Evolution and characteristics of important Non Chordate taxa**

- Organization and affinities in fossils (such as trilobites). Affinities of living fossils, Limulus and Peripatus.
- Polymorphism and colony formation. Parasitic adaptations and life cycle patterns in parasites belonging to different taxa.
- The parasites listed by World Health Organization under preventive programmes. Structure and diversity of the pest organisms.
- Invertebrate model organisms and their importance.
- Taxa with special characteristics: Types of canal systems in sponges and their significance.
- Torsion and detorsion in Mollusca. Components of water vascular system in echinoderms.

### **Text Books and References:**

1. Barrington, E J W. (1967) Invertebrate structure and function, Nelson, London. 39
2. Barnes, R. D. (1968) Invertebrate Zoology, 2nd Ed. Saunders, Philadelphia.
3. Hyman, L H. (1940-67). The Invertebrates, Vol. I-VI. McGraw-Hill, New York.
4. 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.
5. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
6. Marshall, A.J and Williams, W.D. (1995) Text book of Zoology-Invertebrates. VII Ed., Vol. I, A.L.T.B.S. Publishers

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester -I**

**Minor**

**Sub: Zoology Lab Course-I**

**Credits: 01**

**Marks: 50**

**Periods: 30 Hr.**

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**Learning Objectives**

- To study of models, permanent slides and museum specimens.
- To dissect out, various non chordates with help of computer software and model.
- To study of larval forms: Ephyra, Planula, Trochophore, Pluteus, Velliger, Zoa, Metazoa, Bipinnaria
- To develop some videos to understand the animals of different taxa.

**Learning Outcomes:**

After completion of the course the students will:

- Understand about models, permanent slides and museum specimens.
  - Learn dissection of various non-chordates
  - Learn Diversity of larval forms: Ephyra, Planula, Trochophore, Pluteus, Velliger, Zoa, Metazoa, Bipinnaria
  - Understand to develop some videos of the animals of different taxa.
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**Practicals:**

1. Study of models, permanent slides and museum specimens representing different protists and non-chordate taxa.
2. Some additional slides/specimens of Protozoans of agricultural importance. Coral-reef forming Cnidarians Plant parasitic nematodes Nematodes used as models in experimental biological research
3. Dissection of Pheretima to expose circumpharyngeal ganglia
4. Dissection of Periplaneta to expose the digestive system and salivary glands
5. Dissection of Palaemon to expose appendages and statocyst
6. Dissection of Pila
7. Study of larval forms: Ephyra, Planula, Trochophore, Pluteus, Velliger, Zoa, Metazoa, Bipinnaria
8. Some videos to develop understanding on the animals of different taxa.
9. Group discussion or Seminar presentation on one or two related topics

**Text Books and References:**

1. Invertebrate Structure & Function by E.J. Barrington Nelson, London Publishers.
2. Invertebrate Zoology by P.S Dhami and J.K Dhami. R-Chand & Company
3. Invertebrate Zoology by Ruppert and Barnes. Holt Saunders Publishers
4. Modern Textbook of Zoology: Invertebrates by R.L Kotpal. Rastogi Publishers
5. Invertebrate Zoology by E.L Jordan and P.S Verma. S. Chand Publishers
5. A Manual of Practical Zoology: INVERTEBRATES

By P. S. Verma · 2010

<https://www.google.co.in/books/edition/A Manual of Practical Zoology INVERTEBRA/mqi-QZp28sEC?hl=en&gbpv=1&dq=invertebrate+practical&printsec=frontcover>

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester –I**

**Generic Elective:**

**Food, Nutrition and Health,**

**Sub: Zoology**

**Credits: 03**

**Marks: 75**

**Periods: 45 Hr.**

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**Learning Objectives**

- To understand Nutrition and dietary nutrients
- To understand Macro nutrients and micronutrients
- To understand Malnutrition and nutrient deficiency diseases
- To understand Diseases caused by microorganisms

**Learning outcomes:**

After completion of the course the students will:

- Learn nutrition and dietary nutrients
- Learn macro nutrients and micronutrients
- Learn Malnutrition and nutrient deficiency diseases
- Learn Diseases caused by microorganisms

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**Unit 1: Nutrition and dietary nutrients**

- Basic concept of Food: Components and nutrients.
- Concept of balanced diet, nutrient requirements
- Dietary pattern for different groups viz., adults, pregnant and nursing mothers, infants, school children, adolescents and elderly people.

**Unit II: Macro nutrients and micronutrients**

- Nutritional Biochemistry: Macronutrients. Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role.
- Micronutrients. Vitamins- Water-soluble and Fat-soluble vitamins- their sources and importance. Important minerals viz., Iron, Calcium, Phosphorus, Iodine, Selenium and Zinc: their biological functions.

**Unit III: Malnutrition and nutrient deficiency diseases**

- Definition and concept of health:
- Common nutritional deficiency diseases- Protein Malnutrition (e.g., Kwashiorkor and Marasmus)
- Vitamin A deficiency, Iron deficiency and Iodine deficiency disorders- their symptoms, treatment, prevention and government initiatives,
- If any. Life style dependent diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention.
- Acquired Immune Deficiency Syndrome (AIDS): causes, treatment and prevention. Other ailments viz., cold, cough, and fever, their causes and treatment.

**Unit IV: Diseases caused by microorganisms**

- Food hygiene: Potable water- sources and methods of purification at domestic level.

- Food and Water-borne infections: Bacterial diseases: cholera, dysentery; typhoid fever, viral diseases: Hepatitis, Poliomyelitis etc., Protozoan diseases: amoebiasis, giardiasis; Parasitic diseases: taeniasis and ascariasis.
- Transmission, causative agent, sources of infection, symptoms and prevention. Causes of food spoilage and its prevention.

### **Text Books and References:**

1. Mudambi, S.R. and Rajagopal, M.V. (2007). Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; New Age International Publishers
2. Srilakshmi, B. (2002). Nutrition Science; New Age International (P) Ltd.
3. Srilakshmi, B. (2007). Food Science; Fourth Ed; New Age International (P) Ltd.
4. Swaminathan, M. (1986). Handbook of Foods and Nutrition; Fifth Ed; BAPPCO.
5. Bamji, M.S.; Rao, N.P. and Reddy, V. (2009). Text Book of Human Nutrition; Oxford & IBH Publishing Co. Pvt Ltd.
6. Wardlaw, G.M. and Hampl, J.S. (2007). Perspectives in Nutrition; Seventh Ed; McGraw Hill.
7. Lakra, P. and Singh M.D. (2008). Textbook of Nutrition and Health; First Ed; Academic Excellence.
8. Manay, M.S. and Shadaksharaswamy, M. (1998). Food-Facts and Principles; New AgeInternational (P) Ltd.
9. Gibney, M.J. et al. (2004). Public Health Nutrition; Blackwell Publishing.
10. Food Nutrition and Health, S Chand & Company Limited  
[https://www.google.co.in/books/edition/Food Nutrition and Health/ajJlDwAAQBAJ?hl=en&gbpv=1&dq=Food,+Nutrition+and+Health.&printsec=frontcover](https://www.google.co.in/books/edition/Food+Nutrition+and+Health/ajJlDwAAQBAJ?hl=en&gbpv=1&dq=Food,+Nutrition+and+Health.&printsec=frontcover)

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester –I**

**Generic Elective:**

**Lab Course-I**

**Sub: Zoology**

**Credits: 03**

**Marks: 75**

**Periods: 45 Hr.**

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**Learning Objectives**

- To detect adulteration in common food Items.
- To estimate Lactose in milk.
- To estimate amount of Ascorbic acid
- To Study the stored grain pests

**Learning Outcome:**

After completion of the course the students will:

- Learn methods of adulteration in common food Items.
- Learn estimation of Lactose in milk.
- Learn estimation of amount of Ascorbic acid
- Learn the Study of stored grain pests

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**Practical**

1. Detection adulteration in common food item a) Ghee b) Sugars c) Tea leaves and d)

Turmeric.

3. Estimation of Lactose in milk.

4. Titrimetric method for Ascorbic acid estimation.

5. Estimation of Calcium in foods by titrimetry.

6. Study of the stored grain pests from slides/ photograph (*Sitophilus oryzae*, *Trogoderma granarium*, *Callosobruchus chinensis* and *Tribolium castaneum*): their identification, habitat and food sources, damage caused and control. Preparation of temporary mounts of the above stored grain pests.

7. Project- Computer aided diet analysis and nutrition counseling for different age groups.

**Text Books and References**

1. Practical Skills in Food Science, Nutrition and Dietetics by William Aspden · 2011

2. Fundamentals of Foods, Nutrition and Diet Therapy by Sumati R. Mudambi · 2007

[https://www.google.co.in/books/edition/Fundamentals\\_of\\_Foods\\_Nutrition\\_and\\_Diet/riaOth9Xf50C?hl=en&gbpv=1&dq=Food,+Nutrition+and+Health+practical&printsec=frontcover](https://www.google.co.in/books/edition/Fundamentals_of_Foods_Nutrition_and_Diet/riaOth9Xf50C?hl=en&gbpv=1&dq=Food,+Nutrition+and+Health+practical&printsec=frontcover)



**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester –II**

**DSC-3: Cell Biology**

**Sub: Zoology**

**Credits: 03**

**Marks: 75**

**Periods: 45 Hr.**

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**Learning Objective:**

- To study the structural and functional organization of cell
- To understand Endomembrane System
- To understand Mitochondria and Cytoskeleton
- To understand Nucleus and Cell Division

**Learning Outcomes:**

After completion of the course the students will:

- Learn the structural and functional organization of cell
  - Understand Endomembrane System
  - Understand Mitochondria and Cytoskeleton
  - Understand Nucleus and Cell Division
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**UNIT –I Overview of Cells and Plasma Membrane**

- Prokaryotic and Eukaryotic cells, Virus, Viroids, Mycoplasma, Prions
- Various models of plasma membrane structures
- Transport across membranes: active and passive transport, facilitated transport
- Cell-cell junctions, structures and functions: Tight junctions, adherens junctions, gap junctions

**UNIT –II Endomembrane System**

- Structure and Functions: Endoplasmic Reticulum
- Signal hypothesis, Vesicular transport from ER to Golgi apparatus
- Protein sorting and transport from Golgi apparatus; Golgi apparatus, Vesicular transport: Coated Vesicles; Lysosomes; Peroxisomes.

**UNIT –III Mitochondria and Cytoskeleton**

- Structure, Semi-autonomous nature, Endo-symbiotic hypothesis; Respiratory chain, Chemiosmotic hypothesis and ATP Synthase
- Structure and Functions: Microtubules, Microfilaments and Intermediate filaments.

**UNIT –IV Nucleus and Cell Division**

- Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Transport of molecules across nuclear membrane, Chromatin: euchromatin, heterochromatin and packaging, nucleosomes, nucleolus
- Mitosis, Meiosis, Cell cycle and its regulation

**Text Books and References:**

1. Cooper, G.M., Hausman, R.E. (2009) the Cell: A Molecular Approach. V Edition, ASM Press and Sinauer Associates.
2. Becker, Kleinsmith, and Hardin (2009) The World of the Cell, VIII Edition, Benjamin Cummings Publishing, San Francisco.
3. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments, VI Edition, John Wiley & Sons Inc.
4. De Robertis, E.D.P. and De Robertis, E.M.F. (2009) the Cell and Molecular Biology, Lippincott Williams & Wilkins, Philadelphia.
5. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Robert Keith and Watson James. (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester –II**

**Sub: Zoology Lab Course-III**

**Credits: 01**

**Marks: 50**

**Periods: 30 Hr.**

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**Learning Objectives**

- To study the Light microscope, Phase contrast microscope and Electron microscope.
- To understand the staining, mounting and micro techniques like blood smear. Squash preparation.
- To understand mitosis and the effect of colchicine on mitosis
- To understand cytochemical staining and preparation of permanent slide.

**Learning Outcomes:**

After completion of the course the students will:

- Learn Light microscope, Phase contrast microscope and Electron microscope.
  - Learn the staining, mounting and micro techniques like blood smear. Squash preparation.
  - Understand mitosis and the effect of colchicine on mitosis
  - Understand cytochemical staining and preparation of permanent slide.
- 

**Practicals:**

1. Principle of Light microscope, Phase contrast microscope and Electron microscope and principle of cell fixation, staining and fractionation.
2. Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
3. Study the effect of colchicine on mitosis at 24 hrs and 48 hrs.
4. Study of various stages of meiosis.
5. Preparation of temporary stained mount to show the presence of Barr body in human female blood cells/ cheek cells.
6. Cytochemical staining and preparation of permanent slide to demonstrate:
  - (a) DNA by Feulgen reaction
  - (b) Mucopolysaccharides by PAS reaction
  - (c) Proteins by Mercuric Bromophenol Blue/Acid Fast Green

**Text Books and References**

Essential Practical Handbook of Cell Biology & Genetics, Biometry & Microbiology A Laboratory Manual by Debarati Das · 2017

[https://www.google.co.in/books/edition/ESSENTIAL\\_PRACTICAL\\_HANDBOOK\\_OF\\_CELL\\_BIO/6W3WDQAAQBAJ?hl=en&gbpv=1](https://www.google.co.in/books/edition/ESSENTIAL_PRACTICAL_HANDBOOK_OF_CELL_BIO/6W3WDQAAQBAJ?hl=en&gbpv=1)

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester –II**

**IKS: History of Zoology and Present Status in India**

**Sub: Zoology**

**Credits: 03**

**Marks: 75**

**Periods: 45 Hr.**

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**Learning Objectives**

- To understand History of zoology and Present Status in India.
- To understand Ancient Indian Scriptures.
- To understand Flora and Fauna in Pre Independence and Post Independence Era
- To understand Zoological parks, sanctuary and Zoological Gardens in India and Endangered Species and Extinct Species in India

**Learning Outcome**

- Understand History of zoology and Present Status in India.
  - Understand Ancient Indian Scriptures.
  - Understand Flora and Fauna in Pre Independence and Post Independence Era
  - Understand Zoological parks, sanctuary and Zoological Gardens in India and Endangered Species and Extinct Species in India
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**UNIT –I**

- Ancient Indian Scriptures: Sushruta Samhita, Panini Astaadhyayi, Mrigpakshishastra
- Origin Of life
- Animal classification in ancient Vedic India
- Charka Classification
- Manu's Classification

**UNIT – II**

- Taxonomy and Classification of animals in Ancient India
- Flora and Fauna in Pre Independence and Post Independence Era.
- Indian Scientist and their contributions in Zoology

**UNIT –III**

- Zoological Museum In India
- Zoological parks ,sanctuary and Zoological Gardens in India
- Zoological survey of India.

**UNIT –IV**

- IUCN List
- Endangered Species and Extinct Species in India
- Animal Conservation Laws ,acts and Conventions
- Animal Taxonomy Summit 2023.

## Text Books and References

1. History of Zoology and Present Status in India, Ramakrishna and Chandrakasan Sivaperuman. ISBN 13 : 9789391095130.
2. Handbook of National Parks, Wildlife Sanctuaries and Biosphere Reserves in India By Sharad Singh Negi  
[https://www.google.co.in/books/edition/Handbook of National Parks Wildlife Sanc/JYFmoOWfmX8C?hl=en&gbpv=1](https://www.google.co.in/books/edition/Handbook_of_National_Parks_Wildlife_Sanc/JYFmoOWfmX8C?hl=en&gbpv=1)
3. Wildlife of India By Bikram Grewal · 2022,  
[https://www.google.co.in/books/edition/Wildlife of India/Cgo0EAAAQBAJ?hl=en&gbpv=1](https://www.google.co.in/books/edition/Wildlife_of_India/Cgo0EAAAQBAJ?hl=en&gbpv=1)
4. A Life with Wildlife From Princely India to the Present By M.K. Ranjitsinh · 2017  
[https://www.google.co.in/books/edition/A Life with Wildlife/IGYlDwAAQBAJ?hl=en&gbpv=1](https://www.google.co.in/books/edition/A_Life_with_Wildlife/IGYlDwAAQBAJ?hl=en&gbpv=1)

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester –II**

**Sub: Zoology Lab Course-IV**

**Credits: 01**

**Marks: 50**

**Periods: 30 Hr.**

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**Learning Objectives**

- To make the students to understand Endangered species and extinct species specimen
- To make the students to understand Collection and preservation of animal species.
- To make the students to understand preservation of fossils and remains
- To make the students to understand Nomenclature and Classification of collected specimen

**Learning Outcome**

- Learners would understand the knowledge about nature conservation and protection of the animals so as to avoid animal extinction.
  - Learners would be able to Museum Study of specimen so as to study biodiversity among animals.
  - Learners would be able to Collection and preservation of animal species.
  - Learners would analyze animal fossil.
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**Practicals:**

1. Study of Endangered species and extinct species specimen
2. Museum Study of specimen (3 D model)
3. Collection and preservation of animal species.
4. Methods of preservation of fossils and remains ( Eggs of Dinosaurs or any other Fossil)
5. Nomenclature and Classification of collected specimen
6. Paleontological study of animal fossil

**Text Books and References**

1. Acting for Endangered Species The Statutory Ark By Shannon Petersen · 2002  
[https://www.google.co.in/books/edition/Acting\\_for\\_Endangered\\_Species/EkyQAAAAMAAI?hl=en&gbpv=1](https://www.google.co.in/books/edition/Acting_for_Endangered_Species/EkyQAAAAMAAI?hl=en&gbpv=1)
2. **Endangered and Disappearing Birds of the Midwest** by Matt Williams; Francesca Cuthbert

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester –II**

**Minor**

**Comparative Anatomy and Physiology of Chordates**

**Sub: Zoology**

**Credits: 03**

**Marks: 75**

**Periods: 45 Hr.**

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**Learning Objectives**

- To make the students to understand Structure and function of integument, skeletal and muscular systems.
- To make the students to understand Structure and function of digestive, circulatory and endocrine systems.
- To make the students to understand Structure and function of respiratory and excretory systems.
- To make the students to understand Structure and Function of Nervous and Reproductive System

**Learning Outcome**

- Learners would understand the knowledge about understand Structure and function of integument, skeletal and muscular systems. .
- Learners would be able to Structure and function of respiratory and excretory systems.
- Learners would be able to Structure and Function of Nervous and Reproductive System

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**UNIT –I: Structure and function of integument, skeletal and muscular systems**

- Structure of integument from fishes to mammals with an account on epidermal and dermal derivatives and their functional significance.
- Anatomy and physiology of axial and appendicular skeleton.
- Comparative anatomy of pelvic and pectoral girdles from fishes (cartilaginous and bony) to mammals.
- Types of muscles, physical properties and ultrastructural organization of skeletal muscle fibres, muscle contraction.

**UNIT – II: Structure and function of digestive, circulatory and endocrine systems**

- Comparative anatomy of jaw suspension, oral cavity, teeth (dentition mammals).
- Structure and diversity of alimentary canal and digestive glands in chordates.
- Biological significance of nutrients- carbohydrates, proteins, fats, vitamins and minerals. Physiology of digestion with special reference to enzymes involved.
- Evolution of aortic arches and their significance.
- Visceral arches and their functional significance in vertebrates.
- Structure and evolution of heart in vertebrates.
- Functional anatomy of heart, cardiac cycle, cardiac output, Integration of cardiovascular function, electrocardiogram.

- Composition of blood, blood groups, Mechanism of blood coagulation. Types and functional significance of endocrine glands and hormones.

### **UNIT –III Structure and function of respiratory and excretory systems**

- Aquatic and terrestrial respiration; transition from water to air breathing.
- Breathing and gas exchange, gas transport, Hb and O<sub>2</sub> dissociation, BMR.
- Comparative anatomy and functional significance of lungs in amphibians, reptiles, birds and mammals.
- Types and development of kidneys and their ducts in anamniotes and amniotes.
- Nephron- structure, types and their function. Physiology of excretion in vertebrates; urine formation, counter current mechanism, Role of ADH and RAAS in excretion.
- Mechanisms of Osmoregulation in fresh water and marine organisms, stenohalinity and euryhalinity.

### **UNIT –IV : Structure and Function of Nervous and Reproductive System**

- Introduction to central and peripheral nervous systems.
- Structural and functional evolution of brain and spinal cord in various classes of chordates.
- Peripheral nervous system- functional significance of somatic and autonomic nervous systems. Structure and functions of neuron, ionic basis of resting and action potentials, nerve impulse and its transmission, synapse and synaptic transmission, Reflex action.
- Types of sense organs- vision, hearing, taste, smell and touch in chordates. Mechanism of thermoregulation in homeotherms and poikilotherms.
- Comparative details of testes and ovaries from fishes to mammals; modes of reproduction; estrous and menstrual cycle, implantation, gestation, parturition, lactation and birth control.

### **Text Books and References:**

1. Weichert, C.K. (1970) Anatomy of Chordates (4th edition).
2. Jordan, E. L. and Verma, P. S. (2013) Chordate Zoology (14th edition).  
[https://www.google.co.in/books/edition/Chordate\\_Zoology/sRlrDAAAQBAJ?hl=en&gbpv=1&dq=Comparative+Anatomy+and+Physiology+of+Chordates&printsec=frontcover](https://www.google.co.in/books/edition/Chordate_Zoology/sRlrDAAAQBAJ?hl=en&gbpv=1&dq=Comparative+Anatomy+and+Physiology+of+Chordates&printsec=frontcover)
3. Saxena, R. K. and Saxena, S. (2015) Comparative Anatomy of Vertebrates (2nd edition).
4. Vander, A.; Sherman, J. and Luciano, D. (2003) Human Physiology (9th edition).
5. Randall, D. et al. (2002) Eckert Animal Physiology (5th edition) Freeman.



**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester -II**

**Minor**

**Sub: Zoology Lab Course-II**

**Credits: 01**

**Marks: 50**

**Periods: 30 Hr.**

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**Learning Objectives**

- To make the students to understand temporary mount.
- To make the students to understand comparative study of various system.
- To make the students to understand study of skeleton system and qualitative analysis of nutrients.
- To make the students to understand various physiological activities.

**Learning Outcome**

- Learn permanent and temporary mount.
  - Learn comparative study of various system
  - Learn skeleton system and qualitative analysis of nutrients..
  - Learners would analyze various physiological activities.
- 

**Practicals:**

1. Temporary mount of external scales in fishes (cycloid, placoid, ganoid, ctenoid).
2. Comparative study of brain with the help of models and charts.
3. Comparative study of urinogenital system with the help of models and charts.
4. Comparative study of heart with the help of models and charts.
5. Mount of weberian ossicles of fish.
6. Study of axial and appendicular skeleton of vertebrates.
7. Qualitative analysis of nutrients: Carbohydrate, Proteins, Lipids.
8. Estimation of haemoglobin.
9. Counting of different types of blood cells using haemocytometer.
10. Study of action of salivary amylase.
11. Rate of oxygen uptake in fish.
12. Effect of temperature on opercular movement of fish.

**Text Books and References:**

1. A Manual of Practical Zoology Chordates By P.S.Verma · 2000  
<https://www.google.co.in/books/edition/A Manual of Practical Zoology Chordates/sxInWntmk0QC?hl=en&gbpv=1>

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester –II**

**Generic Elective:**

**Vectors, Diseases and Control**

**Sub: Zoology**

**Credits: 03**

**Marks: 75**

**Periods: 45 Hr.**

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**Learning Objectives**

- To make the students to understand Vector and vector bionomics
- To make the students to understand Disease vectors and the causes of disease outbreaks.
- To make the students to understand Vector management strategies.
- To make the students to understand Emerging concepts and approaches to vector management.

**Learning Outcome**

- Learners would understand the knowledge about types and morphological peculiarities of vectors.
  - Learners would be able to analyze Diptera, Siphonaptera, Siphunculata, Hemiptera, Arachnida, Blattaria, Acarina.
  - Learners would be able to management strategies various vectors.
  - Learners would analyze Legislation and regulation, Methods of sampling and monitoring, sampling plan, Allocation of sampling units
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**Unit I: Vector and vector bionomics**

- Brief introduction, types and morphological peculiarities of vectors such as mosquitoes, flies, fleas, lice, bugs, ticks and mites.
- Host-vector relationship. Primary and secondary vector concept. Capacity.
- Vector bionomics-larval habitats and host biting preferences, human and animal biting indices. Evolution of vector bionomics and its effect on disease transmission.
- Vector incrimination. Human practices and the occurrence of pests

**Unit II: Disease vectors and the causes of disease outbreaks**

- Salient features of the vectors belonging to Diptera, Siphonaptera, Siphunculata, Hemiptera, Arachnida, Blattaria, Acarina (families Ixodidae and Argasidae) etc.
- Role of non-blood sucking flies in myiasis; of blood sucking flies in transmission of plague and typhus; of lice (body, head, pubic) in transmission of typhus, relapsing and trench fevers, Vagabond's disease and Phthiriasis; of bugs in transmission of Chaga's disease of. Brief account of mites and the associated diseases.

- Population biology, Factors affecting abundance, Density dependence and independence, how do people cause outbreak?

### **Unit III: Vector management strategies**

- Control of vector flies by screening, fly traps, electrocution, poison baits and outdoor residual sprays; biological control by natural parasites and predators.
- Chemical control. Efficacy of synthetic pyrethroids, residual spray of insecticides, treated bed nets/curtains and fumigations.
- Biological control of mosquitoes by the use of viruses, bacteria, fungi, parasites, nematodes and larvivorous fishes. Sterile insect technique, Eradication,
- Other genetic approaches, Pheromones/allelochemicals, Attract-and –kill, Mating disruptors, alarm pheromones and oviposition disruptors

### **Unit IV: Emerging concepts and approaches to vector management**

- Legislation and regulation, Methods of sampling and monitoring, sampling plan, Allocation of sampling units. Exclusion and routes of entry.
- Controlled atmosphere, Risk assessment, The integrated control/ IPM approach, Damage thresholds estimation, Forecasting,
- Increasing agro ecosystem resistance, Pesticide selection, Eradication versus control, Up to what limits IPM should be adopted. Decision support

### **Text Books and References:**

1. Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK.
2. Chapman, R.F. (1998). The Insects: Structure and Function.IV Edition, Cambridge University Press, UK.
3. Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and other Insect Vector borne Disease.Wiley-Blackwell.
4. Belding, D.L. (1942). Textbook of Clinical Parasitological. Appleton-Century Co., Inc., New York.
5. Roy, D.N. and Brown, A.W.A. (2004). Entomology. Biotech Books, Delhi
6. Vector-Borne Diseases: Epidemiology and Control By B.K. Tyagi · 2008,

### **Text Books and References:**

1. Vector-Borne Diseases: Epidemiology and Control By B.K. Tyagi · 2008

[https://www.google.co.in/books/edition/Vector\\_Borne\\_Diseases\\_Epidemiology\\_and\\_C/lep eDwAAQBAJ?hl=en&gbpv=1](https://www.google.co.in/books/edition/Vector_Borne_Diseases_Epidemiology_and_C/lep eDwAAQBAJ?hl=en&gbpv=1)

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester –II**

**Generic Elective:**

**Lab Course-II**

**Sub: Zoology**

**Credits: 03**

**Marks: 75**

**Periods: 45 Hr.**

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**Learning Objectives**

- To make the students to understand various parts of different insects
- To make the students to understand various diseases transmitted
- To make the students to understand modes of diseases.
- To make the students to understand Project report submission, write-up

**Learning Outcome**

- Learners would understand the knowledge about different insects
  - Learners would be able to transmitted diseases.
  - Learners would be able to research project
  - Learners would analyze various taxonomic grades.
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**Practical**

1. Study of mouth parts of different insects.
2. Study of permanent slides of the following insect vectors: Aedes, Culex, Anopheles, Pediculus humanus corporis, Pediculus humanus capitis, Phthirus pubis, Xenopsylla cheopis, Musca domestica, Cimex lectularius, and Phlebotomus argentipes through permanent slides / videos.
3. State the diseases transmitted by above insect vectors.
4. Project report submission on any one of the insect vectors and the disease transmitted.

**Text Books and References:**

1. Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK.
2. Insect Mouthparts Form, Function, Development and Performance, Springer International Publishing

<https://www.google.co.in/books/edition/Acting for Endangered Species/EkyQAAAAMAAI?hl=en&gbpv=1>

**RAJARSHI SHAHU MAHAVIDYALAYA, (AUTONOMOUS), LATUR.**

**Semester wise course structure**

**B.Sc. F.Y. Semester -II**

**Mini Project**

**Sub: Zoology**

**Credits: 02**

**Marks: 50**

**Periods: 45 Hr.**

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