



**Rayat Shikshan Sanstha's**

**SADGURU GADGE MAHARAJ COLLEGE, KARAD.**

**(An Autonomous)**

**Accredited By NAAC with 'A+' (3.63 CGPA) Grade**

**ISO-9001-2015 Certified**

**Affiliated to Shivaji University, Kolhapur**

**Bachelor of Science (B.Sc.)**

**DEPARTMENT OF ZOOLOGY**

**Under the Faculty of Science and Technology**

**Choice Based Credit System (CBCS)**

Regulations in accordance with  
**National Education Policy-2020**

**Syllabus For**

**B. Sc. Part –II (ZOOLOGY)**

**SEMESTER III & IV**

**(Syllabus to be implemented from June 2024)**

**Rayat Shikshan Sanstha's**  
**SADGURU GADGE MAHARAJ COLLEGE, KARAD**  
(An Autonomous College)  
Regulations and Guidelines as per NEP2020  
**Choice Based Credit System (CBCS)**  
**Syllabus for Bachelor of Science Part- II (Zoology)**

**1. Title:** B. Sc. II Zoology

**2. Year of Implementation:** 2024-25

**3. Preamble:**

- 1) To impart the knowledge of animal science to the pupils.
- 2) To make the pupils to use the knowledge in their daily life.
- 3) To make the pupils aware of natural resources and environment.
- 4) Application of knowledge in Zoology for nutrition, agriculture & livestock.
- 5) To provide practical experiences which form a part of their learning processes.
- 6) To develop aptitude for scientific work & ability to pursue studies far beyond graduation.
- 7) To encourage the pupils to take life science as a carrier. This is the need of time.
- 8) To make the pupils fit for the society.
- 9) In Autonomous the addition of more syllabus will be very helpful to students which will improve their knowledge in depth.
- 10) To inculcate in the student's highest values of life, understand the human niche in nature and apply the knowledge of life sciences for betterment of society.
- 11) To inspire students to reach frontiers of life sciences through commitment, hard work, study and research.

#### **4. General Objectives of the Program:**

1. To impart knowledge is the basic aim of education. The students are expected to acquire the knowledge of animal science, natural phenomenon, manipulation of nature & environment by man.
2. Understanding the scientific terms, concepts, facts, phenomena & the interrelationships.
3. Applications of the knowledge.
4. To develop skills in practical work, experiments & laboratory materials, instruments.
5. To develop interests in the subject & scientific hobbies.
6. To develop scientific attitude which is the major objective. This makes the students open minded, critical observations, curiosity, thinking etc.
7. Abilities to apply scientific methods, collection of scientific data, problem solving, organize science exhibitions, clubs etc.
8. Appreciation of the subject, contributions of scientists, scientific methods, scientific programs etc.

#### **5. Program Outcomes:**

1. The student will graduate with proficiency in the subject of his choice.
2. The student will be eligible to continue higher studies in his subject.
3. The student will be eligible to pursue high studies abroad.
4. The student will be eligible to appear for the examinations for jobs in government organizations.
5. The student will be eligible to appear for jobs with minimum requirement of B.Sc.Program.

#### **6. Program Specific Objectives:**

1. The students are expected to understand the fundamentals, principles, concepts and recent developments in the Zoology.
2. The practical course is framed in relevance with the theory courses to improve the understanding of the various concepts in Zoology.
3. It is expected to inspire and boost interest of the students in Zoology.
4. To develop the power of appreciations, the achievements in science and role in nature and society.
5. To enhance student sense of enthusiasm for science and to involve the intellectually stimulating experience of course in a supportive environment.

**Structure of the Course: B. Sc. II (Zoology)**

Level	Year	Sem.	Course Type	CourseCode	CourseTitle	Credits	No. of Lectures/Practicals
5.0	II	III	Major	MJ-BZT23-301 (Paper- V)	Applied Zoology	2T	30
			Major	MJ-BZT23-302 (Paper- VI)	Evolution and Ethology	2T	30
			Major	MJ-BZP23-303 (Practical- III)	Practical based on Applied Zoology & Evolution and Ethology	4P	30
			Minor	MN-BZT23-301 (Paper- V)	Wonders of animal world and footsteps in Zoology	2T	30
			Minor	MN-BZP23-302 (Practical- III)	Practical based on Wonders of animal world and footsteps in Zoology	2P	15
			AEC	AECZ- II	English - III	2T	30
			VAC	VAC - I	Democracy	2T	30
			VAC	VAC - II	Environmental Science	2T	30
			SEC	SECZ23-301 (SEC – II)	Sericulture	2T	30
			SEC	SECZ23-302 (SEC – III)	Practicals based on Sericulture	2P	15
		IV	Major	MJ-BZT23-401 (Paper-VII)	Biochemistry	2T	30
			Major	MJ-BZT23-402 (Paper- VIII)	Biodiversity and Biosystematics	2T	30
			Major	MJ-BZP23-403 (Practical IV)	Practicals Based on Biochemistry & Biodiversity and Biosystematics	4P	30
			Minor	MN-BZT23-401 (Paper-VI)	Instrumentation and Animal Biotechnology	2T	30
			Minor	MN-BZP23-402 (Practical IV)	Practicals based on Instrumentation and Animal Biotechnology	2P	15
			AEC	AECZ- III	English - IV	2T	30
			AEC	AECZ23-II	Environmental Science	2T	30
			SEC	SECZ23-401 (SEC – IV)	Micro-Techniques	2T	30
			SEC	SECZ23-402 (SEC – V)	Practicals based on Micro-Techniques Practical- V	2P	15
			CC	CCZ23- 401		2T	30

**B. Sc. Zoology Semester III  
Paper V**

**Course Code and title: MJ-BZT23-301 APPLIED ZOOLOGY (Major)**

**Credits: 02**

**Total Lectures: 30**

**COURSE OBJECTIVES**

1. Students will be able to know host parasitic relationship.
2. Students will be able to know economic importance of Dairy farming.
3. Students will be able to know aspects of poultry farming.
4. Students will be able to know economic importance of Lac.

Topic No		Lectures
	<b>Credit I</b>	
1	<b>Introduction to Host-parasite Relationship:</b> Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis(Common Infectious Diseases) Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis(Common Infectious Diseases) Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis(Common Infectious Diseases)	5 Hrs
2	<b>Epidemiology of Diseases:</b> Transmission, Prevention and control of diseases: Tuberculosis, Herpes Rickettsiae and Spirochetes: Brief account of <i>Rickettsia prowazekii</i> and <i>Treponema pallidum</i>	10 Hrs
	<b>Credit II</b>	
3	<b>Insects of Economic Importance:</b> Biology, Control and damage caused by <i>Helicoverpa armigera</i> , <i>Pyrilla perpusilla</i> and <i>Papilio demoleus</i> , <i>Callosobruchus chinensis</i> , <i>Sitophilus oryzae</i> , <i>Tribolium castaneum</i>	5 Hrs
4	<b>Poultry Farming:</b> Indigenous and Exotic breeds, Principles of poultry breeding, Management of breeding stock and broilers, Processing and Preservation of eggs. Atomization of Poultry .Poultry Diseases: Coccidiosis, Avian Flu, Fowlpox, Botulism, Fowl chlorella <b>Dairy Farming:</b> Management of model dairy farming Common livestock diseases Nutritive value of Milk products <b>Lac culture:</b> Lifecycle of Lac insect and Economic importance of Lac	10 Hrs

**Course Outcomes: Student should be able to....**

1. Students should understand host-parasitic relationship.
2. Students will learn about transmission, control and prevention about diseases.
3. Students should learn about insect biology and control.
4. Students should apply poultry and dairy farming in career.
5. Students will be able to start their own business.

**Reference Books:**

1. Applied Zoology-Dairy Farming–Dr. N. Arumugam-Saras Publication (Unit4)
2. Text book on Applied Entomology. K. P.Shrivastava (Unit3)
3. Elements of Entomology-Rajendra Singh-(Unit1,2,3)
4. Applied Zoology by R. L. Kotpal (Unit1,2,3,4)
5. Economic Zoology by Manju Yadav (Unit3,4 )
6. Economic Zoology –Shailendra Singh (Unit 3,4 )
7. Animal Husbandry by Ashok Kumar (Unit 1,2,3,4 )
8. Applied Zoology by N. Arumugam (Unit3,4)

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## B. Sc. II Zoology Semester III

### Paper VI

Code and Title: MJ-BZT23-302 Evolution and Ethology (Major)

Credits: 2

Total lectures - 30

**Course Objectives:** Students should be able to

1. Acquire knowledge about the evolutionary history of earth - living and non-living.
2. Acquire basic understanding about evolutionary concepts and theories.
3. Study the distribution of animals on earth, its pattern, evolution, and causative factors.
4. Impart basic knowledge on animal behavioral patterns and their role.

Topic No		Lectures
<b>Credit I - Evolution</b>		
1	<b>Origin of life:</b> Theories - Cosmozoic theory, Theory of spontaneous generation (Abiogenesis or Autogenesis), Special creation, Biogenesis, Endosymbiosis. Chemical evolution - Haldane and Oparin theory, Miller-Urey Experiment; Direct evidences of evolution – Recapitulation Theory of Haeckel, Fossilization, Kinds of fossils, fossil dating, Homologous organs and analogous organs.	5 Hrs
2	<b>Nature of Evolution:</b> <b>Speciation:</b> Types of speciation, Phyletic speciation (autogenous and allogenuous transformations), True speciation, Instantaneous and gradual speciation, allopatric and sympatric speciation. <b>Isolation:</b> Role of isolating mechanisms in evolution Microevolution, Macroevolution (Adaptive radiation -Darwin finches), Mega evolution, Punctuated equilibrium, Geological time scale, and Mass extinction (brief account only). <b>Population genetics and evolution:</b> Hardy-Weinberg Equilibrium, gene pool, Bottleneck effect and founder effect	10Hrs
<b>Credit II - Ethology</b>		
3	Introduction Definition, History, and scope of ethology Learning – Types of learning – Habituation, conditioned reflex, insight learning, latent learning, imprinting, memory, cognition, sleep, and arousal; Biological clocks; Development of behaviour; Social communication; Social dominance Role of hormones in behaviour	10Hrs
4	<b>Social organization</b> Social behaviour in honey bee and termites; Parental care in insects, fishes and amphibians; Courtship and defensive behaviour in insects, fishes and birds. Social organization in insects (ants) and mammals (monkey)	5Hrs

**Course outcomes: Students should be able to .....**

1. Basic knowledge on principles of inheritance and variation
2. Knowledge on molecular basis of inheritance
3. Basic understanding on the mechanism and factors affecting evolution
4. Knowledge on origin and evolution of man

## References:

1. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
2. Barnes, C.W. (1988). Earth, Time and Life. John Wiley & Sons, New York
3. Bendall, D. S. (ed.) (1983). Evolution from Molecules to Man. Cambridge University Press, U.K.
4. Bull J.J and Wichman H.A..(2001). Applied Evolution. Annu. Rev. Ecol. Syst. 32:183-217
5. Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.
6. Chattopadhyay Sajib. (2002). Life Origin, Evolution and Adaptation. Books and Allied (P) Ltd. Kolkata, India.
7. Douglas, J. F (1997). Evolutionary Biology. Sinauer Associates.
8. Goodwin, B. (1996). How the Leopard Changed its Spots: The Evolution of Complexity. Simon & Schuster, NY, USA.
9. Hall, B. K. and Hallgrímsson, B. (2008), Evolution. 4th Edition; Jones and Bartlett Publishers.
10. Coyne J.A. and Allen Orr H. (2004). Speciation, Sinauer Associates
11. Ridley, M. (2004), Evolution 3rd Edition. Blackwell Publishing
12. Rob Desalle and Ian Tattersall (2008). Human Origins: What Bones and Genomes Tell Us about Ourselves. Texas A&M University Press, USA.
13. Strickberger, M.W. 2000. Evolution. Jones and Bartlett, Boston.
14. Agarwal. V. K. (2009). Animal Behaviour. S. Chand and Company Pvt. Ltd., New Delhi.
15. Bonner, J.T. (1980). The Evolution of Culture in Animals. Princeton University Press. NJ, USA.
16. David McFarland. (1999). Animal Behaviour. Pearson Education Ltd. Essex, England.
17. Dawkins, M.S. (1995). Unravelling Animal Behaviour. Harlow: Longman.
18. Dunbar, R. (1988). Primate Social Systems. Croom Helm, London.
19. Gundevia J.S. and Singh H.G. (1996), A Text Book of Animal Behaviour. S. Chand and Company Pvt. Ltd., New Delhi.
20. Aubrey M. and Dawkins M.S. (1998). An Introduction to Animal Behaviour. Cambridge University Press, UK.
21. Sherman P.W and Alcock J., (2001) Exploring Animal Behaviour-

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**B. Sc. II, Semester III**

**Practical III (Major)**

**Based on Applied Zoology & Evolution and Ethology**

**Paper Code: MJ-BZP23-303**

**4 credits**

**Practicals:**

1. Study of arthropod vectors associated with human diseases: *Pediculus*, *Culex*, *Anopheles*, *Aedes* and *Xenopsylla*.
2. Study of insect damage to different plant parts /stored grains through damaged Products/photographs.
3. Identifying feature and economic importance of *Helicoverpa (Heliothis) armigera*, *Papilio demoleus*, *Pyrilla perpusilla*,
4. Identifying feature and economic importance of *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*.
5. Poultry: Egg and Meat Nutritive value
6. Poultry diseases-
7. Dairy: Nutritive value of Milk Products: Curd, Buttermilk, Ghee, Paneer, Cheese
8. Life cycle of lac insect.
9. Economic importance of Lac.
10. Field trip to poultry farm or animal breeding centre or any other suitable place related to Syllabus
11. Submission of field trip report (Printed/Handwritings).
12. Study of parasitism, symbiosis and commensalism with example.
13. Transmission, parasitism and control of Tuberculosis (Herpes Rickettsia)
14. Study of *Treponema pallidum*.
15. Contributions of scientists in Evolution and Ethology (showing photos) - Any four
16. Study of Homology in Animals.
17. Study of Analogy in Animals.
18. Study of connecting links (Peripatus, Archaeopteryx, Protopterus, Echidna)
19. Study of fossil evidences from plaster cast models and pictures.
20. Darwin's Finches with diagrams/ cut outs of beaks of different species.
21. Example Based on Hardy-Weinberg equilibrium. (Any Two Example)
22. Study of mimicry (Viceroy and Monarch butterfly, Honey bee and predator fly) and camouflage (stick insect, leaf insect, dead- leaf butterfly).
23. Study of different types of nests of in birds.
24. Study of parental care in fishes and amphibian.
25. Study of Pheromone traps in insect.
26. Determination of threshold level of sugar in house fly.
27. Experiment on humidity preference by fourth in-star silkworm.
28. Orientation of flesh fly larvae towards flesh.
29. Study of the effect of temperature on heart beats of silkworm.
30. Visit to butterfly garden.

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## B. Sc. Zoology Semester III

### Paper V (Minor)

Course Code and title: MN-BZT23-301 Wonders of Animal World and Footsteps in Zoology

Credits: 02

Total Lectures: 30

#### COURSE OBJECTIVES:

1. Students will be able to know wonder animals.
2. Students will be able to captivate journey of hoarded wealth of marvelous animal world.
3. Students will be able to know social workers

Topic No		Lectures
	<b>Credit I</b>	
1	Echolocation in Bats and Cetaceans: E.g. Dolphins and Whales Mechanism of Pearl formation in Mollusca Bioluminescence in Animals: Noctiluca, Glow worm, Firefly, Angler Fish (Mechanism and use for the animal) Regeneration in Animals E.g. Earthworm and Lizard Mimicry in Butterflies and its significance: Great Egg fly and Common Crow, Common Palm fly and Plain Tiger Mechanism of Coral formation and types of Coral reefs	10 Hrs
2	Bird migration: Definition, types and factors inducing bird migration Breeding and Parental care in: Pisces -Ovo-viviparous (Black Molly/Guppy), Mouth brooders (Tilapia), Brood pouches (Sea horse) Amphibia - Mouth brooders (Darwin's Frog), Egg carriers (Midwife Toad) Mammals- Egg-laying (Duck-billed Platypus), Marsupials (Kangaroo) Aves: Brood Parasitism (Cuckoo)	05 Hrs
	<b>Credit II</b>	
3	<b>Footsteps to follow</b> Dr. Hargobind Khorana (Genetic code) Dr. Varghese Kurien (Amul –White revolution) Dr. Salim Ali (Ornithologist) Gadre Fisheries (Fish processing)	08Hrs
4	<b>Social workers:</b> Anna Hazare (Water Conservation-Ralegan Siddhi) Baba Amte (Anandvan) Medhapatkar (Narmada movement) Two cases preferably of local importance to the college be additionally taught.	07Hrs

**Course Outcomes: Student should be able to....**

1. Students should understand amazing world of animals
2. Students will learn about Migration of birds and fishes and parental care.
3. Students will inspired through great personalities which were studied
4. Students will be able to start their own business.

**ReferenceBooks:**

1. Vertebrate Zoology Volume I- Jordan and Verma , S. Chand and Co.
2. Invertebrate Zoology Volume II- Jordan andVerma , S. Chand and Co.
3. Modern Biology- V. B. Rastogi
4. Biology of Mollusca- D. R. Khanna
5. A Textbook of Zoology, Vol. II- T. Jeffery Parker and William. A. Haswell- Low Price Publications
6. Ecology and Environment- P. D. Sharma, R. K. Rastogi Publications
7. Butterflies of India – Isaac Kehimkar- BNHS Publication

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**B. Sc. II, Semester III**  
**Practical III (Minor)**  
**Course Code and title: MN-BZP23-302**

**Practicals based on Wonders of Animal World and Footsteps in Zoology**

**Credits: 02**

**Total Lectures: 15**

- 1.) Study of Symbiosis (Termite and Trychonympha, hermit crab and sea anemone)
- 2.) Study of Camouflage (leaf insect, chameleon)
- 3.) Study of Cannibalistic mate-eating animals (Spider and Praying Mantis)
- 4.) Study of Animal architects: Termites, Harvester ant and Baya weaver bird
- 5.) Study of bioluminescent organisms – Noctiluca, glow worm, fire fly, Angler fish.
- 6.) Breeding and parental care in Amphibia- Rhacophorus, Midwife toad, Darwin's frog, Caecilian.
- 7.) Mounting of foraminiferan shells from sand
- 8.) Preparation and observation of paramecium culture
- 9.) Study of types of Corals - Brain, Organ pipe, Stag Horn, Mushroom coral
- 10.) Field Report – To be done in a group of ten students (submission of written / typed report preferably along with photographs/ tables/ graphs.
- 11) Observations of fauna in the field (with reference to theory syllabus).

**Learning outcomes:-**

1. Students will be able to acquire the knowledge of applied Zoology for the development own business (Income generation).
2. The students will be able to identify organisms in their own habitat with the help of study tour.
3. Calculate nutritive value of required daily food.
4. Students will study the vectors of human disease.

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**B.Sc. II Semester-III  
SEC - II**

**Course code and title: SECZ23-301 Sericulture**

**Credits: 02**

**Total Lectures: 30**

**COURSE OBJECTIVES**

1. To understand the scope and significance of sericulture for developing startups as a agro based industry.
2. To involve students in learning a thorough knowledge about the cultivation of mulberry, maintenance of the farm, seed technology, silkworm rearing and silk reeling.
3. To train the students in identifying the diseases and pests of the mulberry plant and silkworms
4. To involve students in learning about the various skills that are necessary for self employment in the sericulture.

<b>Topic No.</b>		<b>Lectures</b>
<b>Credit – I</b>		
1.	<p><b>History and scope of Sericulture.</b> Geographical distribution of mulberry and non-mulberry sericulture, scope of sericulture in India.</p> <p><b>Types of silkworms</b> Classification and Life cycle of mulberry and non-mulberry silkworms.</p>	7 Hrs
2.	<p><b>Soil management and cultivation of mulberry</b> Site suitability for mulberry garden establishment, Physical and chemical properties of soils, Selection and preparation of land for mulberry cultivation</p> <p><b>Mori culture</b> Characteristic features of popular mulberry varieties of tropical and temperate regions.</p> <p><b>Mulberry propagation-</b> Different methods of propagation</p> <p><b>Mulberry crop production-</b> Planning for establishment of mulberry garden,</p> <p><b>Water management-</b> Methods of irrigation, Frequency of irrigation.</p>	8 Hrs
<b>Credit –II</b>		
3.	<p><b>Pre-requisites for rearing</b> Selection of silkworm breeds for rearing, estimation of brushing capacity requirements of rearing, disinfecting silkworm rearing house and appliances.</p> <p><b>Egg handling, Incubation &amp; Chawki rearing</b> Pre-incubation care of silkworm eggs, incubation, black boxing, hatching, brushing of larvae and chawki rearing techniques.</p> <p><b>Harvesting and marketing of cocoons</b> Time of harvest, methods of harvest, deflossing, sorting, assessment, transportation and marketing of cocoons. Economics of different scales of rearing and cost benefit ratio.</p>	7Hrs

4.	<p><b>Mulberry diseases, pests and their management</b></p> <p>Types of mulberry diseases, foliar diseases-leaf spot disease, powdery mildew disease, leaf rust disease, leaf blight disease. Soil-borne diseases of mulberry-nursery diseases, root knot disease, root rot disease, integrated disease management (IDM). Types of mulberry pests, sap suckers leaf eaters, root / shoot feeders.</p> <p><b>Mulberry Silkworm diseases, Pests and their management</b> Common diseases of silkworm, Grasserie disease, Flacherie disease, Muscardine disease, Pebrine disease, Disease management. Mulberry Silkworm pests - Uzi fly, dermested beetle identification and management.</p>	8Hrs

**Course Outcomes: Student should be able to.....**

1. Acquire sound knowledge on different components of sericulture industry.
2. Gain skill with hands on training on mulberry cultivation and carry forward to field.
3. Gain skill with hands on training on silkworm egg production and support grainage activity.
4. Acquire knowledge and develop skill in silkworm rearing and support silkworm farming.
5. With the knowledge and skill acquired students may not only acts as resource personnel to sericulture industry but also emerged as potential entrepreneur.

**Reference Books:**

1. Dr. Vaishali Sangram Shewale, *SERICULTURE Present and Future*. (Book Saga Publications, Ahmednagar, : India, May,2023).
2. **Comprehensive Sericulture Manual**-M.Madan Mohan Rao, B.S.Publications, HYDERABAD.Charsley, S.R. (1982). Culture and Sericulture. Academic Press Inc., New York,U.S.A.
3. Rajan, R.K. HemanthRaju 2005, **Text Book on silkworm rearing**, Central SilkBoard, Bangalore.
4. **Hand book of Sericultural Technologies**-Dandin, S.B., J. Jaiswal and K. Gridhar. 2000, Central Silk Board, Bangalore.
5. **Hand book of Sericulture Technologies**, Central Silk Board, Bangalore Dandin, S.B. and K. Giridhar. 2010. Central Silk Board, Bangalore.
6. **Mulberry crop protection**, D D Sharma Central Silk Board, Bangalore.
7. Dokuhon, Z.S. (1998). **Illustrated Textbook on Sericulture**. Oxford & IBH publishing Co., Pvt. Ltd. Calcutta.
8. Jolly, M.S. Chowdhuty, S.N and Sen. (1975). **Non-Mulberry Sericulture in India**. Central Silk Board, Bombay, India

**B.Sc. II Semester-III**  
**SEC – III Course Code and title: SECZ23-302 Practical based on Sericulture**

**Credits- 02**

**Total Lectures-15**

<b>Practical No.</b>	<b>Title of Experiment</b>
1.	Study of Mulberry Silkworm <i>Bombyx mori</i> L.
2.	Study of Non – Mulberry Silkworm i) Tasar ii) Eri iii) Muga
3.	Study of Physical and Chemical properties of soil for mulberry cultivation
4.	Study of popular mulberry varieties
5.	Study of mulberry cultivation
6.	Visit to sericulture industry
7.	Study of Silkworm rearing house
8.	Rearing techniques of silkworm
9.	Estimation of cocoon shell ratio
10.	Reeling of silk
11.	Estimation of defective cocoon percentage from the given sample of cocoon
12.	Identification of different silkworm diseases and method of their disposal
13.	Preparation of different of disinfectant solutions recommended in sericulture
14.	Identification of Major Silkworm Pests
15.	Economic importance of sericulture

**Any other practical as suggested by concerned Teacher**

**B.Sc. II Semester-IV  
Paper VII**

**Course Code and title: MJ-BZT23-401 Biochemistry (Major)**

**Credits: 02**

**Total Lectures:30**

**COURSE OBJECTIVES**

1. Students will be able to acquire the specialized knowledge relevant to biochemistry.
2. Students will be able to demonstrate and understanding the biochemical principles.
3. Students will be able to understand basic laboratory technique in both chemistry and biology
4. Students will be able to apply the scientific method to the experiments.

<b>Topic No</b>		<b>Lectures</b>
	<b>Credit I</b>	
1	<b>Water:</b> Molecular structure of water, Properties of water and Significance of water	5 Hrs
2	<b>Nucleic acids:</b> 1.DNA and RNA.Types ,Structure and functions 2.Carbohydrate Metabolism: Classification, Glycolysis, Krebs cycle, (10)Pentose Phosphate Pathway, Gluconeogenesis, Biological Significance .Metabolic disorders of Carbohydrate metabolism (Diabetes mellitus)	7Hrs
	<b>Credit II</b>	
3	<b>Lipid Metabolism:</b> Classification and $\beta$ oxidation of palmitic acid, Biological Significance. Lipid profile disorder (Obesity) <b>Protein metabolism:</b> Classification, Transamination, Deamination and Urea Cycle, Biological Significance .Disorders of Protein Metabolism (Common any two)	10Hrs
4	<b>Enzymes:</b> Introduction (Classification and structure), Mechanism of enzyme action, Biological Significance, serum glutamic-oxaloacetic transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT) tests.	8Hrs



**Course Outcomes: Students should be able to....**

1. Students should understand properties and significance of water.
2. Student should learn interaction and interdependence of biochemical process.
3. Student should know about synthesis of proteins, lipids and role in metabolic pathway.
4. Students should understand types of enzymes and their mechanism.

**References:**

1. Biotechnology and biochemistry-U.Sattyanarayana (Unit3&4)
2. Elements of Biochemistry-H.S.Shrivastava-(Unit1)
3. Animal Physiology and Biochemistry-Agarwal(Unit 2& 3)
4. Text book of Biochemistry-Arumugam (Unit2,3)
5. Cellbiology,Genetics,MolecularbiologyandEvolution-P.S.Verma(Unit1,2,3)
6. Text book of Biochemistry- Dubey (Unit2,3)
7. Molecular biology of Gene-Lewin (Unit2,3)
8. Biochemistry by Lehninger(Unit1,2,3)
9. Elements of Biochemistry-Kohnstoff(1,2,3)
10. Concept of Biochemistry –Martin(Unit1,2,3)
11. Medical Chemistry –SoodandSood(Unit2,3)
12. Biochemistry and Molecularbiology–WilsonandWalker(Unit1,2,3)
13. Tools and Techniques of Biochemistry –Twyman(Unit2,3)

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## B. Sc. II Zoology Semester IV

### Paper VIII

**Course Code and Title: MJ-BZT23-402 Biodiversity and Biosystematics (Major)**

**Credits: 02**

**Total lectures - 30**

**Course Objectives:** Students should be able to

1. Understand the concepts, values, and measures of biodiversity.
2. Understand IUCN categories, threats, protected areas, and conservation methods.
3. Understand stages, tasks, modern trends in taxonomy, and species concepts.
4. Understand the taxonomic collection methods and zoological nomenclature.

Topic No		Lectures
	<b>Credit I</b>	
1	<b>Biodiversity Science:</b> Concept, definition, and Types of biodiversity Measures of Bio-diversity Values of Biodiversity Evaluation of Biodiversity indices with brief reference Megadiversity zones and biodiversity hotspots with special reference to India.	8 Hrs.
2	<b>Biodiversity Conservation:</b> Concept of threatened fauna – IUCN categories, Causes of biodiversity loss Protected area concept – Sanctuary, National Park, Biosphere reserve, Core Zone, Buffer Zone, Corridor concept, Conservation reserves. In-situ and Ex- situ conservation methods, Role of NGOs, and Colleges in biodiversity conservation. Man–animal conflict (man-tiger and man-elephant) – causes and concern.	7 Hrs.
	<b>Credit II</b>	
3	<b>Basic concepts of Biosystematics and taxonomy:</b> Taxonomy: Historical resume of systematic, Stages and importance of taxonomy Problems, Aim and Tasks of Taxonomy Modern Trends in Taxonomy: Morphological approach, immature stages and Embryological approach, Ecological, behavioural and Cytological approach, Biochemical and Numerical taxonomy. Concept of species Typological species concept, Biological species concept, evolutionary species concept, Polytypic & monotypic species, subspecies, infraspecific groups, super species and other kind of species.	8 Hrs.
4	<b>Taxonomic collections methods and Zoological nomenclature:</b> Collecting ways and data collection Preservation of collected material and curating Methods of identification and problems encountered in identification Taxonomic characters and taxonomic keys Preparation of taxonomic publication and taxonomic paper. Zoological nomenclature: International code of Zoological nomenclatures (ICZN)	7 Hrs.

**Course outcomes: Students should able to .....**

1. Know the importance of biodiversity in the life of human being.
2. Know the various methods of conservation of nature.
3. Understand the species identification methods and species concepts.
4. Understand the collection and preservation methods of animals
5. Know the importance of zoological nomenclature.

**References**

1. M. Kato. The Biology of Biodiversity. Springer.
2. E.O. Wilson, biodiversity. Academic Press, Washington.
3. G.G. Simpson, Principle of animal taxonomy. Oxford IBH Publishing company.
4. E. Mayer. Elements of Taxonomy. Oxford IBH Publishing company.
5. E.O. Wilson. The Diversity of Life (The College edition W.W. Northem & Co.
6. B.K. Tikadar. Threatened Animal of India, ZSI publication Calcutta.
7. V.C. Kapoor. Theory and Practice of Animal Taxonomy. Oxford & IBH Publishing Co.
9. K. V. Krishnamurthy. An advanced Text book on Biodiversity.
10. Ray and Ray. Biodiversity and Biotechnology.
11. Mandal and Nandi. Biodiversity.
12. Kaushik and Kaushik. Perspective in environmental studies.
13. K. C. Agarwal. Biodiversity.

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**B. Sc. II, Semester IV**  
**Practical IV (Major)**  
**Paper Code: MJ-BZP23-403**  
**2 credits**

**Based on Biochemistry and Biodiversity and Biosystematics**

**Practicals**

1. Qualitative tests of carbohydrates and lipid from given solutions (Glucose, Fructose, Sucrose, Lactose and Lipid).
2. Estimation of total protein in given solutions by Lowry's method/  
Quantitative estimation of amino acids by using Ninhydrin reaction.
3. Study of activity of salivary amylase under optimum conditions.
4. DNA isolation from plant/animal.
5. Abnormal constituents of Urine and pathological significance.
6. Estimation of Blood glucose
7. Estimation of Blood Creatinine
8. Estimation of blood Cholesterol
9. Estimation of Blood Urea
9. Biodiversity Hotspots in India
10. Biodiversity Indices examples (Any 3)
11. Any one example of a Sanctuary, National Park, Biosphere reserve, Core Zone, Buffer Zone, Corridor concept, or Conservation reserve in India.
12. Study of IUCN categories
13. Study of endangered species. (Models, pictures, charts.)
14. Methods of collection of animals.
15. Methods of preservation of animals.
16. Identification of insects/molluscs with the help of keys up to orders.
17. Identification of insects/molluscs with the help of keys up to families.
18. Identification of animals with the help of keys up to families (fish/ amphibian with the help of preserved specimens/models/pictures).

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**B. Sc. II Zoology Semester IV  
Paper VI**

**Course Code and Title: MN-BZT23-401 Instrumentation and Animal Biotechnology (Minor)**

**Credits: 2**

**Total lectures - 30**

**Course Objectives:** Students should be able to

1. Understand the concepts, values, and measurements
2. Understand complete insight about the structure and train the learner with operational skills of different instruments
3. Understand the biostatistics.

Topic No		Lectures
<b>Credit I</b>		
1	<p><b>Introduction to laboratory safety practices</b> Safety Measures to be taken in a Zoology Laboratory Units of measurement: Calculations and related conversions of each: Metric system- length (meter to micrometer); weight (gram to microgram), Volumetric (Cubic measures) Temperature: Celsius, Fahrenheit, Kelvin Concentrations: Percent solutions, ppt, ppm, ppb dilutions, Normality, Molarity and Molality.</p>	8 Hrs.
2	<p><b>Biostatistics:</b> Introduction and scope, Sampling and its types, Central Tendencies (mean, median, mode) Tabulation, Graphical representations (Histograms, bar diagrams, pie diagrams).</p>	7 Hrs.
<b>Credit II</b>		
3	<p><b>Microscopy</b> Construction, principle and applications of dissecting and compound microscope. <b>Colorimetry and Spectroscopy</b> - Principle and applications. pH - Sorenson's pH scale, pH meter - principle and applications. <b>Centrifuge</b> - Principle and applications (clinical and ultra-centrifuges). <b>Chromatography</b>- Principle and applications (Partition and Adsorption) <b>Electrophoresis</b> - Principle and applications (AGE and PAGE)</p>	8 Hrs.
4	<p><b>Introduction of Biotechnology, Scope and achievements of Biotechnology</b> (Fishery, Animal Husbandry, Medical and Industrial) Transgenesis: Retroviral method, Nuclear transplantation method, DNA microinjection method and Embryonic stem cell method Cloning (Dolly) <b>Ethical issues of transgenic and cloned animals</b> Zoological nomenclature: International code of Zoological nomenclatures (ICZN)</p>	7 Hrs.

**Course outcomes:**

1. Student should be able to select and operate suitable instruments for the studies
2. Learner would be skilled in the area of research.
3. Students should be able to analysis of statistical data for research

**References**

1. Basic Laboratory Techniques, Instrumentation and Biotechnology- University Text Book of Zoology, F. Y. B. Sc. Semester I Course 2. V.V. Dalvie, R. G. Deshmukh, R. D'souza and H.U. Shingadia University Press.
2. Introduction to Practical Biochemistry – David T. Plummer (Tata McGraw Hill Publishing Co. Ltd.)
3. Introductory Practical Biochemistry – S.K. Sawhney and Randhir Singh (Narosa Publishing House)
4. Methods in Biostatistics – B. K. Mahajan, (Jaypee Publications)
5. Microscopy and Cell Biology - V. K. Sharma, (Tata McGraw Hill Publishing Co. Ltd.)
6. Bioinstrumentation – L. Veerakumari, (M.J.P. Publishers)
7. Principles and Techniques of Practical Biochemistry – Keith Wilson and John Walker, (Cambridge University Press)
8. Biotechnology- Thieman and Pallidino, Pearson edu.
9. Biotechnology –Glick and Pasternak
10. Biochemistry –Satyanarayana
11. Understanding biotechnology- Aluizio Borem ,David Bowe-Low price edition –Pearson Publication
12. A Textbook of Biotechnology – R. C. Dubey, S. Chand Publication.
13. A Manual of Medical Laboratory Technology -A. H. Patel, NavneetPrakashan Ltd.
14. Biological instruments and methodology – Dr. P. K. Bajpai, S. Chand company Ltd.
15. Calculations in Molecular biology and Biotechnology - Frank H. Stephenson, Academic Press.

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**B. Sc. II, Semester IV**  
**Practical IV**  
**Paper Code: MN-BZP23-402**  
**Practical based on Instrumentation and Animal Biotechnology**

**Credits: 2**

**Total Practical- 15**

**Practicals**

1. a) Interpretation of safety symbols (toxic, corrosive, explosive, flammable, skin irritant, oxidizing, compressed gases, aspiration hazards and Biohazardous infectious material.)  
b) Study of central tendencies and plotting of Bar diagram, histogram and pie diagram.
2. Identification of transgenic fish (Trout and Salmon) / cloned animals (Dolly sheep, cc cat and Snuppy dog) from photograph.
3. Calculation of pH of three different samples (one each acidic, alkaline and neutral) using pH paper/Universal Indicator and confirming the result with pH meter.
4. Application of DNA Fingerprinting in criminology (photograph of electrophoretic pattern to be given for interpretation by the students)
5. a) Study of parts of microscope and their functions.  
b) Technique of focussing a permanent slide under 10x and 45x (objectives).
6. a) Dilution of given sample and estimation of OD by using colorimeter.  
b) Calculation of concentration from the given OD using formula.
7. Calculation of pH of three different samples (one each acidic, alkaline and neutral) using pH paper/universal indicator/pH indicator from red cabbage and confirming the result with pH meter.
8. a) Separation of amino acids from the mixture by paper chromatography.  
b) Calculation of R<sub>f</sub> value of separated pigments/amino acids from given chromatogram and their identification from standard chart.  
c) Separation of pigments by adsorption chromatography using chalk.  
d) Separation of lipids by TLC

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**B.Sc. II Semester-IV**  
**SEC – IV**  
**Course code SECZ23 - 401**  
**Title: Micro-Techniques**

**Credit: 02**

**Total lectures: 30**

**Course Objectives:**

1. To understand the essentials of techniques used for histology
2. To learn the techniques of histochemistry and immunohistochemistry.
3. To understand the mechanism of staining.
4. To understand the mode of actions of biochemical on tissues .
5. To study the advantage of histology and histochemistry techniques in histopathological investigations.

Topic No.		Lectures
<b>Credit-I</b>		
1	<p><b>Principles, design and functioning of microtomes, Types of microtome :</b> Automated Microtomes, Ultra-microtome, Cryostat</p> <p><b>Problems and troubleshooting in microtomy.</b></p> <p><b>Techniques in histology:</b> General principles for the preparation of Tissue for histological studies.</p> <p><b>Fixation:</b> – Principle, Aims and Objectives of fixatives.</p> <p><b>Methods of tissue fixation:</b> Chemical fixation and physical fixation. Chemical action of fixatives on cells and tissue components. Procurement of tissue and importance of fixation of tissues.</p> <p><b>Processing of fixed samples:</b> Dehydration (procedure and significance), Clearing Embedding, Block making.</p>	10
2	<p><b>Section cutting:</b> Steps and precautions, Common faults in section cutting, Reasons &amp; remedies, Temporary and permanent preparations, Whole mount preparation, Mounting and spreading of ribbons.</p> <p><b>Staining</b> (staining methods histochemical and immunohistological methods)  Dyes and dye binding reactive groups, mordants and mordanting, General procedure for staining of sections.</p>	05
<b>Credit-II</b>		
3.	<p><b>Fundamentals of histochemical techniques:</b>  Histochemical classification of Carbohydrates and Principle for the Identification of Carbohydrates- glycogen (Periodic acid/Shift method (PAS)</p> <p><b>Histochemical localization of Mucopolysaccharides:</b>  KMNO<sub>4</sub>/AB and PAS method.</p> <p><b>Histochemical classification of Proteins-</b> Principles and mechanism for the identification of total Proteins and Glycoproteins (Bromophenol Blue &amp; Congored method).</p>	10
	<p><b>Importance of Enzyme histochemistry.</b> -Localization of enzymes in tissues, Alkaline and Acid phosphates.</p>	
4	<p><b>Histochemical localization of Nucleic Acids ( DNA and RNA):</b>  (Feulgen reaction &amp; Pyronin method).</p> <p>Application of Histochemical methods for the detection of various types of Carcinoma and Immunofloroscent techniques.</p> <p><b>Histochemical classification of Lipids.</b> Principle for the demonstration of Lipids in various animal tissues (Copperphthalocyanin method and Sudan Blank- B method)</p>	05



## **Course specific outcomes:**

**After successfully completing this course, students will be able to:**

1. Explain the fundamental tissues in details.
2. Describe the process of histological preparations.
3. Illustrate the tools used in histological preparations.
4. Justify the use of various stains and dyes used in histochemical detection of biomolecules.
5. Justify the importance of Immunohistochemistry.
6. Draw the structures of various tissues and label them.

## **Reference books: -**

1. Text book of Histology Roland lesson DL. WB Saunders Company, Tokyo.
2. Histology: Roland lesson and Thomas Leesan WB Saunders company Co., Canada
3. Histochemistry Vol. I II III A G E pearse Churchill Livingstone NY
4. Histochemistry in Focus, A source book of Technics and Research needs (2007),
5. An introduction to Functional Histology, Bourne, G.H. (1988), Churchil, London.
6. HistochemicalTechniqes, Cassilmann,W.G.B (1988), Methuen, London

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**B.Sc. II Semester-IV**  
**SEC – V**  
**Course code SECZ23 - 402**  
**Title: Practicals based on Micro-Techniques**

**Credit: 02**

**Total lectures: 15**

**Course Objectives:**

1. To understand the essentials of techniques used for histology
2. To learn the techniques of histochemistry and immunohistochemistry.
3. To understand the mechanism of staining.
4. To understand the mode of actions of biochemical on tissues.
5. To study the advantage of histology and histochemistry techniques in histopathological investigations.

<b>Sr. No</b>	<b>Practicals</b>	<b>Lectures</b>
1	Study of different types of tissue with help of permanent slides	2P
2	Preparation of different reagent/stains for histology	2P
3	Block preparation and sectioning	2P
4	Effect of fixatives, fixation of tissues	2P
5	Comparative study of effect of fixative on a given tissue	2P
6	Mucopolysaccharide staining, AB pH 1.5, 2.5	1P
7	Proteins and lipid staining by Sudan black	1P
8	Nucleic acid staining: methyl green, pyronine, feulgen stain	1P
9	Effect of fixatives on tissue sections- liver	1P
10	Study of ELISA	1P

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