



Hindi Vidya Prachar Samiti's  
**Ramniranjan Jhunjhunwala College**  
of Arts, Science and Commerce  
(Autonomous College)

Affiliated to  
**UNIVERSITY OF MUMBAI**

Course: Environmental Science  
(Applied Component)

Syllabus for T.Y.B.Sc  
Program: B.Sc. Zoology & Botany  
Program Code: RJSUEVS  
(CBCS 2021-22)

**Refer to page no: 02**  
**highlighting component**  
**of Research Project**

## DISTRIBUTION OF TOPICS AND CREDITS

## APPLIED COMPONENT- ENVIRONMENTAL SCIENCES SEMESTER V

Course code	Nomenclature	Credits	Topic
RJSUEVS505	Indian ecological issues, Environmental pollution, Sustainable energy resources and green chemistry	2	1. Ecological issues of India
			2. Environmental Pollution
			3. Alternate Energy Resources
			4. Green chemistry and Sustainability
RJSUEVSP505	---	2	Practicals based on Course RJSUEVSP505

## APPLIED COMPONENT- ENVIRONMENTAL SCIENCES SEMESTER VI

Course code	Nomenclature	Credits	Topic
RJSUEVS605	Ecological restoration and conservation, ecotourism, climate change and disaster management	2	1. Ecological restoration
			2. Biodiversity conservation & ecotourism
			3. Climate change
			4. Disaster management
RJSUEVSP605	---	2	Practicals based on Course RJSUEVSP605

<b>SEMESTER-V (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper Code: RJSUEVS505</b>		<b>60</b>	<b>2</b>
<b>UNIT I</b>		<b>15</b>	
<b>Ecological issues of India</b>			
1	<p><b>1.1 Introduction</b></p> <p><b>1.2 Environmental challenges of India:</b></p> <ul style="list-style-type: none"> <li>• Population, poverty &amp; environmental degradation.</li> <li>• Water crisis-Groundwater depletion in India.</li> <li>• Land degradation-Land use pattern.</li> <li>• Human settlement.</li> <li>• Energy crisis.</li> </ul> <p><b>1.3 Efforts to meet environmental challenges in India.</b></p> <ul style="list-style-type: none"> <li>• Sustaining life support system.</li> <li>• Urbanization and industrialization.</li> <li>• Capacity building for sustainable development.</li> <li>• India and the world or Global issues.</li> </ul> <p><b>1.4 Case studies:</b></p> <ul style="list-style-type: none"> <li>• Jhum cultivation or shifting cultivation in North east region of India.</li> <li>• Chipko movement.</li> </ul>		
<b>UNIT II</b>		<b>15</b>	
<b>Unit 2: Environmental Pollution</b>			
2	<p><b>2.1. Types of pollution:</b></p> <ul style="list-style-type: none"> <li>• Causes, effects, control measures and Pollution control standards:</li> <li>• Water pollution.</li> <li>• Air pollution.</li> <li>• Nuclear pollution.</li> <li>• Noise pollution</li> </ul> <p><b>2.2. Case studies related to pollution:</b></p> <ul style="list-style-type: none"> <li>• Bhopal gas tragedy, India.</li> <li>• Fukushima Daiichi nuclear disaster, Japan</li> </ul>		
<b>UNIT III</b>		<b>15</b>	
<b>Unit 3: Alternate Energy Resources</b>			
3	<p><b>3.1 Solar energy, wind energy, tidal energy, nuclear energy.</b></p> <p><b>3.2 Energy from Biomass, bio-fuels &amp; petro crops.</b></p> <p><b>3.3 Energy from solid waste.</b></p> <p><b>3.4. Case study:</b></p> <ul style="list-style-type: none"> <li>• Shirdi Devasthan. (Solar cooker)</li> <li>• Jaitapur power plant</li> </ul>		

## T.Y.B.Sc Zoology &amp; Botany Syllabus Semester V &amp; VI

UNIT IV		15	
<b>Green chemistry and Sustainability</b>			
<b>4.1 The Twelve Principles of Green Chemistry.</b> <b>4.2 Sustainable Development- Principles, characteristics and sustainable development indicators.</b> <b>4.3 Areas highlighted by Agenda 21.</b> <b>4.4 Case studies:</b> <ul style="list-style-type: none"> <li>• Ibuprofen (green synthesis).</li> <li>• Green paint.</li> </ul>			

T.Y.B.Sc	Semester V Theory
<b>RJSUEVS505</b>  <b>Indian ecological issues, Environmental pollution, Sustainable energy resources and green chemistry</b>	<b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To make learner acquainted with environmental degradation and capacity building for sustainable development at national and global level.</li> <li>2. To make learner understand different types of pollution its causes, effects and various control measures.</li> <li>3. To expose learner to various alternate energy resources, energy technology and its advantages.</li> <li>4. To educate learner about the principles of Green Chemistry, sustainable development indicators, and areas highlighted by Agenda 21.</li> </ol>
	<b>Learning Outcomes:</b> <ol style="list-style-type: none"> <li>1. Learners would understand various aspects of environmental degradation and efforts taken to meet the related challenges.</li> <li>2. Learners would get to know the types and effects of environmental pollution and different measures to control it.</li> <li>3. Learners would be able to understand the significance of alternate energy resources and learn about related technologies.</li> <li>4. Learners would become aware about principles of green chemistry, sustainable development indicators, and areas highlighted by Agenda 21.</li> <li>5. Case studies would aid the learners to relate with the actual situation in field.</li> </ol>

<b>SEMESTER-V (PRACTICALS)</b>		<b>L</b>	<b>Cr</b>
<b>Paper Code: RJSUEVSP505</b>			<b>1</b>
1. Study of Physico-chemical properties of sewage/ effluent water: <ul style="list-style-type: none"> <li>• Conductivity.</li> <li>• Dissolved oxygen.</li> <li>• BOD.</li> <li>• COD.</li> </ul>			
2. Microbiological parameters: MPN.			
3. Measurement of intensity of light by Lux meter.			
4. Study of application of alternative energy resources (Solar panel, Biogas plant, Photovoltaic cell, Windmill).			
5. Study of indoor plants for reduction of pollution (Adiantum, Cactus, Chlorophytum, Pachira,).			
6. Photographic documentation of environment related issues/ conservation. Submission of soft & hard copy of 5 original photographs taken by the learner.			
7. Study of air & noise pollution monitoring device.			

<b>T.Y.B.Sc</b>	<b>Semester V Practical</b>
<b>RJSUEVSP505</b>	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To equip learners with the skill's necessary to measure of physico-chemical properties of sewage/ effluent water.</li> <li>2. To make the learner understand use of luxmeter and various pollution monitoring devices.</li> <li>3. To make the learner acquainted with pollution controlling plants.</li> <li>4. To educate learners to observe various environmental issues in his/her reach.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. The learner will be able to measure the quality of water and will be able understand the criteria for safe drinking water.</li> <li>2. The learner will be able to demonstrate the use of luxmeter and would acquire knowledge about pollution monitoring devices.</li> <li>3. The learner will get the knowledge about role of indoor plants in controlling pollution.</li> <li>4. The learner will develop skill to observe and stay aware about various environmental issues.</li> </ol>

<b>SEMESTER-VI (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Ecological restoration and conservation, ecotourism, climate change and disaster management.</b>		<b>60</b>	<b>2</b>
<b>Paper Code: RJSUEVS605</b>			
<b>UNIT I</b>		<b>15</b>	
<b>Unit 1: Ecological restoration</b>			
1	1.1 Domestic waste water treatment. 1.2 Industrial waste water treatment. 1.3 Bioremediation. 1.4 Alternatives to conventional resources: biodegradable plastic, biodiesel, bio ethanol & bio pesticides. <b>1.5 Case studies:</b> <ul style="list-style-type: none"> <li>• Developing effluent treatments.</li> <li>• Ice Stupa-Sonam Wangchuk.</li> </ul>		
<b>UNIT II</b>		<b>15</b>	
<b>Unit 2: Biodiversity Conservation &amp; Ecotourism</b>			
2	2.1 Hotspots of biodiversity and biosphere reserve. 2.2 Strategies for biodiversity conservation (in-situ and ex-situ). 2.3 Commercial wildlife photography. 2.4 Ecotourism—definition, policies and practices. <b>2.5 Case studies:</b> <ul style="list-style-type: none"> <li>• Govardhan Eco village</li> <li>• Thennamala Ecopark</li> </ul>		
<b>UNIT III</b>		<b>15</b>	
<b>Climate Change</b>			
3	3.1 Introduction to climate change, global warming and its effects. 3.2 Greenhouse substances: Sources & effects. 3.3 Remote Sensing & GIS. 3.4 Role of IPCC in climate change monitoring; Kyoto Protocol, Montreal Protocol, Earth Summit & UN Convention on Climate Change. <b>3.5 Case studies:</b> Climate change and apple farming in Indian Himalayas. The case of ozone depletion.		
<b>UNIT IV</b>		<b>15</b>	
<b>Disaster management</b>			
4	4.1 Introduction. 4.2 Disaster prone regions of India, major disasters of India. 4.3 Impact of disasters. 4.4 Disaster management plan for schools and colleges. 4.5 Cause, effects and control measures of disasters: <ul style="list-style-type: none"> <li>• Floods</li> <li>• Earthquakes</li> </ul>		

T.Y.B.Sc Zoology & Botany Syllabus Semester V & VI

	<ul style="list-style-type: none"> <li>• Cyclones</li> <li>• Landslides</li> </ul> <p><b>4.6 Case studies:</b></p> <ul style="list-style-type: none"> <li>• Mumbai flood, 26<sup>th</sup> July, 2005.</li> <li>• Odisha cyclone Fani, May, 2019.</li> </ul>		
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T.Y.B.Sc	Semester VI Theory
<p>RJSUEVS605</p> <p><b>Ecological restoration and conservation, ecotourism, climate change and disaster management.</b></p>	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To acquaint learners with the details of waste water treatment and bioremediation.</li> <li>2. To enhance the knowledge of the learners about biodiversity conservation and ecotourism.</li> <li>3. To update the learners about climate change and global efforts in combating with it.</li> <li>4. To introduce the concept and strategies of disaster management.</li> <li>5. To introduce case studies on topics for enhanced learning.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Learners will get an idea on steps involved in waste water treatment and bioremediation.</li> <li>2. Learners will be able to understand importance of biodiversity conservation and also be able to promote ecotourism.</li> <li>3. Learners will be able to understand need of efforts to combat with global climate change.</li> <li>4. Learners will get an insight into disaster management and be prepared for taking correct steps during an event of disaster.</li> <li>5. Case studies will help the learners to understand the concepts in a more practical manner.</li> </ol>

<b>SEMESTER-VI (PRACTICALS)</b>		<b>L</b>	<b>Cr</b>
<b>Paper Code: RJSUEVSP605</b>			<b>1</b>
	1. Study of physical properties of soil: Temperature (for demonstration), moisture, & texture of soil.		
	2. Study of chemical properties of soil: Organic matter and Calcium carbonate.		
	3. Detection of heavy metal cation: Lead from water sample.		
	4. Study of logistic services for medical, toxic waste (Incinerator, Autoclave).		
	5. Observation & study of indicator species.		
	6. Visit to any waste treatment plant/ industry/laboratory/national park and submission of report. (Ref: Annexure II).		
	7. Group project and submission of report (group of 5).		

<b>T.Y.B.Sc</b>	<b>Semester VI Practical</b>
<b>RJSUEVSP605</b>	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>To familiarize the learner with practical techniques for evaluation of significant environmental parameters.</li> <li>To make the learner understand concepts of environmental remediation.</li> <li>To make the learner participate in group activity.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>The learner will be able to analyse different parameters associated with quality of environment.</li> <li>The learner will be able to gain field knowledge on areas of environmental significance.</li> <li>The learner will be able to comprehend the skill of working in group and team spirit.</li> </ol>



**ANNEXURES**

**Annexure I: Suggested topics for assignment Semester V**

(Teachers are expected to develop additional innovative topics, varying every year, to be assigned to the students).

1. List out the instruments or funding agencies or permits required for setting up an environment testing laboratory.
2. Survey of NGO's working in the environmental field in your area.
3. Preparation of proposal for green building and sustainable development.
4. Prepare a cost sheet for setting up a bio degradable plastic unit.
5. Make an inventory of the water bodies presently existing/which existed in the urban/rural area of about 5kms.
6. Find out information regarding pollution testing booths that the Government proposes to set up.(List out the personnel who will man the booths and the indigenous equipment that these booths will have).
7. Make a report on amenities, trees, dimensions of open spaces in your locality. Assess their role in maintaining the ecological balance in the region.
8. Survey housing societies/institutions/ organizations to find out whether they are converting household/kitchen waste into anything utilizable like vermicomposting etc.
9. Meet entrepreneurs involved with manufacture of eco-friendly products/best out of waste etc. Make a report regarding how the entrepreneur decided to pursue such an initiative, its need, the process and benefits to the environment.
10. Calculate carbon footprint of your family/class-room or laboratory/housing society by visiting the appropriate site on internet.
11. Visit architectural /horticulturist firms that deal with vertical gardening /urban farming and prepare a first-hand report on the concept, where implemented and the advantages.

All topics mentioned above are suggestive, more creative and innovative topics are expected from the students, under the able guidance of the concerned teacher, to suit the expertise, human resources, infrastructure and local needs as also the interest of the students. The assignment may be submitted in a group not exceeding three students.

**Annexure II: Suggested Field Visits for Semester VI**

- There shall be various short and long excursions / study tours / field visits / industrial visits in every semester, at least one of which shall be financially affordable to every student in the class; and that assessment and marks of field trips shall be solely based upon such where no student was restrained for financial limitations.
  - Field visits are to be organized to facilitate students to have first-hand experience & exposure to technology/production/functioning of organization/units or witness a relevant activity.
  - Each student must make at least 01 (one) such visit to the units/treatment plants/aquatic or terrestrial habitat organized by the College.
  - The list is suggestive and not exhaustive.
1. Visit to Sewage treatment plant.
  2. Visit to Vermicomposting unit.
  3. Visit to Air Monitoring Laboratory.
  4. Visit to Environment Pollution Detecting Laboratory.
  5. Visit to Cooling towers in industries.
  6. Visit to Rain Water Harvesting System.
  7. Visit to Biogas Plant.
  8. Visit to Green Building/Ecotel Hotel.
  9. Visit to Water Filtration Plant.
  10. Visit to office of Pollution Control Board.
  11. Visit to Greenhouse.
  12. Visit to Solid Waste Management Plant.
  13. Visit to hydro/thermal power plants.
  14. Visit to Environmental Agencies-CITES
  15. Visit to National Parks, Sanctuaries, Biosphere Reserves etc. in Maharashtra/India/abroad.
  16. Visit to NEERI.
  17. Visit to Enviro Vigil, CSM Hospital Campus, Kalwa (W), Thane.

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- An Advanced Textbook on Biodiversity, K.V. Krishnamurthy, Oxford & IBH Publishing Co. Pvt. Ltd. 2009.
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- Practical Methods in Ecology & Environmental Science, Trivedi, Goel & Trisal, Environmental Publications, Karad 1987.
- Text book of Environmental Chemistry & Pollution Control. Revised edition, Dara S.S. & Mishra D.D., S. Chand Publications.
- Waste Water Treatment for Pollution Control, Soli J. Arcivala, TMH 1986.
- Water & Water Pollution Handbook, L.L. Caccio, Marcel Dekker Inc. N.Y. 1971.
- Wildlife photography- Advanced field techniques for amazing images, Classen, Joe.

**SCHEME OF EXAMINATION (FOR BOTH SEMESTERS)**

**Internal examination**

The first internal class test comprising of 20 marks shall consist of 20 multiple choice questions with equal weightage.

The second class test of 20 marks will be in the form of an assignment that the student shall submit on notification.

**Question paper pattern for external theory**

Total: 60 marks

**Note: 1. All questions to be attempted from Q.1 to Q.5**

Q.1 Based on Unit I..... 12 M

a,b,c- Attempt any two questions out of three

Q.2 Based on Unit II.....12M

a,b,c- Attempt any two questions out of three

Q.3 Based on Unit III.....12M

a,b,c- Attempt any two questions out of three

Q.4 Based on Unit IV.....12M

a,b,c- Attempt any two questions out of three

Q.5 Short notes (Mixed from all units two questions from each unit)..... 12M (3M each)

Eight short notes of which the student is expected to attempt any four

**Practical Skeleton Paper Semester V**

**Maximum Marks: 100  
20**

**Q1. Identification:**

Identify spots 'a' to 'e' as per instructions

- Identify and describe the plant and its role in reducing pollution. (*Adiantum*, *Cactus*, *Chlorophytum*,  
• *Pachira*). (any two)
- Study of air and noise pollution monitoring devices-sound level meter, photoionization detector (any one).
- Identify and describe the picture and give application of alternative energy resources (Solar panel, Biogas plant, Photovoltaic cell, Windmill) (any two)

**Major Experiment**

**Q2.** Estimate Biological Oxygen Demand/Chemical Oxygen Demand from the given effluent samples (2) and submit the report. **25**

**Minor Experiment**

**Q3.** Estimate Dissolved Oxygen from the given water sample and submit the report. **15**  
**OR**

**Q3. a.** Determine the intensity of light using Lux meter. **08**  
**b.** Estimate the conductivity of the given sample. / Determine the MPN of the given water sample. **07**

**Q4. a.** Submission of five environment related original photographs. **10**  
**b.** Submission of assignment & viva based on it. **20**

**Q5.** Certified journal. **10**

**Practical Skeleton Paper Semester VI**

**Maximum Marks: 100**

**Q1. Identification:**

**15 M**

Identify spots 'a' to 'c' as per instructions

- a. Identify logistic services for medical, toxic waste (incinerator, Autoclave) (Any one)
- b. Identify and describe the given indicator species (river otters, lichen, northern spotted owl) (Any two)

**Major experiment**

**Q2.** Estimate organic matter content from the given sample and submit a report. **25**

**OR**

**Q2.** Estimate calcium carbonate content from the given sample and submit a report.

**OR**

**Q2.** Investigate the given sample and report about the presence of any (or all) of the following heavy metal cations:-Pb (II) from the given water sample.

**Minor experiment**

**Q3.** Analyse the texture and moisture content of the given soil sample and submit a report. **20**

Q4. Project and viva based on it.

**20**

Q5. Field report.

**10**

Q6. Certified journal.

**10**



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**Refer to page nos: 02 and 03**  
**highlighting component**  
**of Field Project**

Syllabus for T.Y.B.Sc.  
Program: B.Sc. Zoology  
Program Code: RJSUZOO  
(CBCS 2021-22)

## DISTRIBUTION OF TOPICS AND CREDITS

## T.Y.B.Sc. ZOOLOGY SEMESTER V

Course code	Nomenclature	Credits	Topic
RJSUZOO501	Animal type Study, Comparative anatomy, Developmental biology & Endocrinology	2.5	1. Type study-Sepia
			2. Comparative anatomy of vertebrates-I Skin, Digestive system and circulatory system
			3. Developmental biology of frog
			4. Endocrine glands and their regulation
RJSUZOO502	Haematology, Immunology & Physiology	2.5	5. Basic Haematology
			6. Basic Immunology
			7. Applied Haematology & Immunology
			8. Homeostasis- Feedback mechanism, thermoregulation & ionic regulation
RJSUZOO503	Molecular biology, Genetic engineering, Toxicology and Biostatistics	2.5	9. Molecular biology
			10. Genetic engineering
			11. Toxicology
			12. Biostatistics
RJSUZOO504	Osteology, Ethology, Epidemiology, National parks and sanctuaries	2.5	13. Human osteology
			14. Ethology
			15. Epidemiology-I
			16. National parks and sanctuaries
RJSUZOOP501, RJSUZOOP502 & RJSUZOOP503 RJSUZOOP504	Practical I , II, III & IV	06	Practicals based on Paper I, II, III & IV



**T.Y.B.Sc. ZOOLOGY SEMESTER VI**

<b>Course code</b>	<b>Nomenclature</b>	<b>Credits</b>	<b>Topic</b>
RJSUZOO601	Animal type Study, Comparative anatomy, Developmental biology & Histology	2.5	1. Type study-Shark
			2. Comparative anatomy of vertebrates II- respiratory system, urinogenital system and nervous system
			3. Developmental biology of chick
			4. Mammalian Histology
RJSUZOO602	Enzymology, Physiology and Pathology	2.5	5. Enzymology
			6. Chemical messengers and Cardiac physiology
			7. Aspects of human reproduction
			8. General pathology
RJSUZOO603	Cancer biology, Biotechnology, Genetics, and Bioinformatics	2.5	9. Cancer biology
			10. Animal tissue culture
			11. Human genetics
			12. Bioinformatics
RJSUZOO604	Environmental Biology, Zoopharmacognosy, Epidemiology & Wildlife management	2.5	13. Zoogeography
			14. Bioprospecting and Zoopharmacognosy
			15. Epidemiology-II
			16. Wildlife management
RJSUZOOP601, RJSUZOOP602 RJSUZOOP603 RJSUZOOP604	Practical I,II, III &IV	06	Practicals based on Paper I, II, III & IV

SEMESTER-V (THEORY)		L	Cr
<b>Paper- I Animal type Study, Comparative anatomy, Developmental biology &amp; Endocrinology</b>		<b>60</b>	<b>2.5</b>
<b>Paper Code: RJSUZOO501</b>			
<b>UNIT I</b>		<b>15</b>	
<b>Type study: <i>Sepia aculeata</i></b>			
1	<b>1.1: General characters</b> 1.1.1 External characters. 1.1.2 Locomotion. 1.1.3 Economic importance. <b>1.2: Organ systems:</b> 1.2.1 Digestive system. 1.2.2 Respiratory system. 1.2.3 Circulatory system. 1.2.4 Excretory system. 1.2.5 Nervous system and Sense organs. 1.2.6 Reproductive system.		
<b>UNIT II</b>		<b>15</b>	
<b>Comparative Anatomy of Vertebrates I</b>			
2	<b>2.1: Skin:</b> Functions, anatomy of vertebrate skin, epidermal and dermal derivatives, scales, claws, nails, hoofs, horns, antlers, beaks, feathers, hair and glands. <b>2.2: Digestive system:</b> Digestive tube and its evolution. Tooth structure & position, teeth in lower vertebrates, mammalian dentition. <b>2.3: Circulatory System:</b> Aortic arches and venous system in vertebrates.		
<b>UNIT III</b>		<b>15</b>	
<b>Developmental biology of frog</b>			
3	<b>3.1</b> Egg, spawn, cleavage, blastula, gastrula, neurula, morphogenesis and metamorphosis in Frog.		
<b>UNIT IV</b>		<b>15</b>	
4	<b>Endocrine glands and their regulation</b>		
	<b>4.1: Mammalian Endocrinology</b> Mammalian Endocrinology: Hormones, functions of hormones and hormonal disorders of the following endocrine glands: pituitary, adrenal, thyroid, parathyroid & pancreas.		

<b>SEMESTER-V (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper- II Haematology, Immunology &amp; Physiology</b>		<b>60</b>	<b>2.5</b>
<b>Paper Code: RJSUZOO502</b>			
<b>UNIT I</b>		<b>15</b>	
<b>Basic Haematology</b>			
1	<p><b>1.1: Composition of plasma:</b> Water, respiratory gases, plasma proteins and other inorganic constituents.</p> <p><b>1.2: Haematopoiesis:</b> Erythropoiesis, leucopoiesis and thrombopoiesis.</p> <p><b>1.3: Erythrocytes:</b> Structure and functions, abnormalities in structure, total count, variation in number; ESR; types of anaemia.</p> <p><b>1.4: Haemoglobin:</b> Structure, formation and degradation; variants of haemoglobin (foetal, adult).</p> <p><b>1.5: Leucocytes:</b> Types and functions, total count and variation in number; leukaemia and its types.</p> <p><b>1.6: Thrombocytes:</b> Structure, factors and mechanism of clotting, failure of clotting mechanism.</p> <p><b>1.7: Blood volume:</b> Total quantity and regulation; haemorrhage.</p>		
<b>UNIT II</b>		<b>15</b>	
<b>Basic Immunology</b>			
2	<p><b>2.1: Overview of Immunology</b></p> <p>2.1.1: Concept of immunity.</p> <p>2.1.2: Innate immunity - Definition, factors affecting innate immunity, Mechanisms of innate immunity - First line of defence - physical and chemical barriers. Second line of defence - phagocytosis, inflammatory responses and fever.</p> <p>2.1.3: Adaptive or Acquired immunity, Antibody mediated, and cell mediated immunity; Active Acquired immunity - Natural and Artificial; Passive Acquired immunity - Natural and Artificial</p> <p><b>2.2: Cells and Organs of immune system</b></p> <p>2.2.1: Cells of immune system - B cells, T cells and null cells, macrophages, dendritic cells and mast cells</p> <p>2.2.2: Organs of immune system :Primary: Thymus and bone marrow Secondary: Lymph nodes and spleen</p> <p><b>2.3: Antigens:</b> Definition and properties; haptens</p> <p><b>2.4: Antibodies:</b> Definition, basic structure, classes of antibodies - IgG, IgA, IgM, IgD and IgE</p> <p><b>2.5: Antigen processing and presentation</b></p> <p>2.5.1: Endogenous antigens - cytosolic pathways.</p> <p>2.5.2: Exogenous antigens - endocytic pathways.</p>		

UNIT III		15	
<b>Applied Haematology &amp; Immunology</b>			
3	<p><b>3.1: Applied Haematology:</b> Introduction and scope.</p> <p><b>3.2: Clinical significance of Diagnostic Techniques</b></p> <p>3.2.1 Haemoglobinopathies (sickle cell anaemia, thalassemia)</p> <p>3.2.2 Coagulopathies: Haemophilia and purpura</p> <p><b>3.3: Biochemical examination of blood:</b></p> <p>3.3.1 Liver function tests: Total and direct bilirubin</p> <p>3.3.2. Kidney function test: Serum creatinine.</p> <p>3.3.3. Carbohydrate metabolism tests: Blood sugar.</p> <p><b>3.4.: Antigen-Antibody interactions and vaccines.</b></p> <p>3.4.1 : General features of antigen-antibody interaction</p> <p>3.4.2 : Precipitation reaction - Definition, characteristics and mechanism. Precipitation in gels (slide test) - Radial immunodiffusion (Mancini method) Double immunodiffusion (Ouchterlony method)</p> <p>3.4.3: Agglutination reaction definition, characteristics, and mechanism. Coomb's test</p> <p>3.4.4: Immunoassay - ELISA</p>		
<b>UNIT IV</b>		15	
4	<b>Homeostasis- Feedback mechanism, thermoregulation and ionic regulation</b>		
	<p><b>4.1 Homeostasis:</b> External and internal environment; Control systems in Biology: Feedback mechanism; control of blood glucose level as an example.</p> <p><b>4.2 Thermoregulation:</b> temperature balance; Heat production; Shivering and non-shivering thermogenesis, brown fat- special thermogenic tissues in mammals and heat loss; Acclimation and acclimatization; Adaptive response to temperature: Daily torpor, Hibernation, Aestivation.</p> <p><b>4.3 Osmotic and Ionic regulation:</b> Maintaining water and electrolyte balance: ionic regulation in iso-osmotic, hypo-osmotic and hyper-osmotic environment, Problems of living in terrestrial environment: water absorption, salt water ingestion and salt excretion, metabolic water and behavioural adaptations.</p>		

SEMESTER-V (THEORY)		L	Cr
<b>Paper- III Molecular biology, Genetic engineering, Toxicology and Biostatistics</b> <b>Paper Code: RJSUZOO503</b>		60	2.5
UNIT I		15	
Molecular biology			
1	<b>UNIT I: Molecular biology</b> <b>1.1 Types of mutation</b> 1.1.1: Point mutations - substitution, deletion and insertion mutations Types of Substitution mutations - silent, missense and nonsense mutations, transition and transversion. Deletion and Insertion mutations - frameshift mutations. 1.1.2: Trinucleotide repeat expansions - fragile X syndrome, Huntington disease 1.1.3: Spontaneous mutation - tautomeric shifts, spontaneous lesions <b>1.2 Induced mutation Types of mutation</b> 1.2.1 Physical agents: Ionizing radiation (X-rays, $\alpha$ , $\beta$ and $\gamma$ rays) Non-ionizing radiation (UV light) 1.2.2 Chemical agents: Base analogs (5-bromouracil); Intercalating agents (ethidium bromide); Deaminating agents (nitrous acid); Hydroxylating agents (hydroxylamine); Alkylating agents (mustard gas). 1.2.3 Biological mutagenic agents: transposable elements and viruses <b>1.3 Preventive and repair mechanisms for DNA damage</b> 1.3.1: Mechanisms that prevent DNA damage - superoxide dismutase and catalase 1.3.2: Mechanisms that repair damaged DNA - direct DNA repair (alkyl transferases, photoreactivation, excision repair) 1.3.3: Post replication repair - recombination repair, mismatch repair, SOS repair.		
UNIT II		15	
Genetic engineering			
2	<b>2.1: Tools in Genetic Engineering</b> 2.1.1: Enzymes involved in Genetic Engineering: Introduction, nomenclature and types of restriction enzymes with examples, Ligases - <i>E. coli</i> DNA ligase, T4 DNA ligase, polynucleotide kinase, phosphatases, DNA polymerases, reverse transcriptase, terminal transferase. 2.1.2: Vectors for gene cloning: General properties, advantages and disadvantages of cloning vectors - plasmid vectors (pBR322), phage vectors ( $\lambda$ Phage), cosmid vectors (c2XB). 2.1.3: Cloning techniques: Cloning after restriction digestion - blunt and cohesive end ligation, creation of restriction sites using linkers and adapters, cDNA synthesis (Reverse transcription), genomic and cDNA libraries. <b>2.2: Techniques in Genetic Engineering</b> 2.2.1: PCR techniques: Principle of polymerase chain reaction (PCR), Applications of PCR. 2.2.2: Detection techniques: Blotting techniques and their applications.		

## T.Y.B.Sc Zoology Syllabus Semester V &amp; VI

UNIT III		15	
<b>Toxicology</b>			
3	<p><b>3.1 Introduction to toxicology:</b> definition and scope.</p> <p><b>3.2 Natural toxins:</b> mycotoxins, microbial toxins, plant toxins (caffeine &amp; nicotine), animal toxins (honey bee sting, venoms of coelenterates, scorpion, snake).</p> <p><b>3.3 Dose response relationship:</b> Measurement of dose response relationship, dose response curves, LC50 and LD50, acute and chronic toxicity; margin and safety &amp; therapeutic index; threshold dose and no observed effect level (NOEL).</p> <p><b>3.4 Mechanism of absorption through membranes, rates of penetration, routes of absorption in mammals, dermal, gastrointestinal and respiratory.</b></p> <p><b>3.5 Metabolism of toxicants:</b> Phase I reactions, Phase II reactions, metabolism of Paracetamol.</p> <p><b>3.6 Target organ toxicity – hepatotoxicity; examples of hepatotoxicants, nephrotoxicity, examples of nephrotoxicants, neurotoxicity, examples of neurotoxicants.</b></p> <p><b>3.7 Regulatory Toxicology:</b> CPCSEA guidelines for animal testing centre, ethical issues in animal studies, Alternative methods in toxicology (<i>in vitro</i> tests).</p>		
<b>UNIT IV</b>		<b>15</b>	
<b>Biostatistics</b>			
4	<p><b>4.1: Measures of Variation:</b> Variance, standard deviation, standard error.</p> <p><b>4.2: Probability Distributions:</b> Normal, Binomial, p- value, Probability - Addition and multiplication rules and their applications.</p> <p><b>4.3: Testing of Hypothesis:</b> Basic concepts, types of hypothesis: Null hypothesis and Alternate hypothesis, Levels of significance and testing of hypothesis.</p> <p><b>4.4: Parametric and non-parametric test:</b> Parametric tests: two-tailed Z-test and t-test, Non-parametric test: Chi-square test and its applications.</p> <p><b>4.5: Correlation:</b> Correlation coefficient and its significance.</p>		

SEMESTER-V (THEORY)		L	Cr
Paper- IV <b>Osteology, Ethology, Epidemiology, Wildlife conservation</b> Paper Code: RJSUZOO504		60	2.5
UNIT I		15	
Human Osteology			
1	<p><b>1.1: Introduction:</b> Bone structure (Histology) and general functions of bones. Cartilage: General structure, functions</p> <p><b>1.2: Axial skeleton</b></p> <p>1.2.1: Skull: General characteristics of skull bones - Cranial and facial bones</p> <p>1.2.2: Vertebral column: General characteristics of a vertebra, structure of different types of vertebrae (cervical, thoracic, lumbar, sacrum and coccyx)</p> <p>1.2.3: Ribs and sternum: General skeleton of ribs and sternum</p> <p>1.2.4: Hyoid bone: Structure and function.</p> <p><b>1.3: Appendicular skeleton</b></p> <p>1.3.1: Pectoral girdle and bones of forelimbs</p> <p>1.3.2: Pelvic girdle and bones of hind limbs</p> <p><b>1.4: Sexual dimorphism of human skeleton.</b></p>		
UNIT II		15	
Ethology			
2	<p><b>2.1: Social behaviour:</b></p> <p>2.1.1: Territoriality, Schooling in fishes, Herd migration,</p> <p>2.1.2: Kin selection, Altruism, reciprocal altruism,</p> <p>2.1.3: Social organization in insects and primates.</p> <p><b>2.2: Reproductive Behaviour patterns:</b></p> <p>2.2.1: Mating systems in animals,</p> <p>2.2.2: Courtship behaviour- characteristics of courtship, Examples of courtship- Invertebrate (Spider) and Vertebrate (Bower bird), Nest building- Baya weaver bird.</p> <p>2.2.3: Parental care-Factors affecting parental care, Parental care in fishes and amphibians.</p> <p><b>2.3: Biological clocks:</b> Circadian, Circalunar and Circannual rhythms.</p>		
UNIT III		15	
Epidemiology-I			
3	<p><b>3.1: Scope of epidemiology:</b> Perspective of epidemiology; descriptive and analytical epidemiology; epidemiological triad; stages of diseases, screening for diseases.</p> <p><b>3.2: Epidemiology of communicable diseases:</b> definition of common terms.</p> <p><b>3.3: Dynamics of disease transmission:</b> Reservoir, route of transmission, incubation.</p>		

## T.Y.B.Sc Zoology Syllabus Semester V &amp; VI

<b>UNIT IV</b>		<b>15</b>	
<b>National parks and sanctuaries</b>			
4	<b>4.1: India biodiversity; rare and endangered animals of India:</b> wildlife conservation projects; important national parks, sanctuaries (Sanjay Gandhi, Tadoba, Jim Corbett, Kaziranga, Nagarhole, Kanha, Bhitkarnika, Periyar) and tiger projects in India.		



T.Y.B.Sc	Semester V Theory
RJSUZOO501	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To acquaint learners with the details of Sepia as a representative of invertebrates.</li> <li>2. To provide them with general idea of comparative anatomy of vertebrates.</li> <li>3. To introduce concept of endocrine glands and associated disorders to the learners.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Learner will get an idea of general characters and system details of Sepia.</li> <li>2. Learner will be familiarized with process of evolution trend which has occurred during vertebrate evolution.</li> <li>3. The learner will understand concept of hormones and its functions.</li> </ol>
T.Y.B.Sc	Semester V Theory
RJSUZOO502	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To introduce the different aspects of human blood and its clinical significance.</li> <li>2. To introduce the topic of immunology with emphasis on building strong foundation about the immune system.</li> <li>3. To acquaint learners with knowledge of diagnostic techniques in haematology as well as immunology.</li> <li>4. To comprehend the physiological aspects of homeostasis and endocrinology.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Learner will be able to identify various components of blood and their importance.</li> <li>2. Learner will be familiarized with types of immunity and the significant role of immune system.</li> <li>3. Learner will be better equipped for further pathological courses or working in a diagnostic laboratory.</li> <li>4. Learner will be familiarized with adaptations of animals for regulation of heat and ionic balance.</li> </ol>

## T.Y.B.Sc Zoology Syllabus Semester V &amp; VI

T.Y.B.Sc	Semester V Theory
RJSUZOO503	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To introduce molecular biology of gene alteration and its effects.</li> <li>2. To understand the tools and techniques used in genetic engineering.</li> <li>3. To introduce the learner basics of toxicology.</li> <li>4. To introduce the learner to the principles of toxicology, mechanisms of toxicants and regulatory affairs in toxicological studies.</li> <li>5. To make learner familiar with biostatistics as tool for analysis and application.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Learner will get an insight in the intricacies of chemical and molecular processes that alter the gene.</li> <li>2. Learner will be familiarized with vast arrays of techniques of gene manipulation.</li> <li>3. Learner will be familiarized with concepts of toxicology and will be able to apply it in pharmaceutical industry and allied branches</li> <li>4. Learner will be able to develop critical thinking and apply the knowledge in formulating hypothesis and research problems.</li> </ol>
T.Y.B.Sc	Semester V Theory
RJSUZOO504	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To introduce the structure and function of human bones and muscles.</li> <li>2. To acquaint the learner with sociobiological behaviour and interaction of animals within population.</li> <li>3. To study the course, or natural history, of disease, determine the frequency of disease in populations.</li> <li>4. To introduce learner to the various national parks, sanctuaries and ecotourism.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Learner will be familiarized with the arrangement of bones in the human body. It will help in understanding nature of anatomical injuries.</li> <li>2. Learner will understand different aspects of social, reproductive and chronobiological behaviour in animals.</li> <li>3. Learners will get an idea of scope and dynamics of epidemiology.</li> <li>4. The learner will understand importance of national parks, sanctuaries and need of ecotourism.</li> </ol>

		cr
		<b>06</b>
<b>Practical Course Code: RJSUZOOP501</b>		
1	<p>1. Study of Sepia with the help of diagram / Photograph / Simulation whichever possible. No animal shall be dissected.</p> <p>a) Digestive system, b) Reproductive system c) Nervous system d) Jaws e) Radula f) Chromatophores g) Spermatophores h) One demonstration of Sepia systems.</p> <p>2. Mounting of fish scales- Placoid, cycloid and ctenoid. 3. Frog embryology- Egg spawn, cleavage, blastula, gastrula, tadpole stages. 4. Study of slides of pituitary, adrenal, thyroid, parathyroid &amp; pancreas.</p>	
<b>Practical Course Code: RJSUZOOP502</b>		
2	<p>1. Enumeration of Erythrocytes - Total Count. 2. Enumeration of Leucocytes - Total Count. 3. Differential count of Leucocytes. 4. Erythrocyte Sedimentation Rate by suitable method - Westergren or Wintrobe method. 5. Estimation of haemoglobin by Sahli's acid haematin method. 6. Estimation of total serum/ plasma proteins by Folin's method. 7. Separation of plasma proteins by PAGE. 8. Estimation of blood glucose by o-toluidine method. 9. Estimation of serum/ plasma total triglycerides by Phosphovanillin method. 10. Latex agglutination test - Rheumatoid Arthritis. 11. Vidal Test- Typhoid detection.</p>	
<b>Practical Course Code: RJSUZOOP503</b>		
	<p>1. Quantitative Estimation of RNA by Orcinol method. 2. Quantitative Estimation of DNA by Diphenylamine method. 3. Separation of Genomic DNA by Agarose gel electrophoresis. 4. Problems based on Restriction endonucleases. 5. To study the effect of CCl<sub>4</sub> on the level of enzyme activity in liver on aspartate and alanine amino transferase, alkaline phosphatase (<i>in vitro</i> approach). 6. Following biostatistics practicals will be done manually: a. Problems based on Z-test b. Problems based on t-test c. Problems based on Chi-square test</p> <p>(Learner is expected to identify appropriate test for the given problem)</p>	

## T.Y.B.Sc Zoology Syllabus Semester V &amp; VI

	<b>Practical Course Code: RJSUZOOP504</b>	
	<ol style="list-style-type: none"> <li>1. Study of Human Axial Skeleton - Skull (whole) and Vertebral column (axis, atlas, typical cervical, typical thoracic, typical lumbar, sacrum, coccyx).</li> <li>2. Study of Human Appendicular Skeleton - Pectoral and pelvic girdle with limb bones.</li> <li>3. Disorders associated with skeletal system-Tendonitis, foot rot.</li> <li>4. Study of social organization in termites, honey bee, elephants and hanuman langur.</li> <li>5. Study of parental care in sea horse, gourami, Tilapia, Caecilian, Mid-wife toad.</li> <li>6. To mark national parks and sanctuaries on map of India.</li> <li>7. To identify brand animals of various national parks, sanctuaries and comment on its IUCN status.</li> <li>8. Project or assignment on epidemiology (Group study on disease).</li> </ol>	

<b>SEMESTER-VI (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper- I Animal type Study, Comparative anatomy, Developmental biology &amp; Histology</b>		<b>60</b>	<b>2.5</b>
<b>Paper Code: RJSUZOO601</b>			
<b>UNIT I</b>		<b>15</b>	
<b>Type Study : Shark</b>			
1	1.1: Habit, habitat, distribution, external characters including sexual dimorphism, classification and economic importance. 1.2: Skin, exoskeleton, endoskeleton and systems: 1.2.1 Digestive system. 1.2.2 Respiratory system. 1.2.3 Blood vascular system. 1.2.4 Nervous system and receptor organs. 1.2.5 Urinogenital system, copulation, fertilization and development.		
<b>UNIT II</b>		<b>15</b>	
<b>Comparative anatomy of vertebrates II- respiratory system, urinogenital system &amp; nervous system.</b>			
2	<b>2.1: Nervous system:</b> Development and differentiation of primary brain vesicles and their cavities, flexures of brain, evolution of cerebral hemispheres & cerebellum with reference to shark, frog, lizard, pigeon & rabbit.  <b>2.2: Urinogenital System:</b> Archinephros, pronephros, mesonephros, metanephros, structure of nephron, urinogenital ducts, urinary bladder in vertebrates.		
<b>UNIT III</b>		<b>15</b>	
<b>Developmental biology of chick</b>			
3	3.1.1: Structure of Hen's egg, physico-chemical nature and forms of yolk - granular, platelets and spheres; fertilization, cleavage, blastulation, gastrulation 3.1.2: Structure of chick embryo - 18hours, 24 hours, 33 hours, 48 hours & 72 hours 3.1.3: Extra embryonic membranes		
<b>UNIT IV</b>		<b>15</b>	
<b>Mammalian histology</b>			
	Histological structures of the following mammalian organs: stomach, intestine, liver, kidney, testes and ovary.		



## T.Y.B.Sc Zoology Syllabus Semester V &amp; VI

<b>SEMESTER-VI (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper- II Enzymology, Physiology and Pathology</b>		<b>60</b>	<b>2.5</b>
<b>Course Code: RJSUZOO602</b>			
<b>UNIT I</b>		<b>15</b>	
<b>Enzymology</b>			
1	<p><b>1.1: Introduction and Nomenclature:</b> Definition; concept of activation energy; nomenclature and classification (based on IUB - Enzyme Commission) of enzymes; chemical nature of enzyme, co-factors and co-enzymes</p> <p><b>1.2: Enzyme Action and Kinetics:</b> Mechanism; Factors affecting enzyme activity - substrate, pH and temperature. Derivation of Michaelis-Menten equation and Lineweaver-Burk plot; Concept and significance of Km, Vmax</p> <p><b>1.3: Enzyme Inhibition:</b> Competitive and non-competitive inhibitors and their kinetics; therapeutic applications of enzyme inhibitors</p> <p><b>1.4: Regulation of Enzyme Activity:</b> Allosteric regulation and regulation by covalent modification of enzymes; Isozymes (LDH)</p> <p><b>1.5: Industrial applications of enzymes:</b> Food and detergents</p>		
<b>UNIT II</b>		<b>15</b>	
<b>Chemical messengers and Cardiac physiology</b>			
2	<p><b>2.1 Chemical Messengers:</b> Introduction, concept and classification; Neurotransmitters and Neurosecretory substances, acetyl catecholamine, gamma-amino butyric acid (GABA), aspartic acid, purine ATP, mode of working of transmitters.</p> <p><b>2.2 Cardiac Physiology:</b> Vascular pumps: Suction pump in open circulation and pressure pump in closed circulation; Cardiac output, Venous Return, Pace maker, Electrical activity in heart muscles: Electrocardiogram; Chemical and nervous regulation of heart.</p>		
<b>UNIT III</b>		<b>15</b>	
<b>Aspects of human reproduction</b>			
3	<p><b>3.1 Human Reproductive system and Hormonal regulation:</b> Anatomy of human male and female reproductive system, Hormonal regulation of Reproduction, Impact of age on reproduction-Menopause and Andropause.</p> <p><b>3.2 Contraception &amp; birth control:</b> Methods of Contraception- Natural Methods and Artificial methods, Sterilization, Termination, Abortion.</p> <p><b>3.3 Infertility-</b> Causes and treatment in females and males.</p> <p><b>3.4 Infertility associated disorders:</b> Endometriosis, Polycystic Ovarian syndrome (PCOS), POF (Primary ovarian failure).</p> <p><b>3.5 Assisted Reproductive Technology:</b> Sperm banks, cryopreservation of gametes and embryos, Surrogacy, Techniques of ART - In vitro fertilization (IVF), Embryo transfer (ET), Gamete intra-fallopian transfer (GIFT), intra-zygote transfer (ZIFT), Intracytoplasmic sperm injection (ICSI) with ejaculated sperm and with sperm</p>		

## T.Y.B.Sc Zoology Syllabus Semester V &amp; VI

	retrieved from testicular biopsies- Testicular sperm extraction (TESE) , Ethical Considerations of ART.		
	<b>UNIT IV</b>	<b>15</b>	
	<b>General Pathology</b>		
	<p><b>4.1: General Pathology:</b> Introduction and scope</p> <p><b>4.2: Cell injury:</b> Mechanisms of cell injury: ischemic, hypoxic, free radical mediated and chemical.</p> <p><b>4.3: Retrogressive changes:</b> Definition, types of degeneration (causes and effects): cellular swelling, fatty, mucoid and amyloid.</p> <p><b>4.4: Disorders of pigmentation:</b> Endogenous: Brief ideas about normal process of pigmentation, melanosis, jaundice (causes and effects).</p> <p><b>4.5: Necrosis:</b> Definition and causes; nuclear and cytoplasmic changes; types: coagulative, liquefactive, caseous, fat and fibroid.</p> <p><b>4.6: Gangrene:</b> Definition and types - dry, moist and gas gangrene.</p>		



<b>SEMESTER-VI (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper- III - Cancer biology, Biotechnology, Genetics and Bioinformatics</b> <b>Paper Code: RJSUZOO603</b>		<b>60</b>	<b>2.5</b>
<b>UNIT I</b>		<b>15</b>	
<b>Cancer biology</b>			
1	<p><b>1.1: Biology of cancer:</b> Introduction, general properties of cancer cells.</p> <p><b>1.2: Cell Cycle :</b> Eukaryotic Cell Cycle, Regulation of Cell cycle progression.</p> <p><b>1.3: Cell Signaling:</b> Signaling molecules and their receptor; functions of cell surface receptors; Intracellular signal transduction pathway. Programmed Cell Death.</p> <p><b>1.4: Causes of Cancer:</b> carcinogens – radiation, chemical and Viral , Oncogenes, Tumor Suppressor genes.</p> <p><b>1.5: Prevention and treatment:</b> Prevention and regulation; Chemotherapy, radiation Therapy, Immunotherapy and gene therapy.</p> <p><b>1.6: Tumor immunology :</b> Antitumor Effector Cells and Regulation of Tumor Immunity, Tumor-Associated Antigens, Mechanisms of Tumor Rejection.</p>		
<b>UNIT II</b>		<b>15</b>	
<b>Animal tissue culture</b>			
2	<p><b>2.1: Aseptic techniques</b></p> <p>2.1.1: Sterilization - basic principles of sterilization, importance of sterility in cell culture</p> <p>2.1.2: Sterile handling - swabbing, capping, flaming, handling bottles and flasks, pipetting, pouring of plates.</p> <p><b>2.2: Culture media</b></p> <p>2.2.1: Types of media - Natural and Artificial media</p> <p>2.2.2: Balanced Salt Solutions</p> <p>2.2.3: Complete Media - amino acids, vitamins, salts, glucose, oxygen supplements, hormones and growth factors, antibiotics</p>		

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	<p>2.2.4: Factors influencing cell culture - surface tension and foaming, viscosity, temperature, osmolality, pH, CO<sub>2</sub>, bicarbonate and O<sub>2</sub>.</p> <p><b>2.3:</b> Advantages of tissue culture –concept of HeLa cells and stem cells, control of the environment, <i>in vitro</i> modelling of <i>in vivo</i> conditions in tissue culture.</p> <p><b>2.4:</b> Limitations of tissue culture.</p> <p><b>2.5: Culture techniques</b></p> <p>2.5.1: Preparation of cells / organs for culture</p> <p>2.5.2: Cover slip, Flask and Tube culture</p> <p>2.5.3: Primary and established cell lines</p> <p>2.5.4: Hybridoma technology</p>		
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<b>UNIT III</b>		<b>15</b>	
<b>Human Genetics</b>			
3	<p><b>3.1: Chromosomal Aberrations:</b></p> <p>3.1.1 Numerical: Aneuploid and Polyploidy (Autopolyploidy and Allopolyploidy); Non-disjunction during mitosis and meiosis.</p> <p>3.1.2 Structural: Deletion: types, effects and disorders; Translocation: types, effects, disorders; Inversion: types, effects and significance; Duplication, types, effects and evolutionary significance (multigene families).</p> <p><b>3.2: Genetic Disorders:</b> Inborn Errors of Metabolism: Phenylketonuria, G-6-PD deficiency, Alkaptonuria, Albinism; Single gene mutation: Cystic fibrosis; Multifactorial: Breast cancer; Uniparental Disomy: Angelman Syndrome and Prader-Willi Syndrome.</p> <p><b>3.3: Diagnosis:</b> Prenatal Diagnosis: Amniocentesis and Chorionic villus sampling, Banding techniques (G, C, Q), FISH, Protein truncation test (PTT).</p>		
<b>UNIT IV</b>		<b>15</b>	
<b>Bioinformatics</b>			
4	<p><b>4.1: Introduction</b></p> <p>4.1.1: Introduction to Bioinformatics and Bioinformatics web resource (NCBI, EBI, OMIM, PubMed)</p> <p>4.1.2: Applications of Bioinformatics</p> <p><b>4.2: Databases - Tools and their uses</b></p> <p>4.2.1: Biological databases;</p> <p>Primary sequence databases: Nucleic acid sequence databases (GenBank, EMBL-EBI, DDBJ) Protein sequence databases (UniProtKB, PIR) Secondary sequence databases OR Derived databases - PROSITE, BLOCKS</p> <p>Structure databases and bibliographic databases</p> <p><b>4.3: Sequence alignment methods</b></p> <p>4.3.1: BLAST, FASTA</p> <p>4.3.2: Types of sequence alignment (Pairwise &amp; Multiple sequence alignment)</p> <p>4.3.3: Significance of sequence alignment</p>		

## T.Y.B.Sc Zoology Syllabus Semester V &amp; VI

	<p><b>4.4: Predictive applications using DNA and protein sequences</b>  4.4.1: Evolutionary studies: Concept of phylogenetic tree, convergent and parallel evolution  4.4.2: Pharmacogenomics: Concept and applications  4.4.3: Metabolomics: Concept and applications  <b>4.5: Bioinformatics programme in India.</b></p>		
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<b>SEMESTER-VI (THEORY)</b>		<b>L</b>	<b>Cr</b>
<p align="center"><b>Paper- IV - Environmental Biology, Zoopharmacognosy, Epidemiology &amp; Wildlife management.</b>  <b>Paper Code: RJSUZOO604</b></p>		<b>60</b>	<b>2.5</b>
<p align="center"><b>UNIT I</b></p>		<b>15</b>	
<p align="center"><b>Zoogeography</b></p>			
<p><b>1.1: Introduction:</b> Plate tectonics and continental drift theory.  <b>1.2: Animal Distribution and Barriers</b>  1.2.1: Isolating Mechanisms  1.2.2: Patterns of animal distribution - continuous, discontinuous and bipolar  1.2.3: Barriers of distribution -Topographic, climatic, vegetative, large water masses, land mass, lack of salinity and special characteristic habit (homing instinct).  1.2.4: Means of dispersal - land bridges, natural rafts and drift wood, favouring gales, migration by host, accidental transportation and by human agencies  <b>1.3: Zoogeographical Realms:</b> Palearctic, Ethiopian, Oriental, Australian, Neotropical, Nearctic and Antarctic.</p>			
<p align="center"><b>UNIT II</b></p>		<b>15</b>	
<p align="center"><b>Bioprospecting and Zoopharmacognosy</b></p>			
<p><b>2.1: Bioprospecting</b>  2.1.1: Traditional and modern bioprospecting, economic value of bioprospecting  2.1.2: Bioprospecting and conservation, advantages and disadvantages  <b>2.2: Zoopharmacognosy</b>  2.2.1: Definition and types.  2.2.2: Self-medication and its mechanism.  2.2.3: Methods of self-medication through: a) Ingestion - ants and mammals  b) Geophagy - invertebrates and birds c) Absorption and adsorption  2.2.4: Applications - Social and trans-generational aspects of insects, birds and Mammals.  2.2.5: Contribution to human medicines.</p>			

	<b>UNIT III</b>	<b>15</b>	
3	<b>Epidemiology-II</b>		
	<p><b>3.1: Prevention and control of communicable diseases-</b> Notification, isolation, quarantine, disinfection; concurrent, terminal, precurrent/ prophylactic methods of disinfection: natural, physical, chemical, immunization; general measures.</p> <p><b>3.2: Epidemiology of communicable diseases:</b> Diagnosis, transmission, prevention,</p> <p><b>3.3 WHO and its programme:</b> Malaria, Tuberculosis, Polio control programme, outcome with control measures and treatment of- a) Diseases of viral origin- dengue, swine flue b) Diseases of bacterial origin- TB, leprosy, leptospirosis c) Diseases of protozoan origin- Malaria d) Diseases of helminths origin- Ascariasis, dracunculosis, filariasis respect to India.</p>		
	<b>UNIT IV</b>	<b>15</b>	
	<b>Wildlife management</b>		
	<p><b>4.1: Habit, Habitat, Territory of Wild Animals:</b> Herbivores, carnivores, solitary, social, types of habitats and territories.</p> <p><b>4.2: Threats to Wildlife</b></p> <p>4.2.1: Poaching and hunting, deforestation, encroachment, competition (intra-specific and inter-specific), overgrazing and climate change, diseases (zoonosis and reverse zoonosis).</p> <p>4.2.2: Tourism and human animal conflict.</p> <p><b>4.3: Wildlife Conservation</b></p> <p>4.3.1: Techniques and methods used for wildlife census: Aerial counts, camera trap, line transect census and track surveys, capture mark recapture method, wildlife radio telemetry</p> <p>4.3.2: Forest management, policies and Acts: Management- Prescribed burning, Reforestation; Forest policy 1988; The Indian Forest Act, 1927; Indian Wildlife (Protection) Act, 1972 and Convention for International Trade of endangered species (CITES).</p> <p><b>4.4 Case studies</b> Community-based conservation and management in Namibia; Wolf reintroduction in Yellow Stone National Park; Silent Valley conservation- people's movement; Diclofenac and vulture population decline.</p>		

## T.Y.B.Sc Zoology Syllabus Semester V &amp; VI

T.Y.B.Sc	Semester VI Theory
RJSUZOO601	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To acquaint learners with the details of Shark as a representative of vertebrates.</li> <li>2. To provide them with general idea of comparative anatomy of vertebrates.</li> <li>3. To acquaint learners with knowledge of developmental biology with chick as a model.</li> <li>4. To make understand learner concept of histology.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Learner will get an idea of general characters and system details of Shark.</li> <li>2. Learner will be familiarized with process of evolution trend which has occurred during vertebrate evolution.</li> <li>3. Learner will understand the basics of chick embryo development and the practical applications of studying chick embryology.</li> <li>4. Learner will understand histology of various mammalian tissues.</li> </ol>

T.Y.B.Sc	Semester VI Theory
RJSUZOO602	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To introduce concepts of enzyme biochemistry and applications of enzymes.</li> <li>2. To understand the working of neurotransmitters and basics of cardiac physiology.</li> <li>3. To comprehend the physiological aspects of homeostasis and endocrinology.</li> <li>4. To acquaint learner with the concept and details of tissue culture.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Learner will understand enzyme kinetics and therapeutic role of enzymes.</li> <li>2. The student will identify the role of neurotransmitters and appreciate the working of human heart.</li> <li>3. Learner will be familiarized with adaptations of animals for regulation of heat and ionic balance. They will understand the structure, function and disorders of endocrine glands.</li> <li>4. Learner will get an idea of tissue culture practices and its wide range of scope in allied industries.</li> </ol>

T.Y.B.Sc	Semester VI ( Theory)
RJSUZOO603	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To impart the knowledge of cellular and molecular biology of cancer.</li> <li>2. To introduce molecular biology of gene alteration and its effects.</li> <li>3. To understand the tools and techniques used in genetic engineering.</li> <li>4. To acquaint learners with the fascinating world of human genetics and bioinformatics.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. The student will understand at the cellular level the causes, preventive measures and treatment for cancer.</li> <li>2. Learner will get an insight in the intricacies of chemical and molecular processes that alter the gene.</li> <li>3. Learner will be familiarized with vast arrays of techniques of gene manipulation.</li> <li>4. Learner will get an idea on the significance of genetic health and the role of computational biology in present time.</li> </ol>

T.Y.B.Sc	Semester VI (Theory)
RJSUZOO604	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. Learner should understand the different factors affecting the environment and wildlife.</li> <li>2. To introduce the learner to concepts of bioprospecting and zoopharmacognosy.</li> <li>3. To acquaint learner with the distribution on animals around the world.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Learner will get sensitized to the issues concerning with environment, threats to wildlife and the different methods of conservation.</li> <li>2. Learner will become aware about commercialization of biological discoveries as well as ethological aspect of non-human self medication.</li> <li>3. Learner will get an idea about how and why animals got distributed on the earth.</li> </ol>

<b>SEMESTER-VI (Practical)</b>		<b>Cr</b>
	<b>Practical Course Code: RJSUZOOP601</b>	<b>06</b>
1	<p>1. Study of Shark with the help of diagram / Photograph / Simulation whichever possible. No animal shall be dissected.</p> <p>a) Digestive system b) Heart and Aortic arches c) Urinogenital System d) Endoskeleton of shark: i. Axial - Skull and vertebral column ii. Appendicular - Pelvic and pectoral fins, pelvic and pectoral girdle</p> <p>2. Brain: Comparative study of brains of shark, frog, lizard, bird (pigeon /fowl) &amp; rat. 3. Study of ontogeny of chick embryo using permanent slides - 18 hours, 24 hours, 33 hours, 48 hours and 72 hours. 4. Preparation of temporary mounting of chick embryo up to 48 hours of incubation. 5. Observation of Permanent slides: Mammalian Tissues- liver, kidney, testis, ovary, stomach and intestine.</p>	
	<b>Practical Course Code: RJSUZOOP602</b>	
2	<p>1. Effect of varying pH on activity of enzyme Acid Phosphatase. 2. Effect of varying enzyme concentration on activity of enzyme Acid Phosphatase. 3. Effect of varying substrate concentration on activity of enzyme Acid Phosphatase. 4. Effect of inhibitor on the activity of enzyme Acid Phosphatase. 5. Separation of LDH isozymes by agarose / polyacrylamide gel electrophoresis. 6. Study of stages of estrous cycle in mice by vaginal cytology. 7. Mounting of nerve cells and neurosecretory cells from cockroach brain. 8. Study of ECG and disorders of heart function. 9. Study of contraceptive devices- condom, diaphragm, contraceptive pills, copper-T 10. Study of pregnancy detection kit.</p>	
	<b>Practical Course Code: RJSUZOOP503</b>	
	<p>1. Study of slides and photographs: leukemia/ sarcoma/lymphoma/carcinoma 2 Calculation of mitotic index from the photograph or stained preparation of onion root tip or cancer cells. 3. Instruments for tissue culture – Autoclave, Millipore filter, CO2 incubator, Laminar air-flow. (Principle and use). 4. Packaging of glassware for tissue culture. 5. Aseptic transfer techniques( demonstration only) 6. Trypsinization and vital staining using Trypan blue stain (demonstration only) 7. Karyotype (Idiogram) analysis for the following syndromes with comments on numerical and / or structural variations in chromosomes .</p>	

T.Y.B.Sc Zoology Syllabus Semester V & VI

	<ul style="list-style-type: none"> <li>a. Turner's syndrome</li> <li>b. Klinefelter's syndrome</li> <li>c. Down's syndrome</li> <li>d. Cri-du-chat syndrome</li> <li>e. D-G translocation</li> <li>f. Edward's syndrome</li> <li>g. Patau's syndrome</li> </ul> <p>8. Interpretation of genetic formulae: Deletion, duplication, inversion and translocation.</p> <p>9. Explore BLAST for nucleotide sequence comparison.</p> <p>10. Explore the databases (Nucleotide, Protein) at NCBI for querying a nucleotide or protein sequence.</p> <p>11. Exploring bibliographic database PubMed for downloading a research paper on subject of interest with the use of operators.</p>		
<b>Practical Course Code: RJSUZOOP504</b>			
	<p>1. Indicate the distribution of fauna in the world map with respect to its realm and comment on the pattern of distribution.</p> <ul style="list-style-type: none"> <li>a. Palearctic: Giant Panda and Japanese Macaque</li> <li>b. Ethiopian: Common ostrich and African bush elephant</li> <li>c. Oriental: Indian one-horned Rhinoceros and Gharial</li> <li>d. Australian: Platypus and Red Kangaroo</li> <li>e. Neotropical: Guanaco and South American Tapir</li> <li>f. Nearctic: Virginia opossum and Sea otter , Raccoon</li> <li>g. Antarctic: Emperor Penguin and Antarctic Minke Whale</li> </ul> <p>2. Excursion (Study tour / Visit) to Zoo / Sanctuary / National park / Research institute, etc. and submit a report. College may conduct more than one field visit for wide exposure, if feasible. However, at least one field visit should be such that it is affordable to every student.</p> <p>3. Study of bioprospecting:</p> <ul style="list-style-type: none"> <li>a. Tumour suppression compounds e.g. Sponge.</li> <li>b. Skin erythema treatment from gel - Aloe vera, Aloe ferox.</li> </ul> <p>4. Study of Zoopharmacognosy in ants, cats, elephants and dogs.</p> <p>5. Temporary preparation of head and mouth parts of mosquito.</p> <p>6. Identification of Diseases with the help of Photograph/ specimen</p> <ul style="list-style-type: none"> <li>a)TB</li> <li>b) Leprosy</li> <li>c)Ascariasis</li> <li>d)Dracunculosis</li> <li>e)Filariasis</li> </ul> <p>7. Study of population density by line transect &amp; quadrature method and calculate different diversity indices.</p> <p>8. Identification of animals with the help of pug marks.</p>		



## T.Y.B.Sc Zoology Syllabus Semester V &amp; VI

T.Y.B.Sc	Semester VI Practical
RJSUZOO601 & RJSUZOO602  Practical- I & II	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To acquaint learners with the details of Shark as a representative of vertebrates &amp; to familiarize them with histological structure of some mammalian organs.</li> <li>2. To familiarize them with different stages of chick embryo development.</li> <li>3. To make the learner understand enzyme kinetics and other physiological aspects practically.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. The learner will be able to understand about vertebrate organ systems and histology of mammalian organs.</li> <li>2. Students would be able to understand changes which occur in the chick embryo during development.</li> <li>3. The learner will be able to comprehend the kinetics of enzyme activity in a better way and they would understand how different factors can affect enzymatic reactions.</li> </ol>

T.Y.B.Sc	Semester VI Practical
RJSUZOO603 & RJSUZOO604  Practical- III & IV	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To provide opportunity to learner to deal with some basic aspects of tissue culture.</li> <li>2. To introduce karyotype analysis and use of bioinformatics tool.</li> <li>3. To make them aware about Zoogeographical distribution of animals on earth. To familiarize them with some basic techniques of population analysis.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. The learner will be able to understand importance of aseptic techniques in tissue culture and would get hands on experience of using computer for obtaining gene or protein sequences through bioinformatics tools.</li> <li>2. The learner will understand the different factors which affect Zoogeographical distribution of animals.</li> <li>3. Basic population analysis techniques would help the learner in environmental research projects.</li> </ol>

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## SCHEME OF EXAMINATION ( FOR BOTH THE SEMESTERS)

### 1. Internal examination

- Two internal class tests comprising of 20 marks each.
- Each class test shall consist of 20 multiple choice questions with equal weightage.

### 2. External Examination

- One External (Semester End Examination) of 60 marks. Duration 2 hours.

### 3. Practical examination

- One Practical at the end of each Semester.
- Practical I-50 marks and Practical II-50 marks but passing combined out of 100.
- Practical III-50 marks and Practical IV-50 marks but passing combined out of 100.
  
- Candidate will be allowed to appear for the practical examinations if he/she submits a certified journal of T.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 T.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.
- HOD's decision, in consultation with the Principal, shall remain final and abiding to all.

**Evaluation and Assessment**

**Question paper pattern for external theory**

Total: 60 marks

Q.1 Based on Unit I 12 M

Attempt any two questions out of three.

- a.
- b.
- c.

Q.2 Based on Unit II 12M

Attempt any two questions out of three.

- a.
- b.
- c.

Q.3 Based on Unit III 12M

Attempt any two questions out of three.

- a.
- b.
- c.

Q.4 Based on Unit IV 12M

Attempt any two questions out of three.

- a.
- b.
- c.

Q.5 Short notes (from all Units) 12M (3M each)

- a or a- Unit I
- b or b- Unit II
- c or c- Unit III
- d or d- Unit IV

**T. Y. B. Sc. Zoology: Semester V (Practical)**

**Skeleton of Practical Examination Question Paper- Practical I**

**Total Marks: 50**

Q1. Sketch, label and describe Digestive/ Nervous / Reproductive System of Sepia.	10M
Q2. Sketch and label jaws/ radula/ chromatophores/ spermatophores of Sepia.	05M
Q3. Mountings of scales any two– placoid/cycloid/ctenoid.	10 M
Q3. Identify and describe. (a,b,c based on frog embryology and d,e based on endocrinology).	15M
Q4. Viva voce	05M
Q5. Journal	05M

**Skeleton of Practical Examination Question Paper- Practical II**

**Total Marks: 50**

Q.1 Estimate total plasma proteins by Folin's method.	15 M
<b>OR</b>	
Estimate serum/plasma total triglycerides by Phosphovanillin method.	
<b>OR</b>	
Estimation of glucose by O-toluidine method.	
Q.2. Enumerate erythrocytes in the given sample and comment on clinical condition.	10 M
<b>OR</b>	
Enumerate leucocytes in the given sample and comment on clinical condition.	
<b>OR</b>	
Present a report on differential count of leucocytes and comment on clinical condition.	
Q.3. Estimate haemoglobin by Sahli's acid haematin method.	10 M
<b>OR</b>	
Record Erythrocyte Sedimentation Rate by Westergren / Wintrobe method.	
<b>OR</b>	
Perform separation of plasma proteins by PAGE.	
Q.4. Perform Latex agglutination test - Rheumatoid Arthritis.	05 M
<b>OR</b>	
Perform Vidal test.	
Q.5. Viva voce	05 M
Q.6. Journal	05 M

**Skeleton of Practical Examination Question Paper-Practical III**

**Total Marks: 50**

Q.1 Demonstrate the effect of CCl <sub>4</sub> on the level of enzyme activity of aspartate/alanine amino transferase / alkaline phosphatase in liver ( <i>in vitro</i> approach)	12M
Q.2 Estimate the amount of RNA by Orcinol method from the given sample.	10 M
or	
Estimate the amount of DNA by Diphenylamine method from the given sample.	
or	
Separation of Genomic DNA by Agarose gel electrophoresis.	
Q.3 Problems based on Restriction endonucleases.	08M
Q.4 Problems based on Biostatistics.	10 M
Q.5 Viva voce	05 M
Q.6 Journal	05 M

**Skeleton Question Paper for Practical Examination- Practical IV**

**Total Marks: 50**

Q.1 Identification	24 M
<b>Spot a) and b)</b> Based on osteology – (human axial skeleton ,skull (whole) and vertebral column (axis, atlas, typical cervical, typical thoracic, typical lumbar, sacrum, coccyx). Any two.	
<b>Spot c) and d)</b> Based on osteology - human Appendicular skeleton (Pectoral and pelvic girdle with limb bones.) Any two.	
<b>Spot e)</b> Based on social organization (termites, honeybee, elephants and hanuman langur.) Any one.	
<b>Spot f)</b> Based on of parental care (sea horse, gourami, Tilapia, Caecilian, Mid-wife toad.) Any one.	
Q.2 To mark national parks and sanctuaries on map of India and Describe about the identified National Park or Sanctuary. (Sanjay Gandhi, Tadoba, Gir, Jim Corbett, Bharatpur, Kaziranga, Bandipur-Mudumalai) Any one.	10M
Q. 3 To identify brand animals of national parks/sanctuaries & comment on its IUCN status.	06 M
Q.4 Viva Voce	05M
Q.5. Journal	05M

**Skeleton of Practical Examination Question Paper-Practical I**

**Total Marks: 50**

Q1. Sketch and label and describe Digestive system, Heart and aortic arches, Urinogenital, Cranial nerves of Shark.	10M
Q2. Sketch and label endoskeleton of Shark (Any one skull/ vertebra / pelvic fin/ pectoral fin/ pelvic girdle/ pectoral girdle)	05M
Q3. Preparations of temporary mounting of chick embryo upto 48 hours of incubation.	10 M
Q3. Identify and describe. (a,b, based on brains c,d based on chick embryology And e,f on mammalian histology)	15M
Q4. Viva	05M
Q5. Journal	05M

**Skeleton of Practical Examination Question Paper- Practical II**

**Total Marks: 50**

Q.1 Demonstrate the effect of _____ on the activity of acid phosphatase (Substrate concentration / pH variation / Enzyme concentration / Inhibitor concentration).	15M
Q.2 Separate LDH isozymes from the given sample by agarose / polyacrylamide gel Electrophoresis.	10M
<b>OR</b>	
Q.2 Mounting of nerve cells and neurosecretory cells from cockroach.	
<b>OR</b>	
Q.2 Pregnancy detection using kit.	10M
Q.3 Identify and describe a, b, c, d, e.	15 M
a. Any one stage of Estrous cycle of mice	
b and c: ECG	
d and e: Contraceptive device.	
Q.4 Viva voce	05 M
Q.5 Journal	05 M

**Skeleton of Practical Examination Question Paper- Practical III**



**Total Marks: 50**

Q.1 Arrange the chromosomes from the given karyotype and identify and describe the syndrome.	12M
Q.2 Prepare the given glassware for sterilization.	08M
Q.3 Identify and describe A and B A: slides or photographs: leukaemia / sarcoma/lymphoma/carcinoma B: Autoclave, Millipore filter, CO <sub>2</sub> incubator, Laminar air-flow. (Principle and use).	04 M
Q.4. a) Interpret the of genetic formula	03M
b) Calculation of mitotic index from the photograph.	05M
Q.5 Project based on bioinformatics	08M
Q.6 Viva voce	05M
Q.7 Journal	05 M

**Skeleton Question Paper for Practical Examination-Paper IV**

**Total Marks: 50**

Q1. Identify the given animals with respect to their realms and comment. (any two).	06M
Q2. Identification with the help of Photograph/ specimen based on a) Bioprospecting: (Sponge, Aloe vera, Aloe ferox.) (any one). b) Zoo pharmacognosy: (ants, cats, elephants and dogs) (any one). c) Epidemiology: (TB, Leprosy, Ascariasis, Dracunculosis, Filariasis) (any one)	09M
Q3. Temporary preparation of head and mouth parts of mosquito.	05M
Q4. Study of population density by line transect or quadrat method and calculate different diversity indices.	10M
Q5 Identification of animals with the help of pug marks.	02M
Q6. Study tour or field report Submission and discussion	08M
Q7. Viva Voce	05M
Q8 Journal	05M



Hindi Vidya Prachar Samiti's  
**Ramniranjan Jhunjhunwala College**  
of Arts, Science and Commerce  
(Autonomous College)

Affiliated to  
**UNIVERSITY OF MUMBAI**

**Refer to page no: 02**  
**highlighting component**  
**of Research Project**

Syllabus for S.Y.B.Sc.  
Program: B.Sc. Zoology  
Program Code: RJSUZOO  
(CBCS 2021-22)

## DISTRIBUTION OF TOPICS AND CREDITS

## S.Y.B.Sc. ZOOLOGY SEMESTER III

Course code	Nomenclature	Credits	Topic
RJSUZOO301	Type study, Life processes and Developmental biology	02	1. Type study Earthworm
			2. Life processes-I
			3. Developmental Biology
RJSUZOO302	Biochemistry, Genetics and Molecular Biology	02	4. Biochemistry- I
			5. Genetics
			6. Molecular Biology
RJSUZOO303	Ecology, Fishery Biology and Economic Entomology	02	7. Ecosystem ecology and community dynamics
			8. Fishery Biology
			9. Economic entomology
RJSUZOOP301, RJSUZOOP302 & RJSUZOOP303.	Practical I , II and III	03	Practicals based on Paper I, II and III

## S.Y.B.Sc. ZOOLOGY SEMESTER IV

Course code	Nomenclature	Credits	Topic
RJSUZOO401	Type study, Life Processes and Cell biology	02	1.Type study-Cockroach
			2. Life processes-II
			3. Cell biology
RJSUZOO402	Biochemistry, Chromosomal inheritance and Evolution	02	4. Biochemistry-II
			5. Chromosomes and heredity
			6. Evolution
RJSUZOO403	Parasitology, Animal husbandry and Behavioural ethology	02	7. Parasitology
			8. Animal husbandry
			9. Behavioural ethology
RJSUZOOP401, RJSUZOOP402 and RJSUZOOP403.	Practical I,II & III	03	Practicals based on Paper I, II and III

<b>SEMESTER-III (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper- I Type Study, Life Processes And Developmental Biology</b> <b>Paper Code: RJSUZOO301</b>		<b>45</b>	<b>2</b>
<b>UNIT I</b>		<b>15</b>	
<b>Type study; Earthworm</b>			
1	<b>1.1</b> Classification and Salient features. <b>1.2</b> Digestive system <b>1.3</b> Circulatory system <b>1.4</b> Excretory system <b>1.5</b> Nervous system <b>1.6</b> Reproductive system, copulation, cocoon formation and development. <b>1.7</b> Locomotion <b>1.8</b> Economic importance		
<b>UNIT II</b>		<b>15</b>	
<b>Life processes-I</b>			
2	<b>2.1 Study of Nutrition and Excretion</b> 2.1.1 Comparative study of Nutritional Apparatus (structure and function): <i>Amoeba</i> , <i>Hydra</i> , <i>Amphioxus</i> , Pigeon, Ruminants. 2.1.2 Physiology of digestion in human 2.1.3 Comparative study of Excretory and Osmoregulatory structures and function a. <i>Amoeba</i> -contractile vacuoles b. <i>Planaria</i> -Flame cells c. Earthworm -Nephridia 2.1.4 Categorization of animals based on principle nitrogenous excretory products 2.1.5 Structure of kidney, Uriniferous tubule and physiology of urine formation in human.  <b>2. 2 Study of Respiration</b> 2.2.1 Comparative study of Respiratory organs (structure & function): Earthworm, Fish, Frog and Pigeon. 2.2.2 Structure of lungs and mechanism of breathing in human  <b>2.3 Study of Reproduction</b> 2.3.1 Asexual Reproduction- Fission, fragmentation, gemmule formation, budding. 2.3.2 Sexual reproduction; i. Gametogenesis ii. Structure of male and female gametes in human		
<b>UNIT III</b>		<b>15</b>	
<b>Developmental Biology</b>			
3	<b>3.1. Fertilization</b> i. Types of fertilization ii. Oviparity, viviparity, ovo-viviparity <b>3.2 Eggs and Cleavage</b>		

## S.Y.B.Sc Zoology Syllabus Semester III &amp; IV

	A] Types of Eggs B] Types of Cleavage 3.3 <b>Types of Blastulae:</b> Amphibia, Bird and Mammal 3.4 <b>Gastrulation:</b> Epiboly, Emboly, invagination, involution and infiltration 3.5 Fate of three Germinal Layers and Coelom formation		
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S.Y.B.Sc	Semester III Theory
RJSUZOO301  <b>Paper I– Type Study, Life Processes And Developmental Biology</b>	<b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To acquaint learners with the detail of earthworm as a representative of invertebrate.</li> <li>2. To introduce the physiology of various life processes with evolutionary significance.</li> <li>3. To introduce the learners to the basics of developmental biology</li> </ol> <b>Learning Outcomes:</b> <ol style="list-style-type: none"> <li>1. Learners will get an idea of general characteristic and details of invertebrate animal.</li> <li>2. Learners will be able to understand increase in complexity of physiology in evolutionary hierarchy.</li> <li>3. Learners will be able to understand the processes involved in embryonic development</li> </ol>

## S.Y.B.Sc Zoology Syllabus Semester III &amp; IV

<b>SEMESTER-III (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper- II Biochemistry, Genetics And Molecular Biology</b>		<b>45</b>	<b>2</b>
<b>Paper Code: RJSUZOO302</b>			
<b>UNIT I</b>		<b>15</b>	
<b>Biomolecules-I</b>			
1	<b>UNIT I: Biochemistry I</b> <b>1.1 Fundamentals of Biochemistry.</b> 1.1.1: Buffer, pKa, Henderson-Hasselbach equation. 1.1.2: Thermodynamics in Biochemistry, Concept of Bioenergetics. 1.1.3: Introduction to metabolism: Concept of metabolic pathways, anabolism, and catabolism. <b>1.2 Carbohydrate metabolism.</b> 1.2.1 Carbohydrate metabolism-an overview. 1.2.2 Glycolysis, TCA cycle, ETS, anaerobic pathway. 1.2.3 Gluconeogenesis, HMP, Glycogenesis and Glycogenolysis. 1.2.4 Disorders: Diabetes mellitus, Glycogen storage diseases.		
<b>UNIT II</b>		<b>15</b>	
<b>Genetics</b>			
2	<b>2.1 Introduction to genetics</b> 2.1.1 Definition, scope and importance of genetics. 2.1.2 Classical and Modern concept of Gene (Cistron, muton, recon). 2.1.3 Brief explanation of the following terms: Allele, wild type and mutant alleles, locus, dominant and recessive traits, homozygous and heterozygous, genotype and phenotype. <b>2.2 Mendelian Genetics</b> 2.2.1 Mendelian Genetics: Mendel's laws of Inheritance, Monohybrid cross, Dihybrid cross. 2.2.2 Exceptions to Mendelian Inheritance: Incomplete dominance, Co-dominance, Epistasis - Recessive, Double recessive, dominant and double dominant. <b>2.3 Multiple Alleles and Multiple Genes (Polygenes)</b> 2.3.1 Concept of multiple alleles, Coat colour in rabbit, ABO and Rh blood group systems in man. 2.3.2 Polygenic inheritance with reference to skin colour. <b>2.4 Linkage and Crossing Over</b> 2.4.1 Concept of Linkage and crossing over. 2.4.2 Mechanism and types of crossing over.		
<b>UNIT III</b>		<b>15</b>	
<b>Molecular Biology</b>			
3	<b>3.1 Genetic material.</b> 3.1.1 Experiments for proving DNA as genetic material in living organisms: Griffith's transformation experiment, Avery-Macleod and McCarty experiment, Hershey-Chase experiment. 3.1.2 RNA as genetic material: Singer & Conrat experiment. 3.1.3 Prokaryotes: Chromosomal DNA (Nucleoid) and plasmid (extrachromosomal DNA)		

## S.Y.B.Sc Zoology Syllabus Semester III &amp; IV

	<p>3.1.4 Eukaryotes: Extra-nuclear DNA in Mitochondria &amp; Chloroplast.</p> <p><b>3.2 Genetic code:</b> History, concept &amp; properties.</p> <p><b>3.3 Flow of genetic information in prokaryotes:</b> DNA replication, Transcription, Translation.</p> <p><b>3.4 Operon:</b> Concept of Operon, Structure &amp; regulation of lac operon.</p>		
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S.Y.B.Sc	Semester III Theory
<p>RJSUZOO302</p> <p><b>Paper- II Biochemistry, Genetics And Molecular Biology</b></p>	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To introduce various concept of biochemistry and metabolism.</li> <li>2. To introduce concepts of inheritance with special emphasis on Mendelian genetics, multiple allele, linkage and crossing over.</li> <li>3. To introduce classical experiments of molecular biology, phenomenon of central dogma of protein synthesis and operon system.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Learners would appreciate the importance of metabolism.</li> <li>2. Learners would understand and apply the principle of inheritance.</li> <li>3. Learners would understand the basics and processes of molecular biology.</li> </ol>

## S.Y.B.Sc Zoology Syllabus Semester III &amp; IV

<b>SEMESTER-III (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper- III - Ecology, Fishery Biology And Economic Entomology</b>		<b>45</b>	<b>2</b>
<b>Paper Code: RJSUZOO303</b>			
<b>UNIT I</b>		<b>15</b>	
<b>Ecosystem ecology and community dynamics.</b>			
1	<b>1.1 Types of ecosystems;</b> 1.1.1 Terrestrial ecosystem- Forest, grassland, desert and tundra 1.1.2 Aquatic ecosystem- Freshwater, estuarine and marine <b>1.2 Amazing ecosystems-</b> Coral reef, Amazon Rainforest and Sunderbans <b>1.3 Ecological succession</b> 1.3.1 Concept of succession. 1.3.2 Types of succession: Hydrosere and Xerosere. 1.3.3 Climax concept in succession.		
<b>UNIT II</b>		<b>15</b>	
<b>Fishery biology</b>			
2	<b>2.1-</b> Geographical and morphological features of coastline & fishing communities in India. <b>2.2- Brief classification of fisheries;</b> a) Marine: coastal, offshore & deep sea fisheries b) Brackish water fisheries c) Fresh water fisheries <b>2.3- Important fisheries of India</b> 2.3.1- Fin fish- Oil sardine, Mackerel, Bombay duck, Pomfret. 2.3.2- Crustacean fisheries- Prawns & lobsters. 2.3.3- Molluscan fisheries- Clams, edible oysters, loligo. <b>2.4- Methods of fish preservation.</b> <b>2.5- Nutritive value of fish &amp; fish products.</b>		
<b>UNIT III</b>		<b>15</b>	
<b>Economic Entomology</b>			
3	<b>3.1 Honey bee:</b> Social life and communication, life history, Apiculture, Economic Importance <b>3.2 Lac insect:</b> Life history, lac culture, composition of lac & its uses. <b>3.3 Silk moth:</b> Life history, Sericulture, Economic Importance, types of silk. <b>3.4</b> Life history and control measures of Locust ( <i>Schistocerca gregaria</i> ), Aphids, Rice Weevil ( <i>Sitophilus oryzae</i> ). <b>3.5 Methods of insect control:</b> Chemical control by synthetic and natural chemicals. <b>3.6 Biological control-</b> <i>Bacillus thuringiensis</i> .		



<b>S.Y.B.Sc</b>	<b>Semester III Theory</b>
RJSUZOO303  <b>Paper- III - Ecology, Fishery Biology And Economic Entomology</b>	<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To introduce the concept of ecology, ecosystem and community dynamics.</li><li>2. To introduce learners fishery biology with emphasis on classification, fishery community importance, method of preservation and notional value.</li><li>3. To understand different aspect of economic entomology.</li></ol> <b>Learning Outcomes:</b> <ol style="list-style-type: none"><li>1. Learners will get an idea about types of ecosystem and succession.</li><li>2. Learners will be able to understand importance of fishery biology.</li><li>3. Learners will be able to understand the processes involved apiculture, sericulture and control measures for crop pest.</li></ol>

<b>SEMESTER-IV (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper I- Types Study, Life Processes And Cell Biology</b> <b>Paper Code: RJSUZOO401</b>		<b>45</b>	<b>2</b>
<b>UNIT I</b>		<b>15</b>	
<b>Type Study: Cockroach</b>			
1	<b>1.1</b> Classification <b>1.2</b> External characters <b>1.3</b> Digestive system <b>1.4</b> Blood vascular system <b>1.5</b> Respiratory system <b>1.6</b> Nervous system <b>1.7</b> Excretory system <b>1.8</b> Reproductive system, copulation and fertilisation.		
<b>UNIT II</b>		<b>15</b>	
<b>LIFE PROCESSES II</b>			
2	<b>2.1 Circulation:</b> 2.1.1 Comparative study of circulation: Open and closed - single and double. 2.1.2 Types of circulating fluids- Water, coelomic fluid, haemolymph, lymph and blood. 2.1.3 Comparative study of vertebrate Hearts (Structure and function) 2.1.4 Structure and mechanism of working of heart in human  <b>2.2 Locomotory organs -structures and functions.</b> a. Pseudopodia in <i>Amoeba</i> (sol gel theory) b. Cilia in <i>Paramecium</i> , Ultrastructure of cilia & ciliary movement c. Structure of Striated muscle fibre in human and Sliding filament theory  <b>2.3 Control and coordination</b> 2.3.1 Irritability – <i>Paramecium</i> , Nerve net in <i>Hydra</i> . 2.3.2 Types of neurons on the basis of structure and function 2.3.3 Conduction of nerve impulse: Resting potential, action potential and refractory period 2.3.4 Synaptic transmission		
<b>UNIT III</b>		<b>15</b>	
<b>CELL BIOLOGY</b>			
3	<b>3.1 Cellular Organization:</b> Difference between Prokaryotes and Eukaryotes <b>3.2 Structure and function</b> of Plasma membrane, Importance of membrane fluidity and asymmetry, Membrane Transport, Passive diffusion, facilitated transport, active transport, Exocytosis and endocytosis. <b>3.3 Cytoplasmic Membrane System: Structure and function</b> a) Cytoskeleton: Microtubules and Microfilaments. b) Endoplasmic Reticulum: SER, RER c) Golgi Complex d) Lysosomes: Primary and Secondary Lysosomes <b>3.4 Mitochondria:</b> Structure and function		

## S.Y.B.Sc Zoology Syllabus Semester III &amp; IV

	<b>3.5 Structure of nucleus, Nuclear Pore and pore Complex, Nucleolus, Organization of Chromatin and Chromosomes.</b>		
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S.Y.B.Sc	Semester IV Theory
RJSUZOO401  <b>Paper- I Types Study, Life Processes And Cell Biology</b>	<b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To acquaint the learners with the detail of cockroach as a representative of invertebrate.</li> <li>2. To introduce the physiology of various life processes with evolutionary significance.</li> <li>3. To understand the learner structural and functional organization of cell.</li> </ol> <b>Learning Outcomes:</b> <ol style="list-style-type: none"> <li>1. Learners will get an idea of general characteristic and details of invertebrate animal.</li> <li>2. Learners will be able to understand increase in complexity of physiology in evolutionary hierarchy.</li> <li>3. Learners will acquire insight of the structural and functional aspects of cell biology.</li> </ol>

<b>SEMESTER-IV (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper II- Biochemistry, Chromosomal Inheritance And Cell Biology</b> <b>Paper Code: RJSUZOO402</b>		<b>45</b>	<b>2</b>
<b>UNIT I</b>		<b>15</b>	
<b>Biochemistry II</b>			
<b>1</b>	<p><b>1.1 Lipid Metabolism:</b> 1.1.1 Overview, Triacylglycerol, <math>\beta</math>- Oxidation, Ketogenesis 1.1.2 Disorders: Obesity, Diabetic ketoacidosis, respiratory Distress syndrome</p> <p><b>1.2 Protein Metabolism:</b> Overview, 1.2.1 Metabolism of amino acids- transamination, deamination (oxidative and non-oxidative), Urea cycle. 1.2.2 Disorders of Urea cycle.</p> <p><b>1.3 Intermediary metabolism:</b> Acetyl – CoA as a common product in metabolism of carbohydrates, proteins and lipids.</p>		
<b>UNIT II</b>		<b>15</b>	
<b>Chromosomes and Heredity</b>			
<b>2</b>	<p><b>2.1 Chromosomes</b> 2.1.1 Types of chromosomes–Autosomes and Sex chromosomes 2.1.2 Chromosome structure - Heterochromatin, Euchromatin 2.1.3 Classification based on the position of centromere 2.1.4 Endomitosis, Giant chromosomes- Polytene and Lamp brush chromosomes and significance of Balbiani rings.</p> <p><b>2.2 Sex- determination</b> 2.2.1 Chromosomal Mechanisms: XX-XO, XX-XY, ZZ-ZW. 2.2.2 Sex determination in honey bees- Haplodiploidy, 2.2.3 Sex determination in Drosophila-Genic balance theory. 2.2.4 Hormonal influence on sex determination-Freemartin and sex reversal. 2.2.5 Role of environmental factors- Bonellia and Crocodile 2.2.6 Barr bodies and Lyon hypothesis</p> <p><b>2.3 Sex linked inheritance.</b> 2.3.1 X-Linked: Colourblindness, Haemophilia 2.3.2 Y-linked: Hypertrichosis</p> <p><b>2.4 Pedigree analysis</b> Autosomal; dominant and recessive, X-linked; dominant and recessive.</p>		
<b>UNIT III</b>		<b>15</b>	
<b>EVOLUTION</b>			
<b>3</b>	<p><b>3.1:</b> Geological timescale. <b>3.2</b> Theories of Evolution <b>3.3 Origin of life:</b> Emergence of life on primitive earth <b>3.4: Evolution and adaptations:</b> Microevolution, Role of natural selection in microevolution, Co-evolution. <b>3.5:</b> Ecological niches and adaptations.</p>		

## S.Y.B.Sc Zoology Syllabus Semester III &amp; IV

<b>S.Y.B.Sc</b>	<b>Semester IV Theory</b>
RJSUZOO402  <b>Paper- II Biochemistry, Chromosomal Inheritance And Cell Biology</b>	<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To introduce various concept of biochemistry and metabolism.</li><li>2. To introduce concepts of chromosome sex determination and chromosomal basis of inheritance.</li><li>3. To familiarize learner with concept of geological timescale, adaptation, origin of life with reference to evolution.</li></ol> <b>Learning Outcomes:</b> <ol style="list-style-type: none"><li>1. Learners would appreciate the importance of metabolism.</li><li>2. Learners would able to correlate chromosome with principle of inheritance.</li><li>3. Learners would understand different aspects of evolution.</li></ol>

<b>SEMESTER-IV (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper III- Parasitology, Animal Husbandry And Behavioural Ethology</b>		<b>45</b>	<b>2</b>
<b>Paper Code: RJSUZOO403</b>			
<b>UNIT I</b>		<b>15</b>	
<b>Parasitology</b>			
1	<p>1.1 Definitions: parasite, parasitism, host, vector-biological and mechanical.</p> <p>1.2 Types of parasites- Ectoparasites, Endoparasite and their subtypes</p> <p>1.3 Parasitic adaptations in Ectoparasites and Endoparasites</p> <p>1.4 Types of hosts: intermediate, definitive and reservoir</p> <p>1.5 Host-parasite relationship Host specificity: Definition, structural specificity, physiological specificity and ecological specificity.</p> <p>1.6 Protozoan and helminth parasites of man and domesticated animals: Life cycle, pathogenicity, control measures and treatment of;</p> <p>a) <i>Entamoeba histolytica</i>, b) <i>Leishmania</i>, c) <i>Toxoplasma gondii</i>, d) <i>Fasciola hepatica</i>, e) <i>Taenia solium</i></p>		
<b>UNIT II</b>		<b>15</b>	
<b>Animal Husbandry</b>			
2	<p>2.1 Introduction: concept of integrated farming.</p> <p>2.2 Poultry:</p> <p>2.2.1 Definition and nomenclature.</p> <p>2.2.2 Breeds of fowl (Aseel, Kadaknath, Leghorn, Rhode Island red),</p> <p>2.2.3 Factors affecting size of eggs, abnormal eggs, hatching of eggs,</p> <p>2.2.4 Housing and equipments, Brooding and rearing.</p> <p>2.2.5 Poultry diseases- Coccidiosis, Avian flu.</p> <p>2.3 Cattle Farming:</p> <p>2.3.1 Classification of breeds (Milch breeds, Dual Purpose Breeds, Draught breeds, New breeds).</p> <p>2.3.2 Various breeds of Cows: Indigenous – Red Sindhi, Sahiwal, Khillari, Hariana. Exotic – Holstein–Friesian, Brown Swiss, Jersey.</p> <p>2.3.3 Various breeds of Buffalo: Murrah, Nagpuri, Jaffrabadi.</p> <p>2.3.4 Dairy Science: Composition of Milk, Methods of Preservation of Milk Products.</p>		
<b>UNIT III</b>		<b>15</b>	
<b>Behavioral Ethology</b>			
3	<p>3.1 Concept of instincts: Innate release mechanism, significance of instincts.</p> <p>3.2 Concepts of imprinting: Filial imprinting, sexual imprinting, Functional aspects of imprinting.</p> <p>3.3 Displacement behaviour: Causes and functional aspects, ritualization of displacement activity.</p> <p>3.4 Animal communication: Visual, Sound, Chemical (pheromones), Round &amp; Waggle dance in bees.</p>		

<b>S.Y.B.Sc</b>	<b>Semester IV Theory</b>
<b>RJSUZOO403</b>  <b>Paper- III</b> <b>Parasitology,</b> <b>Animal</b> <b>Husbandry</b> <b>And</b> <b>Behavioural</b> <b>Ethology</b>	<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To introduce key concept of parasitology.</li><li>2. To introduce the learner to the concepts of animal farming.</li><li>3. To familiarize learner with concept animal behaviour.</li></ol> <b>Learning Outcomes:</b> <ol style="list-style-type: none"><li>1. Learners would appreciate the importance of parasite, their relation with host and life cycle.</li><li>2. Learners would able to understand concept of types and methodology of animal farming with economic value.</li><li>3. Learners would understand different aspects of animal behaviour with special emphasis on imprinting, communication and displacement behaviour.</li></ol>

<b>SEMESTER-III (PRACTICALS)</b>		<b>L</b>	<b>Cr</b>
<b>Practical I- Type Study, Life Processes And Developmental Biology</b> <b>Paper Code: RJSUZOOP301</b>			<b>1</b>
1. Study of earthworm a. External characters b. Digestive system c. Nervous system (Demonstration) d. Reproductive system (Demonstration) e. Mounting- Septal nephridia, spermatheca, setae.			
2. Urine analysis—Normal and abnormal constituents.			
3. Detection of ammonia in water excreted by fish.			
4. Detection of uric acid from excreta of birds.			
5. Study of nutritional Apparatus ( <i>Amoeba, Hydra, Amphioxus, Pigeon, Ruminant stomach</i> )			
6. Study of respiratory structures: Gills of Bony fish and Cartilaginous fish, Lungs of frog, Lungs of mammal, Air sacs of Pigeon.			
7. Study of permanent slides on topic of Reproduction: <i>Paramecium</i> - Binary fission and conjugation, <i>Sponge</i> gemmules, <i>Hydra</i> budding, T.S. of mammalian testis, T.S. of mammalian ovary.			
8. Study of Egg types –Fish eggs, Frog eggs, Hen's egg.			
9. Study of Cleavage, blastula and gastrula ( <i>Amphioxus, Frog and Bird</i> ).			
<b>Practical II - Biochemistry, Genetics And Molecular Biology</b> <b>Paper Code: RJSUZOOP302</b>			<b>1</b>
1. Preparation of buffer of different pH using Henderson-Hasselbalch equation			
2. Preparation of titration curve for strong acid and strong base with the help of pH meter			
3. Determination of pKa for weak acid			
4. Colorimetry: a) Selection of ideal filters b) Determination of unknown concentration.			
5. Study of drosophila: Phenotypic traits (eye colour, wing length, sexual dimorphism, gynandromorphs)			
6. Problems in Genetics-monohybrid cross, dihybrid cross, multiple allelism.			
7. Blood grouping			
8. Problems based on molecular biology.			



## S.Y.B.Sc Zoology Syllabus Semester III &amp; IV

<b>Practical III - Ecology, Fishery Biology And Economic Entomology</b>		<b>1</b>
<b>Paper Code: RJSUZOOP303</b>		
1.	Study of different ecosystems (biomes) and their representative animals.	
2.	Study of commercially important fishery a. Fin fish fishery- Catla, Rohu, Mackerel, Pomfret, Bombay duck b. Non-fin fish fishery- Prawn, Crab, Lobster, Edible oyster)	
3.	Study of crafts and gears.	
4.	Study of honey bee: a) Life cycle of honey bee b) Study of bee hive. c) Mouth parts, d) Legs of honeybee e) Sting apparatus,	
5.	Life cycle of Silk Moth	
6.	Detection of adulterants in honey	
7.	Study of Insects a. Harmful insect :Locust, Aphids, Rice weevil b. Entomophagus insect – Dragonfly c. Parasite Insect – Ichneumon wasp.	
8.	Visit to fish market/docks/fish landing centers and submission of report.	

S.Y.B.Sc	Semester III Practical
RJSUZOOP301  Practical- I	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>To familiarize the learner to understand various system of invertebrate</li> <li>To make the learner understand different organ involved in different physiological mechanism</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>The learner will be able to apply the knowledge of different biochemical test to detect excretory product.</li> <li>The learner can able to make histological analysis by studying the specimen and slides</li> </ol>

S.Y.B.Sc	Semester III Practical
RJSUZOO302 Practical- II	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To make the learner understand preparation of buffer and other chemical solution.</li> <li>2. To understand the application of genetics by observation of morphological characteristic of drosophila</li> <li>3. Introduction to study of some laboratory techniques.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Learners will get an idea about type of solution and also get hands on training on colorimeter.</li> <li>2. Learners will be able to understand mathematical approach and probability to solve problems based on genetics.</li> </ol>

S.Y.B.Sc	Semester III Practical
RJSUZOO303 Practical- III	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To introduce the concept of biomes by introducing different animal by observing specimen.</li> <li>2. To introduce commercially important fishery by observing different specimen of fish</li> <li>3. To familiarize the learner to economically important insect with practical involving observation of specimen in the laboratory as well as on field study.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Learners will able to apply knowledge of biomes on field.</li> <li>2. Learners will be able to identify different types of fish and economically Important insect on field.</li> </ol>

<b>SEMESTER-IV(PRACTICALS)</b>		<b>L</b>	<b>Cr</b>
<b>Practical I Types Study, Life Processes And Cell Biology</b> <b>Paper Code: RJSUZOOP401</b>			<b>1</b>
1. Study of cockroach a) External characters b) Digestive system c) Nervous system (Demonstration) d) Reproductive system (Demonstration) e) Mounting- ommatidia, mouth parts, trachea & spiracles.			
2. Study of hearts (Cockroach, Shark, Frog, Calotes, Crocodile, Mammal)			
3. Study of locomotory organs (Amoeba, Cockroach, Unio, Starfish, Fish, and Birds)			
4. Study of striated and non- striated muscle fibre			
5. Ultra structure of cell organelles – (Electron micrographs) a.Nucleus b.Endoplasmic reticulum (Smooth and rough) c.Mitochondria. d.Golgi apparatus e.Lysosomes			
6. Study of permeability of cell through plasma membrane (Osmosis in blood cells).			
7. Mounting of Polytene chromosome.			
<b>Practical II Biochemistry, Chromosomal Inheritance And Cell Biology</b> <b>Paper Code: RJSUZOOP402</b>			<b>1</b>
1. Estimation of creatinine from serum/urine sample.			
2. Estimation on serum cholesterol.			
3. Study of mitosis (onion root tip)			
4. Mounting of Barr body			
5. Problems based on genetics-X-linked inheritance.			
6. Pedigree analysis(X-linked- dominant, recessive), Autosomal (dominant, recessive).			
7. Study of fossils-Trilobite, Ammonite, Archaeopteryx.			
8. Study of evidences of evolution: a. Analogy – Leg of grasshopper and leg of mammal, Wing of insect and wing of bird. b. Homology - Fore limb of amphibian and Fore limb of reptile, Wing of bird and forelimb of man.			

<b>Practical III Parasitology, Animal Husbandry And Behavioural Ethology</b> <b>Paper Code: RJSUZOOP403</b>		<b>1</b>
1. Study of endoparasites a. Protozoan parasites- <i>Trypanosoma gambiense</i> , <i>Entamoeba histolytica</i> b. Helminth parasites- <i>Ancylostoma duodenale</i> , <i>Taenia solium</i>		
2. Study of Ectoparasites: Leech, Tick, Mite		
3. Poultry – Aseel, Kadaknath, Leghorn, Rhode island red		
4. Cattle breeds- a. Cow breeds-Indigenous: Red Sindhi and Sahiwal. Exotic: Jersey, Holstein Friesian, b. Buffalo breeds- Murrah, Nagpuri and Jaffrabadi		
5. Quantitative estimation of proteins from eggs.		
6. Extraction and qualitative test of casein from milk.		
7. Measurement of density of milk samples by Lactometer.		
8. Detection of milk adulterants: starch, urea, glucose.		
9. To evaluate the quality of milk by methylene blue reduction method.		
10. Study of ethological aspects: a) Instincts b) Imprinting c) Communication in animals: Chemical signals and sound signals d) Displacement activities in animals: Courtship and mating behavior in animals and ritualization.		
11. Field visit to a natural ecosystem/dairy industry/apiary/sericulture unit and report submission		

## S.Y.B.Sc Zoology Syllabus Semester III &amp; IV

S.Y.B.Sc	Semester IV Practical
RJSUZOO401 Practical- I	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>To familiarize the learner to understand various system of invertebrate</li> <li>To make the learner understand different organ involved in different physiological mechanism.</li> <li>To make the learner observe different cell organelles using permanent slide or microphotograph.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>The learner will be able to explore different system of invertebrate.</li> <li>The learner can able to make histological analysis by studying the specimen and slides.</li> <li>Learner can able to observe and study permeability of membrane and polytene chromosome by mounting on slide.</li> </ol>

S.Y.B.Sc	Semester IV Practical
RJSUZOO402 Practical- II	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>Introduction of study of laboratory technique and diagnostic test.</li> <li>To familiarize learner to evolution with practical involving observation of specimen in the laboratory.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>The learner will be able to use instrument and kits for clinical diagnostics in pathology laboratory</li> <li>The learner can able to study cell division for different research purpose</li> </ol>

S.Y.B.Sc	Semester IV Practical
RJSUZOO403 Practical- III	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>Introduction of study of laboratory technique and diagnostic test useful for animal farming.</li> <li>To familiarize learner to parasitology with practical involving observation of specimen in the laboratory.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>The learner will be able to use instrument and technique for diagnosis of milk product and adulterants.</li> <li>The learner can able to identify and select different breeds for animal farming.</li> </ol>

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### SCHEME OF EXAMINATION (FOR BOTH SEMESTERS)

#### Internal examination

The first internal class test comprising of 20 marks shall consist of 20 multiple choice questions with equal weightage.

The second class test will comprise of three short notes- one from each unit of 4 marks each and eight questions of one mark each from all units.

#### External theory paper pattern

**Total: 60 marks**

**Q.1 Based on Unit I..... 15M**

- a. 8 M
- b. 7 M

**OR**

- a. 5 M
- b. 5M
- c. 5M

**Q.2 Based on Unit II.....15M**

- a. 8 M
- b. 7 M

**OR**

- a. 5 M
- b. 5M
- c. 5M

**Q.3 Based on Unit III.....15M**

- a. 8 M
- b. 7 M

**OR**

- a. 5 M
- b. 5M
- c. 5M

**Q.4 Short notes (mixed on all units).....15M (5marks each)**

- a or a (Unit I)
- b or b (Unit II)
- c or c (Unit III)

**EVALUATION AND ASSESSMENT:****QUESTION PAPER FOR PRACTICAL EXAMINATION****SEMESTER III****PRACTICAL I**

Total marks: 50

<b>Q.1 Major experiment</b>	12M
Urine analysis/ Dissection of earthworm digestive system	
<b>Q.2 Minor experiment</b>	08M
Detection of ammonia/uric acid	
<b>Q.3 Mounting of septal nephridium/setae/spermatheca (any one)</b>	05M
<b>Q.4 Identify and describe</b>	15M
a. One specimen from nutritional apparatus	
b. One specimen from respiratory structures	
c. One specimen from reproductive structures	
d& e. specimens from types of eggs, cleavage, blastula & gastrula	
<b>Q.5 Viva</b>	05M
<b>Q.6 Journal</b>	05M

**PRACTICAL II**

Total marks: 50

<b>Q.1 Major experiment</b>	12M
(Titration curve/pKa/Determination of unknown concentration)	
<b>Q.2 Minor experiment</b>	08M
(Preparation of buffer/Blood grouping/ Selection of ideal filter)	
<b>Q.3 Identification (any one Phenotypic trait of Drosophila)</b>	05M
<b>Q.4 a. Problems based on genetics (two problems)</b>	08M
b. <b>Problem based on molecular biology</b>	07M
<b>Q.5 Viva</b>	05M
<b>Q.6 Journal</b>	05M

**PRACTICAL III**

Total marks: 50

<b>Q.1 Major experiment</b>	12M
Detection of honey adulterants	
<b>Q.2 Mountings of honey bee (Legs/mouth parts/Sting apparatus)</b>	05M
<b>Q.3 Identification</b>	18M
a. One animal from ecosystem (biome) study	
b. One specimen from fin fish fishery	
c. One specimen from non-fin fish fishery	
d. One specimen from craft/gear	
e. Life cycle of silk moth/honey bee/ structure of beehive	
f. One specimen from economic entomology	
<b>Q.4 Report on fish market visit.</b>	05M
<b>Q.5 Viva</b>	05M
<b>Q.6 Journal</b>	05M



**QUESTION PAPER FOR PRACTICAL EXAMINATION****SEMESTER IV****PRACTICAL I**

Total marks: 50

<b>Q.1 Major experiment</b>	12M
(Osmosis/Polytene chromosome/Digestive system of cockroach)	
<b>Q.2 Minor experiment</b>	08M
(Mountings of cockroach- Spiracles/ cornea/ mouth parts)	
<b>Q.3 Identification</b>	15M
a. One specimen from study of hearts	
b& c. Specimens from locomotary organs and muscles	
d& e. Electron micrographs of cell organelles	
<b>Q.4 Viva</b>	05M
<b>Q.5 Journal</b>	05M

**PRACTICAL II**

Total marks: 50

<b>Q.1 Major experiment</b>	12M
Estimation of creatinine/cholesterol	
<b>Q.2 a. Problem based on genetics.</b>	06M
<b>b. Problem based on pedigree analysis</b>	05M
<b>Q.3 Minor experiment</b>	08M
Mitosis/ Barr body mounting	
<b>Q.4 Identification based on evidences of evolution</b>	09M
a, b and c (fossils, homology & analogy)	
<b>Q.5 Viva</b>	05M
<b>Q.6 Journal</b>	05M

**PRACTICAL III**

Total marks: 50

<b>Q.1 Major experiment</b>	12M
Estimation of protein/milk adulterants	
<b>Q.2 Minor experiment</b>	08M
Extraction of casein/MBRT/Lactometer	
<b>Q.3 Identification</b>	12M
a. One example from Protozoan/Helminth parasite	
b. One example from ectoparasites	
c. One example of poultry breed	
d. One example of cattle/buffalo breed	
e& f. examples from ethology	
<b>Q.4 Report on field visit.</b>	08M
<b>Q.5 Viva</b>	05M
<b>Q.6 Journal</b>	05M



Hindi Vidya Prachar Samiti's  
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**Refer to page no: 02**  
**highlighting component**  
**of Research Project**

Syllabus for F.Y.B.Sc.  
Program: B.Sc. Zoology  
Program Code: RJSUZOO  
(CBCS 2021-22)

## DISTRIBUTION OF TOPICS AND CREDITS

## F.Y.B.Sc. ZOOLOGY SEMESTER I

Course code	Nomenclature	Credits	Topic
RJSUZOO101	Animal Diversity-I, Ecology- I and Biodiversity & Conservation	02	1. Levels of organization and classification of animal kingdom-I
			2. Ecology-I
			3. Biodiversity and Conservation
RJSUZOO102	Biomolecules-I, Basic Biotechnology and Laboratory safety & Measurement	02	4. Biomolecules-I
			5. Basic Biotechnology
			6. Laboratory safety, Units and Measurement
RJSUZOOP101 & RJSUZOOP102.	Practical I & II	02	Practicals based on Paper I and II

## F.Y.B.Sc. ZOOLOGY SEMESTER II

Course code	Nomenclature	Credits	Topic
RJSUZOO201	Animal Diversity II, Ecology-II & Ethology	02	7. Classification of Animal kingdom-II
			8. Ecology-II
			9. Basics of ethology
RJSUZOO202	Biomolecules-II, Health ,Hygiene and Health Hazards & Instrumentation	02	10. Biomolecules-II
			11. Health, Hygiene and Health hazards
			12. Instrumentation
RJSUZOOP201 & RJSUZOOP202.	Practical I & II	02	Practicals based on Paper I and II

<b>SEMESTER-I (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper- I Animal Diversity-I, Ecology- I and Biodiversity &amp; Conservation</b> <b>Paper Code: RJSUZOO101</b>		<b>45</b>	<b>2</b>
<b>UNIT I</b>		<b>15</b>	
<b>Levels of organization and classification of animal kingdom-I</b>			
1	<p><b>1.1: Levels of organization</b></p> <p>1.1.1: Unicellularity vs. multicellularity: Colonization and organization of germ layers (Diploblastic and triploblastic condition).</p> <p>1.1.2: Division of labour and organization of tissues (brief fate of ectoderm, mesoderm and endoderm).</p> <p>1.1.3: Development of coelom: acoelomate, pseudo coelomate and eucoelomate.</p> <p>1.1.4: Types of symmetry: Asymmetry, Radial and bilateral symmetry.</p> <p>1.1.5: Segmentation and cephalization.</p> <p><b>1.2: Salient features with examples of phyla, subphyla and classes mentioned below</b></p> <p>1.2.1: Multicellular organization: Colonization level- Phylum Porifera.</p> <p>1.2.2: Multicellular organization: Division of labour (cell differentiation)- Phylum Coelenterata.</p> <p>1.2.3: Acoelomate organization - Phylum Platyhelminthes.</p> <p>1.2.4: Pseudo coelomate organization - Phylum Nematelminthes.</p> <p>1.2.5: Triploblastic coelomate organization</p> <p>a) Animals with metameric segmentation- Phylum Annelida.</p> <p>b) Animals with jointed appendages- Phylum Arthropoda.</p> <p>c) Animals with mantle- Phylum Mollusca.</p> <p>d) Animals with enterocoel-Phylum Echinodermata.</p>		
<b>UNIT II</b>		<b>15</b>	
<b>Ecology-I</b>			
2	<p><b>2.1 Overview of Ecology</b></p> <p><b>2.2 Physical Factors:</b></p> <p>2.2.1 Edaphic: Soil formation, Components of Soil, Types of soil and Soil Profile.</p> <p>2.2.2 Light: Relation to terrestrial and aquatic habitat, photoperiodism, diurnal migrations, adaptations of animals to dark.</p> <p>2.2.3 Temperature: range, tolerance, Bergman's Principle, Allen's Rule, effects of temperature on living organisms.</p> <p>2.2.4 Biogeochemical Cycles: oxygen, carbon, sulphur, nitrogen, phosphorus, human activities affecting biogeochemical cycles.</p>		
<b>UNIT III</b>		<b>15</b>	
<b>Biodiversity and Conservation</b>			
3	<p><b>3.1: Introduction to Biodiversity</b> - Definition, Concept and Scope.</p> <p><b>3.2: Levels of Biodiversity</b> -Genetic, Species and Ecosystem Biodiversity.</p> <p><b>3.3: Biodiversity Hotspots</b>- Western Ghats and Indo-Burma Border.</p>		

F.Y.B.Sc Zoology Syllabus Semester I & II

	<p><b>3.4: Threats to Biodiversity</b> - Habitat loss and Man-Wildlife conflict.</p> <p><b>3.5: Biodiversity Conservation and Management:</b></p> <p>3.5.1: Conservation strategies: <i>in situ</i>, <i>ex-situ</i>, National parks, Sanctuaries and Biosphere reserves.</p> <p>3.5.2: International efforts : Convention on Biological Diversity (CBD), International Union for Conservation of Nature and Natural Resources (IUCN), United Nations Environment Program - World Conservation Monitoring Centre (UNEP-WCMC).</p>		
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F.Y.B.Sc	Semester I Theory
<p>RJSUZOO101</p> <p>Paper- I</p> <p>Animal Diversity-I, Ecology- I and Biodiversity &amp; Conservation</p>	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To introduce the basic structural organization and classification of living organisms.</li> <li>2. To understand the concepts of ecology.</li> <li>3. To familiarize the learners with the biodiversity and strategies of conservation.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. The learners will be able identify and associate the phylum with specific structural organization.</li> <li>2. Learners will understand the interaction and effects of various biotic and abiotic factors.</li> <li>3. Learners will perceive the significance of biodiversity and its conservation.</li> </ol>

## F.Y.B.Sc Zoology Syllabus Semester I &amp; II

<b>SEMESTER-I (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper- II Biomolecules-I, Basic Biotechnology And Laboratory Safety &amp; Measurement</b>		<b>45</b>	<b>2</b>
<b>Paper Code: RJSUZOO102</b>			
<b>UNIT I</b>		<b>15</b>	
<b>Biomolecules-I</b>			
1	<p><b>1.1: Basic biochemistry:</b> Concept of monomers &amp; polymers, Role and significance of carbon, types of chemical bonds. Water- role as universal solvent, properties of water.</p> <p><b>1.2: Carbohydrates</b>            1.2.1: Nomenclature and isomerism.            1.2.2: Glycosidic bond.            1.2.3: Classification of carbohydrate.                a. Monosaccharides- galactose &amp; fructose                b. Disaccharides- sucrose &amp; lactose                c. Polysaccharides- Starch, cellulose, glycogen, chitin            1.2.4: Biological role of carbohydrates.</p> <p><b>1.3:Nucleic Acids</b>            1.3.1: Structure (structure of purine &amp; pyrimidine bases, hydrogen bonding between nitrogenous bases in DNA, structure of nucleosides, nucleotides and polynucleotides) &amp; functions of nucleic acids.            1.3.2: Properties and types of DNA (A, B, &amp; Z) &amp; RNA.            1.3.3: Differences between DNA and RNA.</p>		
<b>UNIT II</b>		<b>15</b>	
<b>Basic Biotechnology</b>			
2	<p><b>2.1: Concept of Biotechnology</b>            2.1.1: Definition            2.1.2: An overview of achievements and scope (fishery, animal husbandry, medical, industrial, agriculture).</p> <p><b>2.2: Transgenesis and cloning</b>            2.2.1 Methods of transgenesis: Retroviral method, nuclear transplantation method, DNA micro injection method and embryonic stem cell method.            2.2.2. Animal Cloning (Dolly experiment).            2.2.3 Ethical issues of transgenic and cloned animals.</p> <p><b>2.3: Applications of Biotechnology</b>            2.3.1 Forensic biotechnology: DNA fingerprinting; Technique in brief and its application in forensic science (Crime Investigation).            2.3.2: Enzyme Technology:                a. Bio-detergents</p>		

## F.Y.B.Sc Zoology Syllabus Semester I &amp; II

	<p>b. Concept of enzyme immobilization.</p> <p>c. Enzymes as meat tenderizer.</p> <p>2.3.3: Medical biotechnology:</p> <p>a. Recombinant DNA in medicines (recombinant insulin).</p> <p>b. Gene therapy: Ex-vivo and <i>In vivo</i>, Severe Combined Immunodeficiency (SCID), Cystic Fibrosis.</p> <p>2.3.4: Environmental Biotechnology:</p> <p>a. Bioremediation: Concepts and applications.</p> <p>b. Biodegradation of polycyclic aromatic hydrocarbons (PAHs) and petrochemicals.</p>		
	<b>UNIT III</b>	<b>15</b>	
	<b>Laboratory safety, Units and Measurement</b>		
3	<p><b>3.1: Introduction to good laboratory practices.</b></p> <p><b>3.2: Use of safety symbols:</b> meaning, types of hazards and precautions.</p> <p><b>3.3: Units of measurement:</b></p> <p>3.3.1: Calculations and related conversions of each: Metric system- length (meter to micrometer); weight (gram to microgram), Volumetric (cubic measures)</p> <p>3.3.2: Temperature: Celsius, Fahrenheit, Kelvin.</p> <p>3.3.3: Concentrations: percent solutions, ppt, ppm, ppb dilutions, normality, molarity and molality.</p> <p><b>3.4: Biostatistics:</b> Introduction and scope, sampling and its types, central tendencies (mean, median, and mode) tabulation, graphical representations (histograms, bar diagrams, pie diagrams).</p>		

F.Y.B.Sc	Semester I Theory
<p>RJSUZOO102</p> <p>Paper- II</p> <p>Biomolecules- I, Basic Biotechnology And Laboratory Safety &amp; Measurement</p>	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>To appreciate the structure and function of biomolecules.</li> <li>To introduce the concept of biotechnology and the techniques involved in transgenesis and cloning.</li> <li>To introduce the basic laboratory techniques and biostatistics.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>The learners will understand the structure- function relationship.</li> <li>Learners will comprehend the methods of transgenesis and various ethical issues associated with it. They will get familiarized with the applications of biotechnology.</li> <li>Learners will understand the importance of accuracy, precision and reproducibility in experiments. Use of different statistical methods of representation of biological data.</li> </ol>

<b>SEMESTER-II (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper I- Animal Diversity II, Ecology II &amp; Ethology</b>		<b>45</b>	<b>2</b>
<b>Paper Code: RJSUZOO201</b>			
<b>UNIT I</b>		<b>15</b>	
<b>Classification of Animal kingdom-II</b>			
1	<p><b>1.1: Phylum Hemichordata</b></p> <p><b>1.2: Phylum Chordata</b></p> <p>1.2.1: Subphylum: Urochordata</p> <p>1.2.2: Subphylum: Cephalochordata</p> <p>1.2.3: Subplylum: Vertebrata</p> <p>I. Division: Agnatha; Class Cyclostomata</p> <p>II. Division: Gnathostomata</p> <p><b>A. Super class: Pisces</b></p> <p>i . Class Chondrichthyes</p> <p>ii. Class Osteichthyes</p> <p><b>B. Super class: Tetrapoda</b></p> <p>i. Class Amphibia</p> <p>ii. Class Reptilia</p> <p>iii. Class Aves</p> <p>iv. Class Mammalia</p>		
<b>UNIT II</b>		<b>15</b>	
<b>Ecology-II</b>			
2	<p><b>2.1: Concepts of Ecosystem:</b> Components of ecosystem, energy flow in ecosystem, food chain and food web, energy pyramids.</p> <p><b>2.2: Population Ecology:</b> Concept, Factors influencing population dynamics: natality, mortality, migration, density, age structure and sex ratio, fecundity, growth curves and survivorship curves.</p> <p><b>2.3: Animal Interactions:</b> Concept, Positive and negative interactions, ecological significance.</p>		
<b>UNIT III</b>		<b>15</b>	
<b>Basics of Ethology</b>			
3	<p><b>3.1: Development of Behaviour:</b> Ontogeny of behaviour, sensitive periods during development e.g bird song development.</p> <p><b>3.2: Innate behaviour:</b> Fixed Action Plan, orientation, taxes, irritability.</p> <p><b>3.3: Learned behaviour:</b> Conditioned reflex, habituation, sensitization, instrumental learning and operant behaviour.</p> <p><b>3.4: Protective behaviour:</b> Camouflage, warning colouration, Mimicry- Batesian &amp; Mullerian, adaptive &amp; evolutionary significance of mimicry.</p>		



## F.Y.B.Sc Zoology Syllabus Semester I &amp; II

<b>F.Y.B.Sc</b>	<b>Semester II Theory</b>
RJSUZOO201  Paper- I  Animal Diversity II, Ecology II & Ethology	<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To understand taxonomy of higher and lower chordates.</li><li>2. To introduce concepts of population ecology.</li><li>3. To familiarize the learners with basics of ethology.</li></ol> <b>Learning Outcomes:</b> <ol style="list-style-type: none"><li>1. The learners will be able identify and associate the phylum with specific structural organization.</li><li>2. Learners will understand the significance of population dynamics.</li><li>3. Learners will appreciate the evolution of behavior and its various types.</li></ol>

<b>SEMESTER-II (THEORY)</b>		<b>L</b>	<b>Cr</b>
<b>Paper II- Biomolecules-II, Health, Hygiene And Health Hazards &amp; Instrumentation</b>		<b>45</b>	<b>2</b>
<b>Paper Code: RJSUZOO202</b>			
<b>UNIT I</b>		<b>15</b>	
<b>Biomolecules-II</b>			
1	<p><b>1.1: Lipids</b></p> <p>1.1.1: Classification of Lipids</p> <p>1.1.2: Types of Fatty Acids (Saturated &amp; Unsaturated)</p> <p>1.1.3: Biological roles of lipids</p> <p>1.1.4: Overview of Phospholipids, Glycerides (mono, di &amp; tri)</p> <p><b>1.2: Proteins</b></p> <p>1.2.1: Amino acids- basic structure, types based on carboxylic, amino &amp; aromatic groups, essential, semi-essential &amp; non-essential amino acids, amino acid pool.</p> <p>1.2.2: Peptide bond.</p> <p>1.2.3- Structure of protein- primary, secondary, tertiary and quaternary</p> <p>1.2.4- Biological role of proteins</p> <p><b>1.3: Vitamins</b></p> <p>1.3.1: Types &amp; Classification (water soluble &amp; lipid soluble).</p> <p>1.3.2: Functions of vitamins</p>		
<b>UNIT II</b>		<b>15</b>	
<b>Health, Hygiene &amp; Health Hazard</b>			
2	<p><b>2.1: Health</b></p> <p>2.1.1: Definition of Health, need for health education.</p> <p>2.1.2: Physical, psychological and social health issues.</p> <p>2.1.3: Water and water supply, standards of potable water.</p> <p>2.1.4: Purification of water: small scale, medium scale and large scale (rapid sand filters)</p> <p>2.1.5: Water footprint: concept, brief account and significance.</p> <p><b>2.2: Hygiene</b></p> <p>2.2.1: Hygiene and health factors at home.</p> <p>2.2.2: Personal hygiene, oral hygiene and sex hygiene.</p> <p><b>2.3: Health Hazards</b></p> <p>2.3.1: Radiation risk: Mobile cell tower and electronic gadgets (data of recommended level, effects and precaution).</p> <p>2.3.2: Ill-effects of self-medication.</p>		
<b>UNIT III</b>		<b>15</b>	
<b>Instrumentation</b>			
3	<p><b>3.1: Microscope</b> (dissecting and compound): Principle, SOP and applications.</p> <p><b>3.2: Analytical balance:</b> Principle, SOP and applications.</p> <p><b>3.3: Colorimetry and spectroscopy:</b> Principle, SOP and applications.</p> <p><b>3.4: pH meter:</b> Principle, SOP and applications.</p>		

## F.Y.B.Sc Zoology Syllabus Semester I &amp; II

	<p><b>3.5: Centrifuge</b> (clinical and ultra-centrifuge): Principle, SOP and applications.</p> <p><b>3.6: Electrophoresis</b> (AGE, PAGE): Principle, SOP and applications.</p> <p><b>3.7: Instruments for sterilization:</b> Autoclave, Incubator, Laminar overflow: Principle, SOP and applications.</p> <p><b>3.8: Chromatography</b> (paper, TLC, adsorption): Principle and applications.</p>		
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F.Y.B.Sc	Semester II Theory
<p>RJSUZOO202</p> <p>Paper- II</p> <p>Biomolecules-II, Health, Hygiene And Health Hazards &amp; Instrumentation</p>	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>1. To appreciate the structure and function of biomolecules.</li> <li>2. To comprehend various health problem arising due to unhygienic conditions.</li> <li>3. To introduce the principle of laboratory instruments their use and maintenance.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>1. The learners will understand the structure function relationship of lipids and proteins.</li> <li>2. Learners will inculcate good personal and public sanitary habits. They will be aware of effects of excessive use of gadgets.</li> <li>3. Learners will know the use of various instruments in a scientific inquiry.</li> </ol>

SEMESTER-I (PRACTICALS)		L	Cr
<b>Practical I- Animal Diversity-I, Ecology- I and Biodiversity &amp; Conservation</b> <b>Paper Code: RJSUZOOP101</b>			<b>1</b>
<b>1. Levels of organization in Animal kingdom</b> A) Symmetry: i) Asymmetric organization: <i>Amoeba</i> , ii) Radial symmetry: Sea anemone, <i>Aurelia</i> iii) Bilateral symmetry: <i>Planaria</i> B) Acoelomate: T.S. of <i>Planaria</i> C) Pseudocoelomate: T.S. of <i>Ascaris</i> 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			
<b>2. Animal Diversity -I</b> <ul style="list-style-type: none"> <li>• Porifera: <i>Leucosolenia</i>, Bath sponge</li> <li>• Coelenterate: <i>Hydra</i>, <i>Obelia</i> colony, <i>Aurelia</i>, Sea anemone and coral (anyone)</li> <li>• Platyhelminthes: <i>Planaria</i>, Liver fluke and Tapeworm</li> <li>• Nematelminthes: <i>Ascaris</i>- male and female</li> <li>• Annelida: <i>Nereis</i>, Earthworm and Leech</li> <li>• Arthropoda: Lobster, <i>Lepisma</i>, Beetle, Butterfly, Moth, Spider, Centipede, Millipede</li> <li>• Mollusca: <i>Chiton</i>, <i>Dentalium</i>, <i>Pila</i>, Bivalve, <i>Sepia</i> and <i>Nautilus</i></li> <li>• Echinodermata: Starfish, Brittle star, Sea urchin, Sea cucumber, Feather star.</li> </ul>			
3. Determination of soil pH: by pH meter, universal indicator, pH paper.			
4. Estimation of salinity by refractometer.			
5. Study of Biodiversity hotspots using world map.			
6. Study of peculiar animals found in the world biodiversity hotspots.			
7. Field visit and report submission.			
<b>Practical II - Biomolecules-I, Basic Biotechnology And Laboratory Safety &amp; Measurement</b> <b>Paper Code: RJSUZOOP102</b>			<b>1</b>
1. Qualitative tests for carbohydrates.			
2. Extraction and qualitative detection of nucleic acids: <ul style="list-style-type: none"> <li>• DNA (SDS-NaCl extraction),</li> <li>• RNA (Phenol extraction)</li> </ul>			
3. Aseptic techniques: Packaging of test tubes, pipettes, petriplates, conical flask.			
4. Aseptic transfer of liquids between burners. (Demonstration)			

## F.Y.B.Sc Zoology Syllabus Semester I &amp; II

5. Assay of immobilized invertase from immobilised yeast cells by DNSA method		
6. (visual observation for comparative colour intensity in test tube)		
7. To demonstrate fermentation of grape juice/sugar cane juice or any fruit juice – (Detection of alcohol generated during fermentation by benzoic acid).		
8. Effect of Papain (raw papaya extract) as a meat tenderizer.		
9. Study of central tendencies and plotting of bar diagram, histogram and pie diagram.		
10. Problem based on concentrations: percent solutions, normality, molarity.		

F.Y.B.Sc	Semester I Practical
RJSUZOO101 RJSUZOO102  Practical- I & II	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>To study the animal classification.</li> <li>To perform soil and water analysis of selected parameters.</li> <li>To understand the significance of qualitative estimation. To get trained in sterilization techniques.</li> </ol> <p><b>Learning Outcomes:</b></p> <ol style="list-style-type: none"> <li>The learners should identify and classify the animals based on their external features into phylum and class.</li> <li>The learners will develop the analytical thinking and calculation skills.</li> <li>A short excursion will inculcate the discipline and experience of field work.</li> </ol>

SEMESTER-II (PRACTICALS)		L	Cr
<b>Practical I- Animal Diversity II, Ecology II &amp; Ethology</b> <b>Paper Code: RJSUZOOP201</b>			<b>1</b>
<b>1. Animal Diversity-II</b> a) Hemichordata: <i>Balanoglossus</i> b) Urochordata: <i>Herdmania</i> c) Cephalochordata: <i>Amphioxus</i> d) Cyclostomata: <i>Petromyzon</i> e) Pisces: Chondrichthyes: Shark, Sting ray Osteichthyes: <i>Sciaena, Synagris</i> f) Amphibia: <i>Caecilian</i> , Salamander, Frog, Toad, g) Reptilia: Turtle, Chameleon, Cobra, Crocodile. h) Aves: Kite, Kingfisher, Duck i) Mammalia: Platypus, Kangaroo, Shrew, Dolphin, Bat.			
<b>2. Determination of population density;</b> a. Subsampling method using <i>Daphnia</i> . b. Capture-recapture method using rice weevil			
<b>3. Interpretation of the given graphs/ tables and comment on pattern of population nature:</b> a) Survivorship curve b) Age structure c) Sex ratio			
4. Calculation of natality, mortality, fecundity w.r.t. population studies.			
5. Interpretation of Growth curves (Sigmoid and J shaped).			
<b>6. Study of animal interaction:</b> a) Commensalism: Hermit crab and sea anemone, <i>Echinus</i> and shark b) Mutualism: Termite and <i>Trichonympha</i> c) Antibiosis: Effect of antibiotic on bacterial growth on a petri plate d) Parasitism: Ectoparasite – head louse and bed bug Endoparasite: <i>Trichinella spiralis</i> e) Predation: Praying mantis and spider			
7. Study of Mimicry: Leaf insect, stick insect, Dead leaf butterfly ( <i>Kallima</i> ), Monarch butterfly and common tiger butterfly (Danoids).			
8. Study of Warning Colouration in animals: Coral snake, strawberry poison dart frog, chameleon, honey badger, blue ring octopus.			

<b>Practical II - Biomolecules-II, Health, Hygiene And Health Hazards &amp; Instrumentation</b>		<b>1</b>
<b>Paper Code: RJSUZOOP202</b>		
1. Qualitative tests for proteins.		
2. Separation of amino acids by paper chromatography.		
3. Thin layer chromatography of lipids		
4. Qualitative tests for lipids.		
5. Qualitative estimation of Vitamin C by Iodometric method.		
6. Study of Microscope: Use, care and functions of its components.		
7. Study of microbial flora of water by Gram's staining.		
8. Estimation of total hardness of water.		
9. Handling of common laboratory equipment: Burner, balance, homogenizer, colorimeter, pH meter, centrifuge.		
10. Sterilization techniques: Autoclave, Oven, Laminar air flow.		
11. Electrophoresis apparatus: AGE, PAGE.		
12. Adsorption (Column) chromatography using chalk to separate mixture of dye.		

F.Y.B.Sc	Semester II Practical
RJSUZOOP201 RJSUZOOP202  Practical- I & II	<p><b>Course Objectives:</b></p> <ol style="list-style-type: none"> <li>To classify animals into different phyla and class based on external morphology.</li> <li>To introduce methods used in population density.</li> <li>To identify different associations of animals.</li> <li>To gets hands on training on basic laboratory instruments.</li> <li>To familiarize the learners with chromatography techniques.</li> </ol> <p><b>Expected Outcome:</b></p> <ol style="list-style-type: none"> <li>The learners will identify the animals and classify them.</li> <li>Learners will be able to calculate basic parameters used in population studies.</li> <li>Learners will know the use of various instruments used in a scientific inquiry.</li> <li>Learners will know the use and application of different chromatography techniques.</li> </ol>

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**SCHEME OF EXAMINATION (FOR BOTH SEMESTERS)**

**Internal examination**

The first internal class test comprising of 20 marks shall consist of 20 multiple choice questions with equal weightage.

The second class test will comprise of three short notes- one from each unit of 4 marks each and eight questions of one mark each from all units.

**External theory paper pattern Total: 60 marks**

**Q.1 Based on Unit I..... 15M**

- a. 8 M
- b. 7 M

**OR**

- a. 5 M
- b. 5M
- c. 5M

**Q.2 Based on Unit II.....15M**

- a. 8 M
- b. 7 M

**OR**

- a. 5 M
- b. 5M
- c. 5M

**Q.3 Based on Unit III.....15M**

- a. 8 M
- b. 7 M

**OR**

- a. 5 M
- b. 5M
- c. 5M

**Q.4 Short notes (mixed on all units).....15M (5marks each)**

- a or a (Unit I)
- b or b (Unit II)
- c or c (Unit III)

**EVALUATION AND ASSESSMENT:**

**QUESTION PAPER FOR PRACTICAL EXAMINATION**

**SEMESTER I- PRACTICAL I**

Total marks: 50

<b>Q.1 Major experiment-</b> Soil pH/ Salinity of water	08M
<b>Q.2 Identify and comment on the level of organization.</b> (Symmetry /coelom/segmentation/cephalization)	03M
<b>Q.3 Identify and Classify with reasons.</b>	15M
a. One specimen from Porifera/Coelenterata	
b. One specimen from Platyhelminthes/Nemathelminthes	
c. One specimen from Annelida/Arthropoda	
d. One specimen from Mollusca	
e. One specimen from Echinodermata	
<b>Q.4 Identification of Biodiversity hotspots using map/peculiar animals of hotspots.</b>	04M
<b>Q.5 Field report</b>	10M
<b>Q.6 Viva</b>	05M
<b>Q.7 Journal</b>	05M

**PRACTICAL II**

Total marks: 50

<b>Q.1 Major experiment-</b> Extraction of DNA/RNA/ Assay of immobilized enzyme	12M
<b>Q.2 Minor experiment-</b> Fermentation/Papain as meat tenderizer/aseptic techniques	08M
<b>Q.3 Problems based on biostatistics</b>	10M
a. Central tendency	
b. Graphical presentation of data	
<b>Q.4 Problems based on concentration calculations</b>	10M
a. % solutions	
b. Normality/ Molarity	
<b>Q.5 Viva</b>	05M
<b>Q.6 Journal</b>	05M

**QUESTION PAPER FOR PRACTICAL EXAMINATION**

**SEMESTER II- PRACTICAL I**

Total marks: 50

<b>Q.1 Major Experiment</b>	09M
Estimation of population density of <i>Daphnia</i> / Rice weevil	
<b>Q.2 Identify and classify with reasons.</b>	12M
a. Any one specimen from Hemichordata/Urochordata/Cephalochordata	
b. Any one specimen from Cyclostomata/ Pisces	
c. Any one specimen from Amphibia/ Reptiles	
d. Any one specimen from Aves/Mammals	
<b>Q.3 Identify and Comment on</b>	09M
a. One specimen from Mimicry	
b. One specimen from warning colouration	
c. One specimen from animal interaction.	
<b>Q.4 Problems based on population ecology (2 problems)</b>	10M
(Natality/Mortality/Fecundity/Sex ratio)	
<b>Q.5 Viva</b>	05M
<b>Q.6 Journal</b>	05M

**PRACTICAL II**

Total marks: 50

<b>Q.1 Major experiment</b> – Paper chromatography/ Grams staining/Hardness	12M
<b>Q.2 Minor experiment</b>	
a. Chromatography (Column/TLC)	07M
b. Qualitative tests (Lipids/Vitamin C/Proteins)	05M
<b>Q.3 Identify and describe the principle/working/uses.</b>	16M
a, b, c & d (Any 4 instruments studied in practical)	
<b>Q.4 Viva</b>	05M
<b>Q.5 Journal</b>	05M