

**SCIENCE FACULTY**

**NORTH MAHARASHTRA UNIVERSITY, JALGAON**



**SYLLABUS**

**FOR**

**T. Y. B. Sc.**

**Zoology**

**(With effect from June - 2017)**

**North Maharashtra University, Jalgaon**  
**T.Y.B.Sc. (Zoology) Syllabus structure w.e.f. June 2017**

Semester	Paper	Course code	Course Title	Period	Marks		
					UA	CA	
<b>V</b>	<b>I</b>	Zoo 351	Non-chordates III	60	60	40	
	<b>II</b>	Zoo 352	Cell and Molecular biology	60	60	40	
	<b>III</b>	Zoo 353	Mammalian Histology and Physiology I	60	60	40	
	<b>IV</b>	Zoo 354	Biochemistry	60	60	40	
	<b>V</b>	Zoo 355	Systematics, Evolution and Palaeontology	60	60	40	
	<b>VI</b>		Zoo 356	A) Biotechnology	60	60	40
				B) Pest management	60	60	40
				C) Public health and hygiene	60	60	40
	<b>VII Practical I</b>	Zoo 357	Practicals related to Zoo 351 and Zoo 353	60	60	40	
<b>VIII Practical II</b>	Zoo 358	Practicals related to Zoo 352 and Zoo 355	60	60	40		
<b>IX Practical III</b>	Zoo 359	Practicals related to Zoo 354 and Zoo 356	60	60	40		

**North Maharashtra University, Jalgaon**  
**T.Y.B.Sc. (Zoology) Syllabus structure w.e.f. June 2017**

Semester	Paper	Course code	Course Title	Period	Marks	
					UA	CA
VI	I	Zoo 361	Chordates III	60	60	40
	II	Zoo 362	General Embryology	60	60	40
	III	Zoo 363	Mammalian Histology and Physiology II	60	60	40
	IV	Zoo 364	Research Methodology	60	60	40
	V	Zoo 365	Microtechnique	60	60	40
	VI	Zoo 366	A) Bioinformatics	60	60	40
			B) Sericulture	60	60	40
			C) Applied Zoology III (Vermiculture, Poultry and Fisheries)	60	60	40
	VII Practical I	Zoo 367	Practicals related to Zoo 361 and Zoo 363	60	60	40
VIII Practical II	Zoo 368	Practicals related to Zoo 362 and Zoo 365	60	60	40	
IX Practical III	Zoo 369	A) Practical related to Zoo 364 , Zoo 366 and Project work	60	15+ 30+ 15= 60	30+ 10 (Project)	

**T. Y. B. Sc. (Zoology) Syllabus w.e.f. June 2017**  
**Semester V, Paper I - ZOO 351**  
**Non-Chordate - III**

Units	Topic	Periods	Marks
1.	<b>Leech- As an animal type <i>Hirudinaria granulosa</i></b> 1.1 Systematic position, Habits and Habitat 1.2 External Characters 1.2.1 Shape, Size and Colouration 1.2.2 Segmentation and Suckers 1.2.3 Body regions or division 1.3 Locomotion – Crawling and Swimming	24	24
2	<b>Digestive system</b> 2.1 Alimentary canal 2.2 Food, feeding and digestion		
3	<b>Haemocoelomic System</b> 3.1 Haemocoelomic fluid 3.2 Haemocoelomic channels 3.3 Capillary system 3.4 Course of circulation		
4	<b>Excretory System</b> 4.1 Testicular nephridia 4.2 Pre- testicular nephridia 4.3 Physiology of excretion		
5	<b>Nervous System</b> 5.1 Central nervous system 5.2 Peripheral nervous system 5.3 Sense Organs –Free nerve endings, Annular receptors, Segmental receptors and Eyes		
6	<b>Reproductive System</b> 6.1 Male reproductive System 6.2 Female reproductive system 6.3 Copulation and Fertilization 6.4 Cocoon formation and development		
7	<b>Economic importance</b> 7.1 As a Food, Predator, Pest, Transmitter of diseases, Surgical agent etc.		

<b>8</b>	<b>Grasshopper- As an animal type <i>Heiroglyphus banian</i></b> <b>Study of grasshopper w. r. t. following:-</b> 8.1 Systematic position habit & habitat 8.2 External characters - Shape-size and colour, Division of body – Head, thorax and abdomen.	<b>24</b>	<b>24</b>
<b>9</b>	<b>Digestive System</b> 9.1 Alimentary canal 9.2. Digestive glands, 9.3. Feeding and Digestion.		
<b>10</b>	<b>Circulatory system of grasshopper</b> 10.1.Haemocoel, 10.2 Haemolymph, 10.3.Heart and aorta, 10.4. Circulation of blood.		
<b>11</b>	<b>Respiratory system of grasshopper</b> 11.1Spiracles, 11.2. Trachea.		
<b>12</b>	<b>Excretory System of Grasshopper.</b>		
<b>13</b>	<b>Nervous system of grasshopper.</b> 13.1. Central Nervous system. 13.2. Peripheral nervous system.		
<b>14</b>	<b>Reproductive system of grasshopper</b> 14.1 Male reproductive system 14.2 Female reproductive system. 14.3 Development		
<b>15</b>	<b>General Topics</b> 15.1 Osmoregulation in Protozoa 15.2 Polymorphism in Siphonophora 15.3 Pearl formation 15.4 Pedicellariae in Echinodermata	<b>12</b>	<b>12</b>
<b>Total</b>		<b>60</b>	<b>60</b>

## **Practical corresponding to Non-Chordates (Zoo-351)**

**To Study of following with the help of charts/ models/ simulations etc**

1. Systematic position and External characters of Leech (*Hirudinaria granulosa*)
2. Digestive system of Leech
3. Male and female reproductive system of Leech
4. Nervous system of Leech.
5. Permanent slides of -Jaws, botryoidal tissue, salivary glands, testicular nephridia of Leech
6. Study of Pedicellariae of Echinoderms
7. Study of external characters and sexual dimorphism of grasshopper
8. Study of digestive system of grasshopper
9. Study of heart and aorta of grasshopper
10. Study of nervous system of grasshopper
11. Study of male and female reproductive system of grasshopper
12. Study of haemocytes, mouthparts, trachea, spiracles, cornea and antenna of grasshopper
13. Field visit to sea shore/ water body

## **Reference Books on Non-Chordates (Zoo-351)**

1. Annelida by R.L.Kotpal, Rastogi Publication.
  2. Invertebrate Zoology by E.L.Jorden, S.C.Chand, New Delhi.
  3. The invertebrates Hymen L. H. MacGraw Hill.
  4. Life of Invertebrates- S.N. Prasad.
  5. A Text book of Zoology – R.D.Vidyarthi.
  6. Invertebrate Zoology -Dhami and Dhami.
  7. The Invertebrates -Barnes R. O., W. B. Saunders & Co.
  8. Modern Textbook of Zoology- R.L. Kotpal, Rastogi Publication Meerut. X Edition.
  9. Invertebrate Zoology Practical- K. Pande and J.P. Shukla.
  10. Invertebrate Zoology Practical- S. M. Lall.
  11. A Textbook of Zoology: Invertebrates Vol I, Marshall and William CBS Publishers, New Delhi.
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# T. Y. B. Sc. (Zoology) Syllabus w.e.f. June 2017

## Semester V Paper II- Zoo 352

### Cell and Molecular Biology

Unit	Topics	Periods	Marks
1.	<b>Introduction to Cell biology and Molecular Biology</b>	02	02
2.	<b>Prokaryotic and eukaryotic cells</b> a) General organization of prokaryotic and eukaryotic cell (Typical animal cell). b) Structure of plasma membrane: i. Bilayer model of Danielli and Davson. ii. Unit membrane model of Robertson and iii. Fluid mosaic model. c) Functions of plasma membrane. d) Study of cell organelles with reference to ultra structure and functions of : i. Nucleus ii. E. R., iii. Golgi bodies, iv. Lysosomes and v. Mitochondria.	09	09
3.	<b>Cell cycle and cell divisions</b> a. Stages of cell cycle – G <sub>1</sub> , S, G <sub>2</sub> and M-Phase. b. Cell division – i. Definition, ii. Stages of mitosis and its significance, iii. Stages of meiosis and its significance c. Distinguish between mitosis and meiosis.	08	08
4.	<b>Cell Signaling and Cancer</b> a. Categories of signaling: i. Endocrine, ii. Paracrine, iii. Autocrine and iv. Juxtacrine. b. Cancer: i. introduction, ii. Benign and Malignant tumour, iii. Properties of cancer cells and iv. Apoptosis.	08	08
5.	<b>Nucleic Acid</b> a. Chemical composition of DNA and RNA b. Watson and Crick model of DNA molecule. c. Different forms of DNA (B, A and Z-form). d. Properties of DNA: Acid-base, Viscosity, Sedimentation behavior, Denaturation and renaturation, Molecular weight).	10	10

	e. DNA replication – semi conservative, Conservative and dispersive. f. RNA: i. Genetic RNA: RNA tumor virus – RSV and HIV. ii. Non- genetic RNA- mRNA, tRNA and rRNA; their structure and functions;		
<b>6.</b>	<b>Gene and Genetic code</b> a. Gene: i. Introduction, ii. Concept of gene, iii. one gene one polypeptide theory. b. Genetic code: i. properties of genetic code, ii. wobble hypothesis and iii. Lac Operon	<b>08</b>	<b>08</b>
<b>7.</b>	<b>Protein Biosynthesis:</b> Transcription and Translation in eukaryotes	<b>06</b>	<b>06</b>
<b>8.</b>	<b>Tools and Techniques in Molecular Biology.</b> i. Polymerase chain reaction (PCR); ii. Electrophoresis- PAGE, SDS - PAGE and Agarose gel electrophoresis. iii. Blotting techniques: Southern, Northern and Western blotting iv. ELISA technique and v. DNA finger printing	<b>09</b>	<b>09</b>
<b>Total</b>		<b>60</b>	<b>60</b>

### **Practical corresponding to Cell and Molecular Biology (Zoo 352)**

**(Any eight)**

- 1 Study of different cell organelles by using microphotographs (D)
- 2 .Study of Mitosis by Suitable material (E)
3. Study of Meiosis by Suitable material (E)
4. Study of cell fractionation (D)
5. Preparation of Paper Model of DNA (D)
6. Extraction of DNA from rat liver/ Spleen (E)
7. Estimation of DNA from suitable material by Diphenylamine reagent. (E)
8. Estimation of RNA from suitable material by Orcinol reagent. (E)
9. Vital staining of mitochondria by using Janus Green B stain. (E)
10. Preparation of salivary gland chromosome from Chironomus / Drosophila larva. (E)



## **Reference Books on Cell and Molecular Biology (Zoo 352)**

- 1.** P. S. Verma and V. K. Agrawal: Cytology
- 2.** Geoffrey M. Cooper and Robert E. Housman: The Cell – A Molecular Approach. 4<sup>th</sup> edition.
- 3.** Lodish et al: Molecular and Cell Biology (Scientific American Book)
- 4.** De Roberties and De Roberties: Cell and Molecular Biology (Saunders College)
- 5.** A C Giese: Cell Physiology
- 6.** Prescott, DM: Reproduction in eukaryotic cells (Academic Press)
- 7.** Wilson, EB: Cell in Development and Inheritance (MacMillan)
- 8.** Edward Gasque: Manual of Laboratory Exp. in Cell Biology (W.C. Brown Publishers)
- 9.** Stryer, L: Biochemistry (Freeman)
- 10.** Conn et al: Outline of Biochemistry (Wiley)
- 11.** Watson J. D. et al: Molecular Biology of Gene (Benzamin/ Cumming)

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**T.Y.B. Sc. (Zoology) Syllabus w.e.f. June 2017**  
**Semester V Paper III- Zoo 353**  
**Mammalian Histology and Physiology I**

<b>Unit</b>	<b>Topic</b>	<b>Periods</b>	<b>Marks</b>
<b>1</b>	<b>Introduction</b> Definitions of Histology & Physiology, History, methods of study.	<b>2</b>	<b>2</b>
<b>2</b>	<b>Tissue and Muscle physiology</b> 2.1 definition, Differentiation and derivative of three germinal layers. 2.2 Types of tissue & Characteristics of tissue. (definition & location only). 2.3 Types- A) Epithelial tissues- a) Simple epithelial tissues b) Compound epithelial tissues, B) Connective tissue, C) Muscular tissue & D) Nervous tissue-a) Structure & types of neurons (nerve cell), b) Medullated & non-medullated nerve fibres. 2.4 Muscle physiology a) Sliding filament theory of muscle contraction, neuromuscular junctions. b) Muscle stimulation-simple muscle twitch, summation, tetanus, muscle fatigue. c) Physical and chemical changes during muscle contraction.	<b>13</b>	<b>13</b>
<b>3</b>	<b>Skin, Thermoregulation and control.</b> 3.1 Structure and function of skin. 3.2 Derivatives of skin- Horns, Nails, Hair, Sweat and Sebaceous gland. 3.3 Definitions of Thermoregulation. 3.4 Poikilotherms and homeotherms. 3.5 Controlling centre-hypothalamus.	<b>10</b>	<b>10</b>
<b>4</b>	<b>Digestive system &amp; Digestion</b> 4.1 Definition of digestion 4.2 Histology of tooth and tongue- Structure and functions. 4.3 Histology of alimentary tract: Histological structure and functions of Oesophagus, Stomach, Duodenum, Colon and Rectum. 4.4 Histology of digestive glands- Salivary, Liver, Pancrease (exocrine & endocrine). 4.5 Physiology of Buccal digestion- salivary secretion and digestion. 4.6 Physiology of Gastric digestion- gastric secretion and	<b>14</b>	<b>14</b>

	<p>digestion.</p> <p>4.7 Intestinal digestion- Pancreatic secretion, bile juice &amp; digestion of small intestine.</p> <p>4.8 Digestion &amp; absorption in large intestine.</p> <p>4.9 Definitions of Ulcer, Constipation, colitis &amp; Cirrhosis.</p>		
<b>5</b>	<p><b>Respiratory system and Respiration.</b></p> <p>5.1 Histological structure of Trachea and Lung.</p> <p>5.2 Definition- Inspiration &amp; expiration (ventilation).</p> <p>5.3 Respiratory pigments- Hb, myoglobin.</p> <p>5.4 Transport of gases-Oxygen and Co<sub>2</sub>.</p> <p>5.5 Chloride shift.</p> <p>5.6 Nervous control of ventilation.</p> <p>5.7 Respiratory quotient.</p> <p>5.8 Definitions of acidosis, alkalosis, asphyxia, hypoxia, anoxia &amp; cyanosis.</p>	<b>9</b>	<b>9</b>
<b>6</b>	<p><b>Circulatory system and Circulation.</b></p> <p>6.1 Structure and function of blood vessels- Artery, Vein and Capillary.</p> <p>6.2 Blood-composition, types of blood cells and their functions.</p> <p>6.3 Heart beat and its hormonal control.</p> <p>6.4 Cardiac cycle-Systole, Diastole (double circulation), Blood pressure, Pace maker &amp; its role.</p> <p>6.5 Neurogenic and Myogenic heart.</p> <p>6.6 Mechanism of Blood coagulation.</p> <p>6.7 Definition of- ECG, Eco-cardiograph, Color Doppler, Angiography, Angioplasty, Angina pectoris, Heart attacks.</p>	<b>12</b>	<b>12</b>
<b>Total</b>		<b>60</b>	<b>60</b>

### **Practicals corresponding to Mammalian Histology and Physiology I (Zoo 353)**

#### **1. Study of following tissue with the help of chart / models / permanent slides / simulations (D).**

- a) Squamous epithelial tissue
- b) Cuboidal epithelial tissue
- c) Columnar epithelial tissue
- d) Ciliated epithelial tissue
- e) Areolar connective tissue
- f) Blood smear –permanent slide.

#### **2. Temporary preparation of the following tissue of preserved Rat (E).**

- a) Striated muscle fibre
- b) Smooth muscle fibre

- c) Medullated nerve fibres
- d) Hyaline cartilage.

**3. Study of histological permanent slide of mammalian skin.**

**4. Study of following histological permanent slide of buccal organs.**

- a) V. S. of Tooth
- b) V. S. of Tongue
- c) C. S. of Salivary gland(Parotid gland)

**5. Study of following histological permanent slide of digestive organs.**

- a) T. S. of oesophagus
- b) T. S. of stomach
- c) T. S. of duodenum
- d) T. S. of rectum
- e) T. S. of pancreas
- f) C. S. of liver

**6. Major experiments of physiology (any two)**

- 1. Study of digestion of starch by salivary amylase.
- 2. Estimation of hemoglobin from blood sample.
- 3. Measurement of blood pressure and heart beat under normal and stress condition.

**7. Minor experiments of Physiology (Any two)**

- 1. Preparation of Haemin crystals.
- 2. Effect of isotonic, hypotonic & hypertonic solution of blood cells (RBCs).
- 3. Detection of blood groups.

**Reference books on mammalian histology and physiology**

- 1. Histology by Arthur W. Ham.
- 2. Histology by Roy O. Greep.
- 3. An advanced atlas of Histology by W. H. Freeman.
- 4. Textbook of Histology by William F. Windle.
- 5. Histology and Genetics by Muzammih Ullah.
- 6. General and comparative physiology- W. S. Hoar.
- 7. Comparative Animal Physiology- C. L. Prosser & Brown.
- 8. A Text book of General Physiology- P. H. Mitchell.
- 9. Introduction of Physiology-Davson (I & II).
- 10. A Text book of Animal Physiology- M. Arora.
- 11. General Endocrinology- Turner & Bungera.
- 12. A Text book of Physiology- Chatterjee.
- 13. A Text book of Physiology- Nagabhushnum.
- 14. A Text book of Physiology & Biochemistry- G. H. Bell; C. R. Paterson & E. Smith.

15. Physiology of Reproduction- Austin & Austin.
16. A Text book of Animal Physiology- Harkat & Mathur.
17. An Introduction of general & comparative Physiology- Barrington.
18. Endocrinology: Hormones and Human Health- Prakash Lohar.
19. A Text book of Practical Physiology- C. L. Ghai.
20. Laboratory Techniques in Modern Biology- N. Swarup; S. Arora & S. C. Pathak.
21. An Advanced Laboratory Manual of Zoology- T. Potdar; M. Mukhopadhyay & S. K. Das.
22. A Manual of Laboratory Technique in Modern Biology- N. Raghuramula & K. Madhavan Nair.

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**T. Y. B. Sc. (Zoology) Syllabus w.e.f. June 2017**  
**Semester V, Paper IV – Zoo -354**  
**Biochemistry**

<b>Units</b>	<b>Topic</b>	<b>Periods</b>	<b>Marks</b>
<b>1</b>	<b>Introduction to biochemistry, objectives, scope and importance.</b>	<b>01</b>	<b>02</b>
<b>2</b>	<b>pH and Buffers</b> 2.1 Concept of pH and pK 2.2 pH value of body fluid, pH scale and significance 2.3 Ionization of acids and bases. 2.4 Derivation of Henderson-Hassel Baltch equation. 2.5 Buffer- Definition, Concept, functions, types and buffers used in biological systems	<b>04</b>	<b>06</b>
<b>3</b>	<b>Molecular Interactions</b> 3.1 Definition, formation and examples of following chemical bonds a) Covalent bonds- peptide and disulphide bond. b) Non-covalent bonds- Hydrogen, Ionic and Hydrophobic bond. c) Other bonds- Glycosidic and phosphodiester bond.	<b>04</b>	<b>05</b>
<b>4</b>	<b>Carbohydrates</b> 4.1 Definition, classification and their biological importance. 4.2 Monosaccharides a) Monosaccharides and their biological importance – trioses, tetraoses, pentoses, Hexoses, Aldo and Keto sugars b) Mutarotation. c) Physical properties of glucose d) Chemical properties- Oxidation and reduction reaction, ester formation, glycoside formation, osazone formation. 4.3 Disaccharides – Structure and significance of Maltose, Isomaltose, Lactose and Sucrose. 4.4 Polysaccharides- Starch, Glycogen, Cellulose and Chitin (Structural formulae not expected)	<b>08</b>	<b>07</b>
<b>5</b>	<b>Lipids</b> 5.1 Definition, classification with examples and their biological importance.	<b>8</b>	<b>7</b>

	<p><b>5.2 Fatty acids</b></p> <p>a) Saturated OR Non-essential fatty acids</p> <p>b) Unsaturated OR Essential fatty acids</p> <p>c) Examples- Prostaglandins, Acyl glycerol and waxes.</p> <p>d) Physical properties of fatty acids</p> <p>e) Chemical properties- Saponification, hydrolysis, rancidity, and antioxidant.</p> <p><b>5.3 Occurrence and significance of</b></p> <p>a) Phospholipids- Lecithin and Cephalin</p> <p>b) Spingolipids</p> <p>c) Glycolipids- Cerebrosides, gangliosides</p> <p>d) Lipoproteins</p> <p>e) Isoprenoids- steriosides (Cholesterol and sex hormones), Terepenoids.</p>		
<b>6</b>	<p><b>Amino acids</b></p> <p><b>6.1</b> Definition, basic structure, classification and biological importance of amino acids.</p> <p><b>6.2</b> Essential, semi-essential and non-essential amino acids; Non-protein amino acids</p> <p><b>6.3</b> Properties of amino acids</p> <p>a) Physical properties</p> <p>b) Chemical properties- reactions of amino acids due to amino, carboxylic and R- groups.</p>	<b>07</b>	<b>07</b>
<b>7</b>	<p><b>Proteins</b></p> <p><b>7.1</b> Definition, biological significance</p> <p><b>7.2</b> Classification with examples- According to solubility, structure based on fibrous and globular proteins</p> <p><b>7.3</b> Increasing complexity into their structures- simple, conjugated and derived proteins</p> <p><b>7.4</b> Structure of proteins- primary, secondary, tertiary and quaternary</p> <p><b>7.5</b> Denaturation and renaturation of proteins.</p> <p><b>7.6</b> Definition of Defensive proteins- Antigens and Antibodies</p>	<b>08</b>	<b>07</b>
<b>8</b>	<p><b>Enzymes</b></p> <p><b>8.1</b> Definition, types and classification (Outline), differences between biocatalysts and chemical catalysts</p> <p><b>8.2</b> Properties of enzymes</p>	<b>08</b>	<b>07</b>

	<p><b>8.3</b> Mechanism of enzyme action –concept of active sites, lock and key model and induced fit model.</p> <p><b>8.4</b> Factors affecting enzymatic activity</p> <p>a) Substrate concentration, b) Enzyme concentration, c) pH d) Temperature, e) Activators and Inhibitors (Competitive and non-competitive)</p> <p><b>8.5</b> Coenzymes, cofactors and prosthetic groups.</p> <p><b>8.6</b> Isoenzymes- Definition, Lactate dehydrogenase, significance.</p> <p><b>8.7</b> Nucleotides as coenzymes (NAD, NADH, FAD, FMN)</p> <p><b>8.8</b> Industrial applications of enzymes – Enzymes involved in the production of glucose from starch &amp; cellulose</p>		
<b>9</b>	<p><b>Vitamins</b> (Structural formulae not expected)</p> <p><b>9.1</b> Definition, classification- Fat and Water soluble.</p> <p><b>9.2</b> Study of Fat- soluble- A, D, E, K vitamins, Water soluble vitamins - B- complex (B1, B2, B6 and B12) nicotinic acid, folic acid, pantothenic acid and Vitamin C with respect to sources, daily requirements, principle role in metabolism and Deficiency diseases.</p> <p><b>9.3</b> Vitamins as Coenzymes</p>	<b>08</b>	<b>07</b>
<b>10</b>	<p><b>Minerals:</b></p> <p><b>10.1</b> Definition and general functions of minerals</p> <p><b>10.2</b> Major or macro minerals: Calcium, Prosperous, sodium, chlorides, potassium, magnesium and sulphur w.r.t. sources, functions and deficiency diseases</p>	<b>4</b>	<b>5</b>
<b>Total</b>		<b>60</b>	<b>60</b>

### **Practicals corresponding to Biochemistry ZOO 314**

#### **Major experiments (Any four)**

1. Identification of Carbohydrates (Mixtures not expected)
  - a) Solubility test, b) Molisch's test, c) Iodine test, d) Benedict's test e) Barfoed's test,
  - f) Phosphoric acid test, g) Osazone test (any 5 test).
2. Isolation of Casein from milk by isoelectric precipitation



3. Chemical test for amino acids (maximum 5 test)
4. Factors affecting enzyme activity- Temp., pH, Inhibitors and activators.
5. Detection of amino acids by ascending or circular paper chromatography
6. Estimation of proteins by Lowry's / Biuret method
7. Qualitative Test for fats

#### **Minor experiments (Any three)**

1. Study of analytical instruments (Principles and uses) of pH meter, Colorimeter, Spectrophotometer, Incubator, Electrophoresis and Centrifuge
2. Isolation of starch from potato
3. Isolation of haemoglobin from blood sample
4. Preparation of solutions of given percentage, normality and molarity
5. Preparation of buffer solutions- acetate buffer/ phosphate or citrate buffer.

#### **Note:**

- 1) Any four major experiments must be conducted.
- 2) Minor experiment No. 1 is compulsory. Any other three minor experiments must be Conducted (Total: Three minor experiments).

### **Reference books on Biochemistry**

1. Biochemistry: Lehninger, A. L.
2. Biochemistry: Kulkarni, M. V., Thonte, S, S., Rathod and Ghiware (Nirali)
3. Biochemistry: Hegde, M. V., Diwan, A. M. and Athwale, M. V.
4. Biochemistry: Rastogi, S. C.
5. Biochemistry: Satyanarayanan
6. Outline of biochemistry: Cohn and Stumpt
7. Biochemistry: Das, D.
8. Practical biochemistry: Plummer, T.
9. General and analytical methods in nutritional biochemistry: Gopal Krishna
10. Standard methods of Biochemical analysis: R. Thimmaiah, Kalyani publishers, Ludhiana.
11. Biochemistry J.L. Jain S. Chand Publication, Meerut.
12. Biochemistry- C.B. Pawar (Himalaya Publication)
13. Text book of Biochemistry- RanganathaRao, Prentice Hall of India.
14. Review of physiological chemistry- Harper H.A.

**T. Y. B. Sc. (Zoology) Syllabus w.e.f. June 2017**  
**Semester V, Paper V - Zoo - 355**  
**Systematics, Evolution and Palaeontology**

Units	Topic	Periods	Marks
<b>1</b>	<b>Systematics</b> <b>1.1 Introduction:</b> origin and development <b>1.2</b> Needs and significance of classification <b>1.3 Systems of classification :</b> a: Artificial b: Natural c: Phylogenic <b>1.4 Nomenclature:</b> a: Binomial b: trinomial c: Rules and recommendations <b>1.5 Taxonomic hierarchy</b> a: Hierarchic classification with examples b: Taxonomic categories c: Species - Concepts and types <b>1.6 Three domain system and Five kingdoms of classification:</b> General characters with examples of kingdom: Monera, Protista, Fungi, Plantae and Animalia	<b>12</b>	<b>12</b>
<b>2</b>	<b>Evolution Origin of life</b> <b>2.1 Introduction</b> <b>2.2 Origin of universe:</b> cosmic evolution and origin of solar Systems <b>2.3 Ancient theories of life cycles:</b> a) Theory of special creation b) Theory of spontaneous generation ( Francesco Redi Expt; Lazzaro Spallanzani Expt and Louis Pasteur Expt) c) Cosmozoic theory <b>2.4 Oparian-Haldane theory of origin of life:</b> a) Miller-Urey's expt. b) Co-acervates c) Origin of autotropism	<b>12</b>	<b>12</b>
<b>3</b>	<b>Theories of organic evolution</b> <b>3.1 Lamarkism:</b> theory of aquired inheritance and principles <b>3.2 Neo-Lamarkism :</b> Experimental evidences	<b>12</b>	<b>12</b>

	<b>3.3 Darwinism:</b> Natural selection theory and Darwin finches		
	<b>3.4 Neo-Darwinism:</b> Industrial melanism <b>3.5 Modern synthetic theory: concepts</b> <b>3.6 Mutation theory of de Vries:</b> Experiment, features and Examples		
<b>4</b>	<b>Evolution through ages</b> <b>4.1 Introduction</b> <b>4.2 Geological time scale:</b> Era, periods and epochs - Characters and examples <b>4.3 Antiquity of Man</b> a) Primate characters and classification b) Origin and characters of followings 1. Prosimii - Tree Shrews, Lemures, Lorises and Tarsiers 2. Apes - Gibbon, Orangutan, Chimpanzee and Gorilla c) Difference between Apes and Man d) Origin, Successive stages and characteristics features w.r.t. geological time scale regards to: 1. Parapithecus      2. Dryopithecus 3. Ramapithecus    4. Australopithecus 5. Homohabilis      6. Homo erectus ( Pithecanthropus - Java man, Sinanthropus - Peking man 7. Neanderthal man 8. Cromagnon man 9. Homo sapiens ( Modern man)	<b>12</b>	<b>12</b>
<b>5</b>	<b>Palaeontology</b> <b>5.1 Introduction</b> <b>5.2 a) Fossils-</b> Definition, process of fossilization and evidences b) Determination of age of rocks and fossils (radiometric dating) i) Uranium-Lead method ii) Radioactive carbon method <b>c) Nature of fossils- unaltered and altered fossils</b> <b>d) Types of fossils-</b> i) Actual remains ii) Petrified fossils, iii) Moults and casts, iv) Foot prints and trails v) Coprolites <b>e) Significance of fossils</b>	<b>12</b>	<b>12</b>

	<p><b>5.3 Distribution and dispersal of animals</b></p> <p>a) Means of dispersal of animals</p> <p>b) Barriers of dispersal( Physical and, climatic and biological)</p> <p>c) Distribution of animals ( continuous and discontinuous)</p> <p>d) Bathymetric distribution ( Geobiotic, limnobiologic and holobiotic)</p> <p><b>5.4 Zoogeographical realm</b></p> <p><b>a) Definition and types</b></p> <p><b>b) Study of following realms with their distinctive animal Distribution</b></p> <p>i) Palaeartic region</p> <p>ii) Neartic region</p> <p>iii) Neotropical region</p> <p>iv) Ethiopian region</p> <p>v) Oriental region</p> <p>vi) Australian region</p> <p>c) Wallace's line</p>		
<b>Total</b>		<b>60</b>	<b>60</b>

**Practicals corresponding to Paper V ( Zoo-355) Systematics,  
Evolution and Palaeontology**

- 1. Hierarchic classification of any two animals from Nonchordates (Cockroach and Apple snail) and Chordates ( Frog and Rat)**
- 2. Evolutionary concepts of origin of life ( Any two)**
  - a) Francesco Redi Expt;
  - b) Lazzaro Spallanzani Expt
  - c) Louis Pasteur Expt
  - d) Miller-Urey's expt.
- 3. Evidences from evolution ( Any two)**
  - a) Lamarkism use theory - ex. Giraffe
  - b) Natural selection theory - Darwin finches
  - c) Neo-Darwinism: Industrial melanism ex. Peppered Moth
  - d) Mutation theory : ex. Ornamental plants ( Oenothera lamarkiana), Ancon sheep
- 4. Study of geological time scale ( Tabel format)**

## 5. Identification / features of stages of Human evolution

- |                     |                    |
|---------------------|--------------------|
| 1. Australopithecus | 2. Pithecanthropus |
| 3. Neanderthal man  | 4. Cromagnon man   |

## 6. Study of fossils

- a) Trilobite
- b) Archaeopteryx
- c) Spinosaurus
- d) Brontosaurus
- e) Nautilus
- f) Submission of fossil pictures

## 7. Identification of zoogeographical realms using map

### Reference books on Systematics, Evolution and Palaeontology

1. Barnes, C.W. 1988. *Earth, Time and Life*. John Wiley & Sons, New York (Module 2,3)
2. Bendall, D. S. (ed.) 1983. *Evolution from Molecules to Man*. Cambridge University Press, UK (Module 2,3 and 5)
3. Bull J.J and H.A. Wichman. 2001. *Applied Evolution*. Rev. Ecol. Syst. -217
4. Chattopadhyay Sajib. 2002. *Life Origin, Evolution and Adaptation*. Books and Allied (P) Ltd. Kolkata, India.
4. Goodwin, B. 1996. *How the Leopard Changed its Spots: The Evolution of Complexity*. Simon & Schuster, NY, USA. (Module 4 & 5)
6. Jerry A. Coyne and H. Allen Orr. 2004. *Speciation*. Sinauer Associates (Module 4)
7. Rob Desalle and Ian Tattersall 2008. *Human Origins: What Bones and Genomes Tell Us about Ourselves*. Texas A&M University Press, USA. (Module 3 & 4)
8. Sean B. Carroll and David M. Kingsley .2005 *Evolution: Constant Change and Common Threads*. Holiday Lectures on Science. Webcast or DVD available at [www.hhmi.org/biointeractive/evolution](http://www.hhmi.org/biointeractive/evolution). (Module 3 & 4)
9. Strickberger, M.W. 2000. *Evolution*. Jones and Bartlett, Boston. (Module 1-5)
10. Verma P.S. and Agarwal V.K 2007 *Cell biology, Genetics, Molecular Biology, Evolution and Ecology*, S. Chand & Company New Delhi (Module 1-5)
11. Ernst, Mayr. *Systematics and the origin of species from the viewpoint of zoologist*. Harvard University Press.

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# T. Y. B. Sc. (Zoology) Syllabus w.e.f. June 2017

## Semester V, Paper-VI, ZOO – 356 (A)

### BIOTECHNOLOGY

Unit	Topic	Period	Marks
1	<b>Introduction, scope and significance of Biotechnology</b>	02	02
2	<b>Animal cell and tissue culture</b> 2.1 Definition and Types of culture media 2.2 Advantages and disadvantages of animal cell/tissue culture 2.3 Laboratory facility for animal tissue culture 2.4 Applications of animal cell and tissue culture 2.5 Primary culture, Examples of Cell lines 2.6 Applications of somatic cell fusion 2.7 Examples of Tissue and organ cultures	12	10
3	<b>Recombinant DNA technology</b> 3.1 Introduction 3.2 Restriction enzymes- classification with examples 3.3 Identification and isolation of desired gene 3.4 Types and properties of Vectors 3.5 Construction of genomic and cDNA libraries 3.6 Application of genetic engineering e.g. production of human Insulin, Growth hormone, TPA and vaccines	12	12
4	<b>Transgenic animals</b> 4.1 Introduction 4.2 Methods of Transfection (Physical, Chemical, Viral and Bacterial) 4.3 Examples and significance of transgenic animals	04	06
5	<b>Hybridoma technology</b> 5.1 Introduction 5.2 Methods for production of monoclonal and polyclonal antibodies 5.3 significance of Monoclonal antibodies 5.4 Types and significance of immunoglobulin	10	12
6	<b>Enzyme biotechnology</b> 6.1 Introduction and Biological sources of enzymes 6.2 Methods for immobilization of enzymes 6.3 Examples and Applications of immobilized enzymes	06	06

<b>7</b>	<b>Industrial and Environmental Biotechnology</b> 7.1 Fermentation technology (Fermenter, selection of microbes and fermentation medium) 7.2 Concept of bio-fuel, bio-ethanol and bio-diesel 7.3 Cleaner technology for pollution control (Effluent Treatment: Biodegradation; phytoremediation) 7.4 Biosensors and their significance	<b>09</b>	<b>07</b>
<b>8</b>	<b>Stem Cell Biotechnology</b> 8.1 Introduction 8.2 Types of Stem Cell and their uses 8.3 Now and Future of Stem cell Biotechnology	<b>05</b>	<b>05</b>
	<b>Total</b>	<b>60</b>	<b>60</b>

### **Practicals corresponding to ZOO 356 (A) BIOTECHNOLOGY**

1. Estimation of DNA in a given sample by Diphenylamine method (E)
2. Estimation of RNA in a given sample by Orcinol method (E)
3. Working principle and application of laminar air flow, autoclave, Inverted microscope, colorimeter and CO<sub>2</sub> incubator (D)
4. Isolation of microorganisms on nutrient agar by dilution plate method or streak plate method (E)
5. Culture of bacteria in liquid medium and agar plates.(E)
6. Production of ethanol by fermentation method by using yeast.(E)
7. Preparation of primary culture media for cell, tissue, organ. (D)
8. Separation of serum proteins by Agarose or polyacrylamide gel electrophoresis(E)
9. Study of Biogas plant/ model (Principal and applications)(D)
10. Visit to dairy / pharmaceutical / tissue culture laboratory and submission of report.

### **References on Zoo 356 A: biotechnology**

1. Lewin, B., (2004), *Genes VIII*, Oxford University Press, New York
2. Stem Cell Biology (2001) Cold Spring Harbor Laboratory Press
3. Watson, J.D. *et al*, (1987) *Molecular Biology of Gene*, 4th ed., The Benjamin/Cummings Publishing Company, Inc. U.S.A.
4. Gerald C., (1996) *Cell and Molecular Biology – Concept and Experiment*, John Wiley and Sons, Inc., U.S.A.

5. Brooks G (ed.) (2002) Gene therapy. *The use of DNA as a drug*. Pharmaceutical Press, London.
6. Prakash S.Lohar (2012) Textbook of Biotechnology ISBN: 9788180941047 MJP Publishers, Chennai
7. Sing, B.D.(2014) Biotechnology Expanding horizons. Kalyani Publishers, Delhi

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# T. Y. B. Sc. (Zoology) Syllabus w.e.f. June 2017

## Semester V, PAPER - VI, ZOO-356 (B)

### Pest Management

Unit	Topics	Periods	Marks
<b>1</b>	<b>Introduction to Pest</b> 1.1 Concept and Scope of Pest 1.2 Classification of pests 1.2.1. Agricultural pest 1.2.2. Store grain pest 1.2.3. Animal husbandry pest 1.2.4. Public health pest 1.2.5. Structural Pest	<b>05</b>	<b>05</b>
<b>2</b>	<b>Study of insect pest w. r. t. their Marks of identification, Life cycle, Nature of damage and Control measures.</b> 2.1 Banana – Banana stem borer- <i>Odoiporus longicollis</i> 2.2 Cotton-Red cotton bug- <i>Dysdercus cingulatus</i> 2.3 Sugarcane-Sugarcane leafhopper- <i>Pyrilla perpusilla</i> 2.4 Mango-Mango stem borer- <i>Batocera rubus</i> 2.5 Jowar- Jowar stem borer- <i>Chilo zonellas</i> 2.6 Brinjal-Brinjal shoot borer- <i>Leucinodes orbonalis guenee</i> 2.7 Store grain – <i>Sitophilus oryzae</i> 2.8 Wood-White ants –Termite- <i>Odontotermes obesus</i>	<b>15</b>	<b>15</b>
<b>3</b>	<b>Primary Control Measures</b> 3.1 Mechanical measures 3.2. Physical measures 3.3. Cultural measures 3.4. Legislative measures 3.5. Quarantine measures	<b>05</b>	<b>05</b>
<b>4</b>	<b>Chemical Control</b> 4.1 Classification of insecticides-based on the modes of their entry with one example each 4.1.1.Stomach poisons 4.1.2.Contact poisons	<b>05</b>	<b>05</b>

	<p>4.1.3. Systematic poison</p> <p>4.1.4. Fumigants</p> <p>4.2 Insecticidal formulations and dilutions</p> <p>4.3 Drawback of Chemical Control</p>		
<b>5</b>	<p><b>Biological Control of Insect Pest</b></p> <p>5.1 Introduction, definition</p> <p>5.2 Biological agents - Desired qualities of biological agents.</p> <p>5.3 5.3. Autocidal control.</p> <p>5.3.1. The male sterile techniques</p> <p>5.3.2. The genetic technique</p> <p>5.3.3. Pheromonal technique</p> <p>5.3.4. Hormonal control</p> <p>5.4 5.4. Advantages of biological control</p> <p>5.5 5.5. Drawbacks of biological control</p> <p>5.6 5.6. Biological control management</p>	<b>06</b>	<b>06</b>
<b>6</b>	<p><b>Integrated pest management</b></p> <p>6.1 Introduction</p> <p>6.2 Principle</p> <p>6.3 Integrated tactics</p> <p>6.3.1. Plant resistance</p> <p>6.3.2. Cultural method</p> <p>6.3.3. Biological control</p> <p>6.3.4. Pesticides</p> <p>6.3.5. Other methods</p> <p>6.4 Pest management strategies</p> <p>6.5 Integrated pest management modeling.</p>	<b>10</b>	<b>10</b>
<b>7</b>	<p>Pesticide-appliances</p> <p>7.1 Dusters and Sprayers</p> <p>7.2 Collection, mounting and preservation of insect pests.</p> <p>7.3 Pesticide safety</p>	<b>05</b>	<b>05</b>
<b>8</b>	<p><b>Preparation and method of application of herbal pesticides</b></p> <p>8.1 Neem extracts- leaves /seeds/bark</p> <p>8.2 Dashparni ark</p>	<b>05</b>	<b>05</b>

	8.3 Tobacco extracts 8.4 Camphor		
<b>9</b>	<b>Non –Insect Pest (Snail, Birds, Rat)</b> 9.1 Introduction, habit and habitat 9.2 Breeding potential, Nature of damage 9.3 Control measures	<b>04</b>	<b>04</b>
	<b>Total</b>	<b>60</b>	<b>60</b>

### Practicals Corresponding to Z00 – 356 (B) Pest Management

- 1) Study of pests with respect to Nature of damage : (D)
  - a) Banana stem borer - *Odoiporus longicollis*
  - b) Red cotton bug - *Dysdercus cingulatus*,
  - c) Sugarcane leafhopper - *Pyrilla perpusilla*,
  - d) Mango stem borer - *Batocera rubus*
  - e) Jowar stem borer - *Chilo zonellas*,
  - f) Brinjal shoot borer - *Leucinodes orbonalis guenee*,
  - g) Rice weevil – *Sitophilus oryzae*,
  - h) Termite - *Odontotermes obesus*,
- 2) Preparation of aqueous Neem extracts from leaves / seeds / bark (E)
- 3) To study the effect of Neem extract on mosquito / any pest (E)
- 4) Study of rearing of Guppy and demonstration of feeding on mosquito larvae (E)
- 5) Preparation of different types of poison baits for the control of rat.(D)
- 6) Study of modern pesticide appliances – Dusters and Sprayers.(D)
- 7) Submission of coloured photographs of any five pests with Systematic position, Host plant, Nature of damage and Control measures.
- 8) Compulsory field visit to observe different pest in their natural habitat.

### Reference books on Pest Management

- 1) Crop Pests and How to Fight Them, Director of Publicity, Govt. of Maharashtra.
- 2) Fadt, : Fundamental of Entomology.
- 3) Gupta : Essentials of biotechnology.
- 4) Little and Little : General and Applied Entomology.
- 5) Pedigo : Entomology and Pest management.
- 6) Pradhan, : Insect Pest of Crops.
- 7) Pruthi, H.S. : Textbook of Agricultural Entomology.
- 8) Ravindranathan K. R. : Economic Zoology, Dominant Pub. & Dist. New Delhi.

- 9) Shrivastava : Applied Entomology Vol. I and II.
- 10)Srivastava P. D. and N. C. Pant : Economic Zoology, Vol. I & II, Commercial Publication Bureau, New Delhi.
- 11)Shukla and Upadhyay: Economic Zoology, Rastogi publication
- 12) Tembhare T. B. : TB of Modern Entomology.
- 13)The Year book of agriculture, U.S. Department of Agriculture
- 14)Wani G. P., P. M. Vyawahare : Applied Zoology, Prashant Publ. Jalgaon
- 15)Waykar B. B., A. Y. Mahajan, B. C. More : Applied Zoology, Prashant Publ. Jalgaon.
- 16)Yadav Manju : Economic Zoology, Discovery publishing house, New Delhi.
- 17)Yadav Manju : Applied Entomology, Discovery publishing house, New Delhi.

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# T. Y. B. Sc. (Zoology) syllabus w.e.f. June 2017

## Semester V, Paper-VI - ZOO 356 (C)

### Public Health and Hygiene

Unit	Topic	Periods	Marks
1	<b>Scope and Importance.</b>	1	1
2	<b>Health Education</b> 2.1 Definition 2.2 Personal and community health 2.3 Health education-WHO Program, 2.4 NGO (Non-Governmental voluntary health organization).	7	7
3	<b>Food</b> 3.1 Introduction and classification of food 3.2 Balanced diet 3.3 Food adulteration 3.4 Food Sanitation	8	5
4	<b>Environment and health</b> 4.1 Water supply and Sources 4.2 Impurities and pollution of water. 4.3 Purification and water quality standard. a. Physico-chemical analysis. b. Microbiological analysis. 4.4 Composition of Air, Air-pollution 4.5 Noise pollution 4.6 Soil pollution 4.7 Radiation and its effects.	10	10
5	<b>Sanitation</b> 5.1 Disposal of Human and animal Excreta. 5.2 Solid waste, sewage and their management	4	4
6	<b>Communicable Diseases:</b> Introduction, transmission and control 6.1 Measles 6.2 Poliomyelitis 6.3 Tuberculosis 6.4 STD: AIDS, Gonorrhoea, Syphilis 6.5 Encephalitis	9	9
7	<b>Non Communicable Diseases:</b> 7.1 Coronary Heart diseases	9	9

	7.2 Diabetes mellitus 7.3 Mental illness 7.4 Alcoholism and drug dependence		
<b>8</b>	<b>Insect Borne diseases</b> 8.1 Introduction 8.2 Study of disease w. r. to Vector/Carrier insect, life cycle in brief, health hazards: Malaria, Filariasis, Dengue, Sleeping sickness, Leishmaniasis	<b>4</b>	<b>4</b>
<b>9</b>	<b>Hygiene</b> 9.1 Hygiene and health factors at home. 9.2 Personal hygiene 9.3 Oral Hygiene 9.4 Mental Hygiene	<b>8</b>	<b>8</b>
	<b>Total</b>	<b>60</b>	<b>60</b>

### **Practicals corresponding to ZOO -356 (C) Public Health and Hygiene**

- To detect adulterants in the food samples by appropriate tests. (E)
- Epidemiological study of measles, tuberculosis and poliomyelitis. (D)
- Testing portability of water for human consumption by MPN method. (D)  
(The principal methods used in the isolation of indicator organisms from water are the membrane-filtration (MF) method, the multiple-tube (MT) or most probable number (MPN) method and presence–absence tests.)
- Biological control of mosquito larvae
- Visit to sewage treatment plant / effluent treatment plant / Public health Laboratory/water purification (treatment) plant (D)

### **References on ZOO -356 (C) Public Health and Hygiene**

- Gibney, Public Health Nutrition, Blackwell.
- Gibney, Clinical Nutrition, Blackwell.
- Sarada Subramanyam and K. Madhavankutty, Textbook of Human Physiology.
- Churchill Livingstone, Davidson's Principles of Practice of Medicine.
- Guyton & Hall, Textbook of Medical Physiology.
- Park and Park, 1995: Text book of preventive and social medicine Banarsidas Bhanot Publication Jodhpur- India.
- Verma, S. 1998: Medical zoology, Rastogi Publ.- Meerut- India.
- Singh, H.s. and Rastogi, P. 2009: Parasitology, Rastogi Publ. India.
- Dubey, R.C and Maheswari, D.K. 2007: Text Book of Microbiology, S. Chand & Co. Publication New Delhi– India.

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**T. Y. B. Sc. (Zoology) Syllabus w.e.f. June 2017**  
**Semester VI, Paper I - ZOO 361**  
**Chordates - III**

Units	Topic	Periods	Marks
<b>1.</b>	<b>Study of Scoliodon w.r.t. following:</b> 1.1 Systematic position, Distribution, Habits and Habitat. 1.2. External Characters - 1.2.1. Shape, Size and Colour. 1.2.2. Division of the body - Head, Trunk and Tail. 1.3. Skin and its derivatives. 1.4. Myotomes and locomotion. 1.5. Coelom	<b>08</b>	<b>04</b>
<b>2.</b>	<b>Internal anatomy of Scoliodon</b> <b>2.1 Digestive system</b> i) Alimentary canal ii) Digestive glands. Food and physiology of digestion. <b>2.2 Respiratory system</b> i) Respiratory organs. ii) Mechanism of respiration. iii) Physiology of respiration. <b>2.3 Blood vascular system</b> i) Blood, structure and working of heart. ii) Arterial system : a) Ventral aorta and afferent branchial arteries b) Efferent branchial and Epibranchial arteries, c) Hypobranchial blood plexus d) Arteries of head e) Dorsal aorta and its branches. iii) Venous System : a) Anterior cardinal system b) Posterior cardinal or renal portal system c) Hepatic portal system d) Lateral abdominal system and cutaneous system. <b>2.4 Nervous System</b> i) Central nervous system - Brain and Spinal cord. ii) Peripheral nervous system - Cranial and spinal	<b>42</b>	<b>44</b>

	<p>nerves.</p> <p>iii) Autonomic nervous system.</p> <p><b>2.5 Sense organs</b></p> <p>a. Olfactory organs.</p> <p>b. Eyes or Photoreceptor</p> <p>c. Internal ear or Stato-acoustic organs.</p> <p>d. Neuromast organ or Lateral line system organs.</p> <p>e. Pit organs.</p> <p>f. Ampullae of Lorenzini.</p> <p><b>2.6 Urinogenital System</b></p> <p>i) Male urinogenital sytem.</p> <p>a) Excretory organs.</p> <p>b) Reproductive organs</p> <p>ii) Female urinogenital system.</p> <p>a) Excretory organs</p> <p>b) Reproductive organs.</p> <p>iii) Reproduction : Copulation, Fertilization and Development</p>		
<b>3</b>	<p><b>Study of Comparative account with reference to the following</b></p> <p><b>3.1.</b> Integument/Skin - comparative histology of skin of Scoliodon, frog, calotes, pigeon and rat.</p> <p><b>3.2.</b> Structure of hearts of Scoliodon, frog, calotes, pigeon and rat.</p> <p><b>3.3.</b> Aortic arches - Evolution of aortic arches</p> <p><b>3.4.</b> kidney: evolution of archioneuros, roneuros, mesoneuros, metaneuros and their ducts</p> <p><b>3.5.</b> Brain: morphological variations in the Scoliodon, frog, calotes, pigeon and rat.</p>	<b>10</b>	<b>12</b>
<b>Total</b>		<b>60</b>	<b>60</b>

### **Practical corresponding to ZOO 361: Chordate III**

1. Study of systemic position, External characters and sexual dimorphism in Scoliodon.
2. Study of the following systems from *Scoliodon* (with the help of models / chars / pictures / simulation).
  - a. Digestive system.
  - b. Bronchial system.
  - c. Brain (Dorsal and ventral view)
  - d. Male urinogenital systems



- e. Female urinogenital systems
3. Study of the following from *Scoliodon* (with the help of models / chars / pictures/ simulation) (D).
- a. Placoid scales.
  - b. Ampullae of Lorenzini.
  - c. Eyeball Muscles.
  - d. Membranous labyrinth
4. Comparative study of skin - *Scoliodon*, Frog, Calotes, Pigeon and Rat.
5. Comparative study of Heart— *Scoliodon*, Frog, Calotes, Pigeon and Rat.
6. Comparative study of Brain— *Scoliodon*, Frog, Calotes, Pigeon and Rat.
7. Visit to a sanctuary, seashore for the study of vertebrate animals.

### References on ZOO 361: Chordate III

1. A text Book of Vertebrate Zoology – S.N.Prasad, Kitab Mahal, Alahabad.
  2. A life of Vertebrate – K.Z.Young, ELBS Oxford University Press.
  3. A Text Book of Chordates – H.S.Bharah and Kavita Juneja.
  4. Modern Text Book of Zoology Vertebrate – R.L.Kotpal, Rastogi Publication Meerut.
  5. A Text Book of Chordates – A .Thangamani, S, Prasannakumas, L.M.Narayanan and Arunmugam Saras Publication, Nagercoil.
  6. A Text Book of Chordate Zoology – R.C.Dalela –Jaiprakashnath Publication, Meerut.
  7. Chordate Zoology – E.L.Jordan and P.S.Verma, S.Chand and Company New Delhi.
  8. A Text book of Practical Zoology Vertebrate – S.S.Lal, Rastogi Publication, Meerut.
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# T. Y. B. Sc. (ZOOLOGY) syllabus w.e.f. June 2017

## Semester VI, PAPER - II ZOO – 362

### GENERAL EMBRYOLOGY

Unit	Name of the Topics	Periods	Marks
1	<b>Concept of embryology</b> 1.1 Growth, Differentiation, De-differentiation, 1.2 Regeneration, Induction, Organizer, 1.3 Totipotency, Fate-map.	03	04
2	<b>Gametogenesis</b> 2.1 Spermatogenesis including spermatogenesis 2.2 Oogenesis 2.3 Difference between spermatogenesis and oogenesis 2.4 Significance of gametogenesis	04	06
3	<b>Structure of Gametes</b> 3.1 Sperm - Ultra structure, mention variations with reference to insect, frog and human- sperms. 3.2 Ovum – General structure, 3.3 Egg membranes – primary, secondary, tertiary. 3.4 Types of eggs - Classification based on the amount of yolk and distribution of yolk.	04	06
4	<b>Fertilization</b> 4.1 Definition and types [external and internal]. 4.2 Monospermy, polyspermy - physiological and pathological 4.3 Process of fertilization 4.3.1: Attraction and recognition of sperm and Androgamones, Gynogamones, fertilizin and antifertilizin. 4.3.2 : Penetration - Mechanism and activation, Acrosome reaction, Cortical reaction, Fertilization membrane 4.4 Amphimixis, Significance of fertilization 4.5 Parthenogenesis - Definition Types – a] Natural – Haploid (Arrhenotoky) and Diploid	10	10

	(Thelytoky) b] Artificial parthenogenesis. Significance of parthenogenesis		
<b>5</b>	<b>Cleavage</b> <b>5.1</b> Definition, characteristics and significance <b>5.2</b> Planes of cleavage, Types - i] Holoblastic - Equal and unequal. ii] Meroblastic – Discoidal, Superficial, Determinate and Indeterminate cleavage <b>5.3</b> Patterns of cleavage with examples - Radial, Spiral, Bilateral and Asymmetrical <b>5.4</b> Blastulation –Definition and types	<b>06</b>	<b>08</b>
<b>6</b>	<b>Gastrulation</b> <b>6.1</b> Definition and concept <b>6.2</b> Basic cell movement in gastrulation – Epiboly - Convergence, Emboly - Invagination, Involution, Ingression, Infiltration, Delamination, Divergence, constriction and elongation with reference to Amphioxus and frog.	<b>03</b>	<b>04</b>
<b>7</b>	<b>Chick Embryology</b> <b>7.1</b> Structure of Hen’s egg [freshly-laid] <b>7.2</b> Egg-membranes <b>7.3</b> Fertilization, cleavage and blastulation <b>7.4</b> Gastrulation - Formation of primitive ectoderm <b>7.5</b> Development of primitive streak <b>7.6</b> Head - Process, somites, regression of primitive streak <b>7.7</b> Development of brain upto 72 hours. <b>7.8</b> Development of heart and main blood vessels upto 72 hours. <b>7.9</b> Development of digestive system upto 72 hours. <b>7.10</b> Development of extra-embryonic membranes <b>7.11</b> Significance or uses of chick - embryology in developmental biology.	<b>20</b>	<b>15</b>

<b>8</b>	<b>Placenta</b> <b>8.1</b> Definition and significance <b>8.2</b> Types of placenta in Mammals <b>8.3</b> With reference to morphological peculiarities - i] Deciduate, ii] Indeciduate and iii] Contra-deciduate placenta	<b>10</b>	<b>07</b>
	<b>8.4</b> With reference to the foetal and maternal tissue involved - i] Diffuse, ii] Cotyledonary, iii] Zonary and iv] Decidual <b>8.5</b> With reference to histological peculiarities – i] Epithelio-chorial ii] Syndesmo-chorial iii] Endothelio-chorial iv] Haemo-chorial v] Hemo-endothelial placenta		
<b>Total</b>		<b>60</b>	<b>60</b>

### **Practicals Corresponding to Z00 – 362: General Embryology**

- 1) Study of sperms of amphioxus, frog, bird and mammals.[D]
- 2) Study of types of eggs[D]
- 3) Study of blastulae and gastrulae of amphioxus, frog, bird and mammals.[D]
- 4) Temporary mounting of chick- embryo [E]
- 5) Study of whole mounts of chick embryos - Primitive streak, 24hrs, 33hrs, 48hrs, 72hrs.[D]
- 6) Study of different types of placenta with suitable histological slides or charts.[D]
- 7) Study of metamorphosis in frog by suitable specimens. [D]
- 8) Study of regeneration in Planaria or any suitable animal. [D]
- 9) Compulsory visit to poultry-farm.

### **Reference Books on General Embryology**

- 1) Balinsky B.L. : An introduction to Embryology (1984), Saunders College, Philadelphia.
- 2) Berry A. K. : A T. B. of Embryology
- 3) Browder L.W : Developmental Biology, 1984, Saunders College Publication, U.S.A.
- 4) Browder L.W Erickson C.A and Williams, R.J : Developmental Biology, 1992, 3rd Ed., Saunders College, Pubication., London.
- 5) Gilbert S.F. : Developmental Biology, 1997, 3rd Edition, Saunder, Associates Inc. U.S.A.
- 6) Lillie : Development of chick embryo, 1972,.

- 7) Pawar Kishor : A T.B. of Embryology, Pragati Prakashan, Pune.
- 8) Puranik P.G : A Text book of Embryology, S. Chand and co.
- 9) Sandhu, Srivastava and Arora : A Text book of Embryology, Anmol Publication Pvt. Ltd. New Delhi.
- 10) Sastry and Shukla : Developmental Biology, Rastogi Publication.
- 11) Singh Inderbir and G.P.Pal : Human embryology
- 12) Suresh C. Goel : Principle of Developmental Biology, Himalaya publishing House.
- 13) Verma, Agrawal and Tyagi : Chordate embryology, S. Chand Company Ltd

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# T.Y.B. Sc. (Zoology) Syllabus w.e.f. June 2017

## Semester VI Paper III- Zoo 363

### Mammalian Histology and Physiology II

Unit	Topic	Period	Marks
1	<b>Excretory system and Excretion</b> 1.1 Definition of Excretion. 1.2 Histology of Kidney- microscopic structure of uriniferous tubules, Juxtra Glomerular complex, Bowman's capsule and Glomerulus. 1.3 Physiology of urine formation by counter current multiplier theory. 1.4 Ultrafiltration, selective re-absorption, tubular secretion. 1.5 Definitions of Kidney failure, artificial kidney, Gout, Nephritis.	11	11
2	<b>Nervous system and Nervous Physiology</b> 2.1 Brain meninges - structure and function. 2.2 Spinal cord- structure and function. 2.3 Neurotransmitters- Definition, properties and types- serotonin, Acetylcholine, Sympathatin, Dopamine. 2.4 Origin and conduction of nerve impulses (medullated & non-medullated). 2.5 Synapse- Ultra structure and transmission. 2.6 Definition- C. T. scan, EEG & epilepsy.	12	12.
3	<b>Sense Organs</b> 3.1 Eye- Structure- V. S. of eye ball. 3.2 Physiology of vision- visual pathway structure and stimulation of photoreceptors- Rods and Cone cells. 3.3 Ear- Structure of external, middle & internal ear. 3.4 Physiology of Hearing- Auditory pathway, Internal structure of Ear, stimulation of organ of corti.	10	10
4	<b>Reproductive system and Reproduction</b> 4.1 Testis- microscopic structure, seminiferous tubules. Structure of sperm. 4.2 Male sex hormones and their physiological role. 4.3 Ovary- Cross section, Graffian follicle. Structure of ovum. 4.4 Female sex hormones and their physiological role. 4.5 Reproductive cycle with hormonal control- Menstrual and Oestrous. 4.6 Definition- Puberty, ovulation, menarche, pregnancy, parturition, lactation, menopause.	13	13
5	<b>Endocrine system and Endocrine glands.</b> 5.1 Definition –Endocrinology and Endocrine. 5.2 Pituitary gland- structure, hormones & hormonal	14	14

physiology. 5.3 Structure and functions of Thyroid gland. 5.4 Structure and functions of Adrenal gland. 5.5 Structure and functions of Pancreas gland (only endocrine). 5.6 Feed back mechanism – positive and negative.		
<b>Total</b>	<b>60</b>	<b>60</b>

## **Practicals corresponding to Zoo 363 Mammalian Histology and PhysiologyII**

### **1. Study of following histological permanent slide of respiratory organs.**

- a) C. S. of trachea
- b) C. S. of lung

### **2 . Study of following histological permanent slide of blood vessels.**

- a) T. S. of artery
- b) T. S. of vein
- c) T. S. of capillary.

### **3. Study of following histological permanent slide of excretory & reproductive.**

- a) L. S. of kidney
- b) T. S. of testis
- c) L. S. of ovary

### **4. Study of following histological permanent slide of endocrine glands.**

- a) T. S. of pituitary gland
- b) T. S. of adrenal gland
- c) C. S. of thyroid gland

### **5. Major experiments of physiology (any three)**

- a) Total count of RBCs from blood sample.
- b) Total count of WBCs from blood sample.
- c) Differential count of WBCs from blood sample.
- d) Detection of Normal constituents of urine (Urea, Uric acid, Ammonia & Creatine).
- e) Detection of abnormal constituents of urine (Glucose, Ketone bodies, Bile salts, Protein).

### **6. Minor experiments of physiology (any two)**

- a) Estimation of bleeding & clotting time in Man/Rat by capillary method.
- b) Demonstration of stages of oestrous cycle in Rat with the help of slides/pictures.
- c) Study of endocrine glands of desected Rat with the help of chart or model.

### **Reference books on Mammalian histology and physiology**

1. Histology by Arthur W. Ham.
2. Histology by Roy O. Greep.
3. An advanced atlas of Histology by W. H. Freeman.
4. Textbook of Histology by William F. Windle.
5. Histology and Genetics by Muzammih Ullah.
6. General and comparative physiology- W. S. Hoar.
7. Comparative Animal Physiology- C. L. Prosser & Brown.
8. A Text book of General Physiology- P. H. Mitchell.
9. Introduction of Physiology-Davson (I & II).
10. A Text book of Animal Physiology- M. Arora.
11. General Endocrinology- Turner & Bungera.
12. A Text book of Physiology- Chatterjee.
13. A Text book of Physiology- Nagabhushnum
14. A Text book of Physiology & Biochemistry- G. H. Bell; C. R. Paterson & E. Smith.
15. Physiology of Reproduction- Austin & Austin.
16. A Text book of Animal Physiology- Harkat & Mathur.
17. An Introduction of general & comparative Physiology- Barrington.
18. Endocrinology: Hormones and Human Health- Prakash Lohar.
19. A Text book of Practical Physiology- C. L. Ghai.
20. Laboratory Techniques in Modern Biology- N. Swarup; S. Arora & S. C. Pathak.
21. In Advanced Laboratory Manual of Zoology- T. Potdar; M. Mukhopadhyay and S. K. Das.
22. A Manual of Laboratory Technique in Modern Biology-N. Raghuramula & K. Madhavan Nair.

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**T. Y. B. Sc. (Zoology) Syllabus w.e.f. June 2017**  
**Semester VI, Paper IV – Zoo -364**  
**Research Methodology**

Units	Topic	Periods	Marks
<b>1</b>	<b>Definition , introduction and scientific approach of research</b> 1.1 Meaning of research-Research, methodology and important characters 1.2 Objectives of research 1.3 Motivation in research 1.4 Types of research 1.5 Significance of research 1.6 Research methods versus methodology 1.7 Research and scientific methods 1.8 Research methods in flow charts 1.9 Various steps of research process 1.10 Criterion of good research 1.11 Need of research in developing countries	<b>10</b>	<b>12</b>
<b>2</b>	<b>Research design</b> 2.1 Selection of problems, suitable approaches and methods 2.2 Meaning of research design 2.3 Need of research design 2.4 Features of good design 2.5 Importance concepts of research design 2.6 Basic principle of experimental design	<b>10</b>	<b>12</b>
<b>3</b>	<b>Data analysis and measurements</b> 3.1 <b>Sampling</b> – Definition and needs 3.2 <b>Scaling</b> – Definition and importance 3.3 <b>Tabulation of data-</b> a) <b>Variables</b> – Definition, types with example b) <b>Frequency distribution</b> - Definition, types and example c) <b>Measurement of central tendency</b> –Definition, types of average – mean, median, mode with example d) <b>Testing hypothesis</b> – Null hypothesis ( H <sub>0</sub> ), Alternative hypothesis (H <sub>1</sub> ), Level of significance and degree of freedom with example	<b>10</b>	<b>06</b>

<b>4</b>	<b>Data presentation (with examples)</b> 4.1 <b>Method of data presentation</b> – a) Bar chart (diagram), b) Pie chart c) Histogram 4.2 <b>Standard deviation (SD)</b> 4.3 <b>Standard error (SE)</b> 4.4 <b>Chi-square test</b> 4.5 <b>Student-t test</b>	<b>08</b>	<b>06</b>
<b>5</b>	<b>Component of research report/paper/project</b> 5.1 Prepare Title, Author and Addresses, key words and Abstract (summary and synopsis) 5.2 <b>Writing of research paper and project- IMMRAD</b> system (Introduction, Material methods, Result and Discussion), Acknowledgement, Summary, Conclusion and references. 5.3 concept of scientific writing 5.4 Meaning of scientific paper 5.5 Write a letter to Editor of scientific journal for publishing a research paper.	<b>18</b>	<b>20</b>
<b>6</b>	<b>Parameters of research</b> 6.1 Writing review of literature ( book and paper) 6.2 Advantages of scientific photographs 6.3 Sources of literature 6.4 Preparation of Cue cards/index card/reference card 6.5 Search engine – Google, Yahoo, Bing, etc 6.6 How search engine works	<b>04</b>	<b>06</b>
<b>Total</b>		<b>60</b>	<b>60</b>

**A) Practicals corresponding to Research methodology (Zoo 364)**

**1.** Define mean, median and mode. Compute the mean and median for the following data of weight of species of Frog.

Weight in grams: 16, 11, 8, 10, 14, 16, 9, 9, 13, and 12.

**2.** Compute the mode of the following data :

Weight of Cat fish in grams: 8, 10, 9, 17, 10, 19, 15, 10, 12, and 19.

**3.** Calculate the simple and complete frequency distribution of the numbers of eggs per nest of the species of bird. Use the following data of 60 nests of birds

2	2	3	6	2	4	1	0	1	2	3	4
4	5	6	4	4	4	2	2	0	1	3	6
2	5	3	5	4	4	2	4	3	1	4	3
1	5	2	2	3	6	4	3	2	3	6	1
2	3	2	5	4	1	2	4	3	3	2	5

4. Compute the S.D. for the following weight in grams of the 06 frogs:  
30,90,20,10,80,70

5. Draw a Pie chart by plotting an area of circle showing 50% (low income people), 15% (Median income people) and 35% (high income people) and show the above income distribution by Bar chart.

6. Draw Bar diagram of following table related to weight of six species of fresh water fish at the age of one year

Sr. No.	Species ( n=10)	Body weight (kg), Mean $\pm$ SD
1	Labeo rohita	1.25 $\pm$ 0.75
2	Cirrhina mrigal	2.10 $\pm$ 0.64
3	Catla catla	2.33 $\pm$ 0.66
4	Cyprinus carpio	1.12 $\pm$ 0.23
5	Tor tor	3.40 $\pm$ 0.76
6	Wallago attu	3.85 0.80

7. Draw histogram length of gold fish by using following data:

Sr. No.	True class interval	frequency
1	3.25 -3.55	2
2	3.55-3.85	5
3	3.85-4.15	11
4	4.15-4.45	5
5	4.45-4.75	2

8. Calculate SE of a sample of 100 fish has mean length of 50 cm with an SD of 5cm.

9. A certain random sample of 100 men from a hill-tribal village gave a mean height of 167cm with a SD of 5cm. Discuss the suggestion that the men of this

tribal village do not form a part of the Dravidian race whose mean height is 170cm.

10. Medical examination of students of city colleges showed that 432 girls out of 1437 and 152 boys out of 441 had defective eye sight. Test whether there is any association between sex and defects in vision

**B) Submission of research Project is compulsory ( at least 15 pages)**

**Reference Books: Research Methodology**

1. Research methodology, for biological science, N. Gurumani, MJP publisher Chennai
2. In Introduction to Biostatistics, N Gurumani, MJP publisher Chennai
3. Research Methodology, Methods and Techniques. C. R. Kothari
4. Hand book of Research methodology, modern methods and New Techniques. M. N. Borase
5. Research Methodology A Handbook. Prof. R. P. Misra
6. Writing good reports. John Bowden
7. How to write and publish a Scientific papers (4th edition). Robert A. Day.
8. Statistical methods for Research workers. M. L. Bansal
9. Better Thesis Writing. Tejinder Singh & N. G. Madhav.
10. Research writings and methodology- Ramdas

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# T.Y.B. Sc. (Zoology) Syllabus w.e.f. June 2017

## Semester VI , Paper -V ZOO- 365

### Microtechnique

Units	Topic	Periods	Marks
1	<b>Introduction</b> -Definition, Scope and Applications of Microtechnique.	2	2
2	<b>Collection of material- Norcotization / Anesthetization.</b> 2.1 Collection of specimen or tissue. 2.2 Kinds of preparation of specimen or tissue. 2.2.1 Whole mounts, Teasing and smearing. 2.3 Preparation whole mounts –Euglena, Paramoecium , Malarial parasites or any smaller organism/chick embryo. 2.4 Fixation -Definition and Importance. 2.5 Theory of fixation. 2.6 Qualities of good fixative. 2.7 Types of fixative –Primary and compound fixatives. 2.7.1 Examples of primary/single fixative- Formaline, Ethyl alcohol.(Ethanol) 2.7.2 Examples of compound fixative-Bouin’s fluid, Zenker’s Fluid and Carnoy’s fluid. 2.8 Specific fixatives for the following- Mitochondria / embryo	12	10
3	<b>Washing</b> 3.1 Theory of washing 3.2 Significance of washing	2	2
4	<b>Dehydration</b> 4.1 Definition , Dehydrating agents-Ethanol, Methanol, Acetone 4.2. Significance and use of dehydrating agents.	2	2
5	<b>Clearing</b> 5.1 Definition and importance 5.2 Clearing agents their merits and demerits- Xylene, Toluene, Benzene, Cedar wood oil, Clove oil.	4	4
6	<b>Embedding and Block making</b> 6.1 Cold and hot infiltration. 6.2 Paraffin 6.3 Selection of paraffin according to need.	10	10

	<p>6.4 Melting and handling of paraffin.</p> <p>6.5 Types of ovens and its uses.</p> <p>6.6 Embedding containers- a)Paper trays b)L-shaped metal pieces c)Glass dishes/Lids.</p> <p>6.7 Embedding procedure, multiple embedding and embedding faults.</p> <p>6.8 Block making, labeling of block and storage of block.</p>		
<b>7</b>	<p><b>Trimming and mounting</b></p> <p>7.1 Trimming and mounting of trimmed block on microtome peg.</p>	<b>2</b>	<b>2</b>
<b>8</b>	<p><b>Section cutting and affixing</b></p> <p>8.1 Microtome types, its uses, precautions and handling of Rotary and Rocking microtome.</p> <p>8.2 Microtome knives – Types, care, sharpening, honing and stropping of knife.</p> <p>8.3 Section cutting- Defects, Possible causes and remedies during section cutting.</p> <p>8.4 Affixing and processing of sections- i)Mayers albumen ii)Slide warmers .</p>	<b>10</b>	<b>12</b>
<b>9</b>	<p><b>Staining</b></p> <p>9.1 Theory of staining.</p> <p>9.2 Types of stain- Acidic, basic, neutral and vital stain.</p> <p>9.3 Preparation of Haematoxyline and Eosin stain.</p> <p>9.4 Mordants - Definition, importance and common mordants.</p> <p>9.5 Double staining- Processing of paraffin section during staining.</p> <p>9.6 special staining methods for Golgi apparatus, Mitochondria and chromosomes.</p>	<b>10</b>	<b>10</b>
<b>10</b>	<p><b>Clearing, Mounting and camera lucida</b></p> <p>10.1 Mounting media-DPX and Canada balsam.</p> <p>10.2 Clearing, labeling and preservation of permanent slides.</p> <p>10.3 Use of camera lucida.</p> <p>10.4 Micrometer scale.</p>	<b>6</b>	<b>6</b>
	<b>Total</b>	<b>60</b>	<b>60</b>

## **Practicals corresponding to ZOO 365 – Microtechnique**

1. Preparation of permanent whole mounts of different kinds- 5 slides.
2. Preparation of permanent slides of histological sections from different mammalian tissues-5 slides.
3. Study of Rotary and Rocking microtome.
4. Vital staining of mitochondria by Janus green B stain.
5. Calibration of micrometer scale of cell diameter from the given permanent slide.
6. Sketching by camera Lucida
7. Submission of permanent slide (5 Whole mounts and 5 histological sections).

### **Reference books on Microtechnique**

1. An Introduction to microtechnique-Patki,Bhalchanda and Jeevaji,S.Chand Publication.
2. Microtechnique (Theory and Practical)-Pathak .
3. Cytological techniques-J. R. Baker.
4. Techniques in life sciences-D.B Tembhare
5. Introduction to medical laboratory technique- F.I Baker & R.E Silverton.
6. General zoological micritechnique – F.M . Weesner.
7. Hand book of basic micro technique-P. Gray.
8. Histochemistry – Vol-I & II-A.G.E. Pearse.
9. Histopathogenic microtechniques-R.D.Lillie.
10. Practical course in Cytology –A.K.Indurkar.
11. Staining methods (Histology & Histochemical)-J.F.A Me Mann & R.W Mowry
12. Histological and Histochemical technique- H.A . Davenport.

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# T. Y. B. Sc. (Zoology) Syllabus w.e.f. June 2017

## Semester VI Paper- VI, Zoo 366 (A)

### Bioinformatics

Unit	Topic	Periods	Marks
1.	1.1 Definition, Objectives and scope of Bioinformatics 1.2 Application of Bioinformatics in various Fields.	04	04
2.	2.1 Computer generations and Type of computer 2.2 Programming Languages: PERL and Java.	08	08
3.	3.1 Biological Databases- Concept and types of databases 3.2 Database retrieval System 3.3 PubMed, ENTREZ, SRS, PIR, ExPASy, Ensembl.	06	06
4.	4.1 Sequence alignment: Global alignment and Local alignment, Significance with example 4.2 BLAST, types and applications. 4.3 FASTA, format and application	08	08
5.	5.1 Proteomics- Definition, Protein structure visualization tools- RasMol and SwissPDB viewer 5.2 Protein sequence databases- PIR, SWISS-PROT, TrMBL 5.3 Structural classification databases- SCOP, CATH, 5.4 Protein folding and disorders 5.5 Applications of Proteomics	14	14
6.	6.1 Genomics- Gene, Genotype, Genome of <i>E. coli</i> , <i>S. cerevisiae</i> , <i>C. elegans</i> , and <i>Homo sapiens</i> . 6.2 Single nucleotide polymorphisms (SNPs), Structure and application of DNA microarray. 6.3 Nucleotide sequence database, GenBank (NCBI, EMBL and DDBJ), cDNA libraries and ESTs, Databases of metabolic pathways- KEGG. 6.4 Genomics in medicine- disease monitoring, Drug designing and development.	05 05 05 05	05 05 05 05
<b>Total</b>		<b>60</b>	<b>60</b>

#### Practicals corresponding to Zoo 366A: Bioinformatics

1. PERL or JAVA programming translation of String of DNA.
2. Demonstrate dot plot method using any programming language.
3. Study of particular human hereditary disease using OMIM website
4. Evaluation of similarity percentage using sequence alignment tool.



5. Visualization of PDB files using SPDBV software.
6. Study of Ramchandran plot of any protein molecule.
7. Login to KEGG homepage to study of any suitable metabolic pathway.
8. Using NCBI resources find out nucleotide database of any one gene on a chromosome of human.
9. Visit to any bioinformatics based laboratory/industry.

#### **References on Bioinformatics:**

1. Aluru, Srinivas, (2006) ed. *Handbook of Computational Molecular Biology*. Chapman & Hall/Crc, ISBN 1584884061 (Chapman & Hall/Crc Computer and Information Science Series)
  2. Attwood, T.K., Michie, A.D. and Jones, M.L. (1996): DbBrowser: integrated access to database worldwide. *TiBS*. Vol. 21(5), 191.
  3. Barnes, M.R. and Gray, I.C.(2003) eds., *Bioinformatics for Geneticists*, first edition. Wiley, ISBN 0-470-84394-2
  4. Curtis Jamison. (2003) *Perl Programming for Biologists*. By Hoboken, NJ: John Wiley & Sons, Inc.
  5. Prakash S.Lohar (2011) *Bioinformatics* ISBN 978-81-8094-066-8 MJP Publishers, Triplicane, Chennai.
  6. Lesk, A.M. (2001): *Introduction to Protein Architecture: The Structural Biology of Proteins* (Oxford: Oxford University Press).
  7. Pocock, M.R. et al. (2000) *BioJava: open source components for bioinformatics*. ACM SIGBIO
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# T. Y. B. Sc. (Zoology) Syllabus w.e.f. June 2017

## Semester VI, Paper VI, ZOO 366 (B)

### Sericulture

Unit No.	Topics	Lectures	Marks
1	<b>Introduction</b> 1.1 Sericulture: Definition, history and present status. 1.2 Scope of sericulture 1.3 Silk producing centers in India and world.	06	06
2	<b>Mulberry silk worm (<i>Bombyx mori</i>)</b> 2.1 Classification, systemic position and distribution. 2.2 Nutrition – factors influencing silkworm growth and development 2.3 Circulatory system of <i>Bombyx mori</i> 2.4 Male reproductive system of <i>Bombyx mori</i> 2.5 Female reproductive system of <i>Bombyx mori</i> 2.6 Life cycle – w.r.t to external and internal morphology of egg, larva, pupa and adult. 2.7 Moulting – structure of integument and cuticle.	10	10
3	<b>Other Silkworm Species.</b> 3.1.1 Muga silkworm 3.1.2 Eri silkworm 3.1.3 Tussar silkworm 3.2 Mulberry silk and Non – Mulberry silk	08	08
4	<b>Endocrine and Exocrine glands</b> 4.1 Structure and function of silk glands 4.2 Endocrine system: Endocrine glands in larva and pupa and synthesis of hormone. 4.3 Hormonal control: metamorphosis, diapause, silk synthesis and reproduction. 4.4 Exocrine glands: Structure, morphology and secretion of exocrine glands. 4.5 Pheromone: sex attractants and their role in mating	10	10
5	<b>Rearing Technology</b> 5.1 Rearing House: Requirements for ideal rearing house –site selection –size of rearing house. 5.2 Model rearing house -B Model –advantages and disadvantages of rearing houses. 5.3 Harvesting of cocoons –time harvesting –hybrid	08	08

	crop of cocoons –preservation and transportation of cocoons. 5.4 Cocoon assessment –significance –cost of cocoon production cocoon ratio -maintenance of rearing records.		
<b>6</b>	<b>Mulberry cultivation.</b> 6.1 Definition of soil, different types of soils in India. 6.2 Importance of soils with reference to mulberry cultivation; soil analysis-soil sampling, soil pH, organic carbon and NPK level. 6.3 Propagation of mulberry-seedling, sapling, grafting and layering. 6.4 Raising of commercial nursery. 6.5 Application of root inducing hormones	<b>12</b>	<b>12</b>
<b>7</b>	<b>Pests, Predators and Parasites of Silkworm</b> 7.1 Pests and predators – Occurrence, Nature of damage and control measures - Uzi fly and Dermestid beetle. 7.2 Diseases of silkworm – Causative agent, source of infection, Symptoms and anagement – Muscardine, Pebrine and Grasserie.	<b>4</b>	<b>4</b>
<b>8</b>	<b>Economical and Commercial importance of sericulture</b>	<b>2</b>	<b>2</b>
<b>Total</b>		<b>60</b>	<b>60</b>

### **Practicals corresponding to Zoo 366 (B) SERICULTURE**

1. Study of different species of silkworm Mulberry silkworm Muga silkworm, Eri silkworm, Tussar silkworm and mulberry silk worm.
2. Study of Silk worm moth (*Bombax mori*) with reference to the following:
  - A) Study of Systematic Position of *Bombax mori*.
  - B) Study of stages of life cycle *Bombax mori*: Egg, Larva, cocoon and adult
  - C) Sexual dimorphism of larva, pupa and moth.
3. Study of Digestives system of *Bombax mori*
4. Mounting of Silk gland and Mouth parts of silkworm.
5. Study of Nervous system *Bombax mori*.
6. Reproductive system of silkworm.
7. Study of Rearing Technology:
8. Study of equipment's in sericulture:
  - a. Rearing tray, b) Foam rubber string,
  - b. Chopping board, d) Chopping knives, mountages- Chandrikas etc.
9. Study of diseases, pets and predators
10. Filed visit/ Compulsory visit to sericulture.

## Reference on Zoo 366 B - Sericulture

1. Modern Entomology: D. B. Tembhare, Himalaya Publishing House, Bombay.
2. A textbook of Agricultural Entomology: Kumar and Nigam Emkay Publications, Delhi.
3. Muga Silk Industry by S. N. Choudhary, Directorate of Sericulture and weaving, Govt. of Assam, 1982.
4. The natures and property of soils (9th edition) N. C. Brady (Mac Millan pub. Co. Inc., New York.
5. Studies on soils of India, S. V. Govind Rajan and H. G. Gopala Rao (1970), Vikas Publ.House Pvt. Ltd., Delhi.
6. Manual on Sericulture; Food and Agriculture Organisation Rome 1976.
7. Appropriate Sericultural Techniques Ed, by M. S. Jolly Director, CSR & TI, Mysore.
8. Handbook of Practical Sericulture : S.R. Ullal and M.N. Narasimhanna CSB, Bangalore 1987.
9. Manual of Silkworm Egg Production: M. N. Narasimhanna, CSB, Bangalore 1988.
10. Silkworm Rearing: Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.
11. The Principle of Insect Physiology: V. B. Wigglesworth: Pub. By English Language Book Soc., Chapman & Hall. 1972.
12. Economics of Sericulture under Irrigated Conditions: M.S. Jolly, CSR & TI, Mysore, 1982.
13. Silk from grub to Glamour: Mahesh M. Nanavathy, Pub. In Indian Paramount House, Bombay, 1965.
14. Principles of Insect Morphology: R. E. Snodgrass, Tata McGraw-Hill, Pub. Co., Ltd., Bombay, 1935.
15. Silk Production, Processing and Marketing: M. M. Nanavaty, V. S. Johari, Wiley Estern Ltd., Ansari Road, Dariyaganj, New Delhi.
16. Textiles (Fiber to Fabric): Bernard P. Corbman, Gregg Division : Mc Graw-Hill Book Company, New Delhi.
17. Principles of Sericulture: Hisao Aruga, Mohan Primlani for Oxford and IBH Publishing Co. Pvt. Ltd., 66, Janpath, New Delhi-110001.

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## T. Y. B. Sc. (Zoology) Syllabus w.e.f. June 2017

### Semester VI, Paper VI, ZOO 366 (C)

#### Applied Zoology II (Vermiculture, Poultry and Fishery)

Unit No.	Topics	Lectures	Marks
1	<p><b>1.1 Vermiculture: Introduction and scope</b></p> <p><b>1.2 Species of earthworm (Classification)</b>  <i>Eisenia foetida</i> (Savigny)  <i>Eudrilus eugeniae</i> (Kinb.)</p> <p><b>1.3 Establishment of vermicomposting and Vermiwash unit:</b></p> <p>i) Biologically degradable material :–Agricultural waste and agro-industry waste</p> <p>ii) Feeding vermicomposting materials :- Materials which should not feed to earthworm, Quantity of material eat by earthworm; Feeding procedure</p> <p>iii) Vermicomposting types: Small scale or Indoor vermicomposting, Large scale or outdoor vermicomposting</p> <p>iv) Physical requirement for vermicomposting : Air; moisture and temperature</p> <p>v) Construction of vermiculture unit: Bedding material; steps of preparation of vermin bed – KISS (Keep It simple and Save) Plan .</p> <p>vi) Set up of vermiwash unit:</p> <p><b>1.4 Factor affecting growth of earthworm:</b> Earthworm and Insect; Tilling and Earthworm population Earthworm and Come Drowning.</p> <p><b>1.5 Earthworm’s Parasites and predators</b> - Mites, Leech, Nematodes, Ciliates, Sporozoans.                      Economic importance of vermicompost and vermiwash</p>	20	20
2	<p><b>2.1 Poultry: Introduction and Scope</b></p> <p><b>2.2 Species of Hens (Classification)</b>                      a. <i>Asil (Aseel)</i>                      b. <i>Brahma</i></p> <p><b>2.3 Housing and equipment of poultry</b> (Feeders; Heaters or Brooders; Incubator with Controller; Egg Tray; Ventilation Fan; Laying Nest; Egg Washer; Water Pots and Drinkers; Cages and Coops; Dressing Machine;</p>	20	20

	Beak trimmer; Sprayer) <b>2.4 Poultry nutrition; Poultry diseases; Poultry care management</b> <b>2.5 Economic importance of egg, flesh, bones, manure,</b>		
3	<b>3.1 Fishery: Importance and Scope</b> <b>3.2 Species of fishes (Classification)</b> <i>a. Labeo rohita</i> <i>b. Catla catla</i> <b>3.3 Construction and maintenance of fish farm</b> <b>Selection of site</b> <b>3.4 Excavation of ponds:</b> Hatchery; Nursery pond; Rearing pond; Stock pond; Common diseases of fish <b>3.5 Fish preservation and processing</b> a. Chilling, b. Freezing, c. Freeze drying, d. Smoking, e. Drying, f. Salting, g. Canning and processing. <b>3.6 Economic importance of fishes</b>	20	20
<b>Total</b>		<b>60</b>	<b>60</b>

**Practicals corresponding to ZOO 366 (C) Applied Zoology III  
(Vermiculture , Poultry and Fishery)**

1. Establishment of vermicompost unit. (E)
2. Establishment of vermiwash unit. (E)
3. Study of poultry breeds: *Aseel, Brahma* (D)
4. Study of poultry equipments. (E)
5. Study of maintenance of aquarium in laboratory. (E)
6. Study of fish breeds: *Labeo rohita* and *Catla catla* (D)
7. Compulsory visits to a vermiculture unit / Poultry farm / Fishery (E)

## **Reference Books on Applied Zoology III (Vermiculture , Poultry and Fishery**

1. Vermicomposting for sustainable agriculture - P.K. Gupta, Publisher - Agrobios, Jodhpur (India)
2. Earthworm in agriculture - Talashilkar and Dosani, Publisher – Agrobios; Jodhpur (India)
3. The complete technology book on vermiculture and vermicompost - National institute of Industrial Research Board, New Delhi (India)
4. Fish and fisheries of India: V.G. Jhingran., Hindustan Publishing orporation (India) Delhi
5. Inland fishes vol. I and II : P.K. Talwar and A.G. Jhingran, Oxford and IBM Publishing Co. Pvt. Ltd.
6. Economic Zoology : Vishwapremi K.K., Akashdeep Publishing House 4374/413 Ansari Road, Darya Ganj, New Delhi 110 002
7. Poultry production – R. A. Singh. Kalyani publishers, New Delhi.
8. A textbook of Animal Husbandry – G. C. Banerjee. Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.

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# NORTH MARARASHTRA UNIVERSITY JALGAON

## Revised Syllabus of T.Y.B.Sc. Zoology (Academic Year 2017-18)

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With course codes, skills, knowledge and job opportunities.

### Semester-V

#### **Paper- I Z00 351: Non-chordates-III**

**Skills** - Student will come know anatomy and physiology of non chordates animals

**Knowledge**-different characters ,classifications, anatomy and physiology.

**Job Opportunities**- Public Health Department like malaria, Eradication program.

#### **Paper -II Z00 352 : Cell and Molecular Biology**

**Skills**-Cell, structure, function and cell culture.

**Knowledge**-Working of different cells, cell organelles.

**Job Opportunities**-Jobs at cell and, molecular laboratories.

#### **Paper - III Z00 353 : Mammalian Histology and Physiology I**

**Skills**- Histology and their corresponding Physiology of different tissues and systems of mammals.

**Knowledge**- Histology and functioning of different tissues and systems of mammals and research importance

**Job Opportunities**- Biochemistry, Pathology and cancer research, etc.

#### **Paper -IV Z00 354 Biochemistry**

**Skills**-Biochemical processes, their reactions and role in life.

**Knowledge**-Biochemistry and role of biochemical in life system.

**Job Opportunities**-Biochemical and food industries.

#### **Paper-V Z00 355 Systematics, Evolution and Palaeontology**

**Skills** –Classification of animals, Fossils study and geographical distribution of animals.

**Knowledge**- Classification of animals, Fossils study and geographical distribution of animals.

**Job Opportunities**- Zoological Parks, Sanctuaries, Animal museum and Archaeology department



**Paper –VI Z00 356 (A)Biotechnology**

**Skills** –Biotechnological methods.

**Knowledge**-Gene action, gene mutation ,gene manipulation.

**Job Opportunities**-Biotechnological laboratories, food and pharmaceutical industries.

**Paper –VI Z00 356 (B)Pest Management**

**Skills** –Study of different kind of Pest Identification, nature of damage and their control measures

**Knowledge**- Study of different kind of Pest, their life cycle and their economic importance

**Job Opportunities**-Agricultural and environmental department, Pesticide industry and Self employment

**Paper –VI Z00 356 (C)Public health and hygiene**

**Skills** –Study of different kind of Pest and their control

**Knowledge**- Study of different kind of Pest, their life cycle and their economic importance

**Job Opportunities**-Agricultural department, Pesticide industry and Self employment

**Practical VII : Practical I ( Zoo 357)**

**Practical VIII : Practical I ( Zoo 358)**

**Practical XI : Practical I ( Zoo 359)**

(Skills , knowledge and job opportunities as mentioned in their theory courses)

**Semester- VI**

**Paper -I Z00 361 Chordates-III**

**Skills**-life of different chordates

**Knowledge**-Anatomy and physiology of different chordates.

**Job Opportunities**-Forest, animal husbandry and museum.

**Paper-II Z00 362 General embryology**

**Skills**- Development of different animals.

**Knowledge**- Development of different animals of economic and research importance.

**Job Opportunities**-Developmental biology and Cell biology Departments, fisheries, Poultry etc.

### **Paper - III Z00 363 : Mammalian Histology and Physiology II**

**Skills-** Histology and their corresponding Physiology of different tissues and systems of mammals.

**Knowledge-** Histology and functioning of different tissues and systems of mammals and research importance

**Job Opportunities-** Biochemistry, Pathology and cancer research, etc.

### **Paper –IV Z00 364 Research Methodology**

**Skills-**Different methods of research.

**Knowledge-**Scientific basis of various research methods.

**Job Opportunities-**Different research laboratories and surveys.

### **Paper V Z00 365 Microtechnique**

**Skills-**Preparation of permanent whole mounts, microscopic slides and staining reactions.

**Knowledge-**Cell-tissue structure, histology of tissues and details of morphology of animals

**Job Opportunities-**Health institutes, Hospitals and Pathological labs.

### **Paper VI Z00 366 (A) Bio-informatics**

**Skills-**taxonomical knowledge and computer operations

**Knowledge-**Software development

**Job Opportunities-** Various bioinformatics companies.

### **Paper –VI Z00 356 (B) Sericulture**

**Skills –** Life cycle of silk moth.

**Knowledge-**Life cycle, silk production .

**Job opportunities-**Sericulture department, industry and self employment.

### **Paper –VI Z00 356 (C) Applied Zoology III (Vermiculture , Poultry and Fishery)**

**Skills –**Biofertilizer /vermicompost production, Rearing and production of birds in captivity and business of aquatic animals

**Knowledge-** Biofertilizer /vermicompost production, Rearing and production of birds and life of aquatic animals.

**Job opportunities-**Fishery department, poultry business and vermiculture industry, self employment.

### **Practical VII : Practical I ( Zoo 367)**

### **Practical VIII : Practical I ( Zoo 368)**

### **Practical XI : Practical I ( Zoo 369)**

**(Skills, knowledge and job opportunities as mentioned in their theory courses)**

**NORTH MARARASHTRA UNIVERSITY  
JALGAON  
T.Y.B. Sc.ZOOLOGY**

**Equivalence for old syllabus 2014**

**Semester V**

<b>Codes : 2014 old syllabus</b>	<b>Codes : 2017 new syllabus</b>
ZOO -351	ZOO -351
ZOO - 352	ZOO - 352
ZOO -353	ZOO -353
ZOO - 354	ZOO - 354
ZOO -355	ZOO -355
ZOO - 356	ZOO - 356
ZOO – 307	ZOO- 357
ZOO -308	ZOO-358
ZOO - 309	ZOO -359

**Semester VI**

<b>Codes : 2014 old syllabus</b>	<b>Codes : 2017 new syllabus</b>
ZOO -361	ZOO -361
ZOO - 362	ZOO - 362
ZOO -363	ZOO -363
ZOO - 364	ZOO - 364
ZOO -365	ZOO -365
ZOO - 366	ZOO - 366
ZOO – 307	ZOO- 367
ZOO -308	ZOO-368
ZOO - 309	ZOO -369

**NORTH MAHARASHTRA UNIVERSITY, JALGAON**  
**PROPOSED SYLLABUS STRUCTURE FOR TYBSc ZOOLOGY**  
**Proposed syllabus structure for TYBSc Zoology ; Year of 2017-18 ( Semester V and VI)**

Course code	Name of course	Teaching scheme				Theory (Marks)		Practical (Marks)		Total Marks	Credits
		Teaching Hrs/Week	Tut.Hrs/Week	PR Hrs./Week	Total Hrs/Week	CA	UA	CA	UA		
Zoo-351	Non-chordates III	3	1	0	4	40	60	0	0	100	3
Zoo 352	Cell and Molecular biology	3	1	0	4	40	60	0	0	100	3
Zoo 353	Mammalian Histology and Physiology I	3	1	0	4	40	60	0	0	100	3
Zoo 354	Biochemistry	3	1	0	4	40	60	0	0	100	3
Zoo 355	Systematics, Evolution and Palaeontology	3	1	0	4	40	60	0	0	100	3
Zoo 356	A) Biotechnology	3	1	0	4	40	60	0	0	100	3
	B) Pest management	3	1	0	4	40	60	0	0	100	3
	C) Public health and hygiene	3	1	0	4	40	60	0	0	100	3
Zoo 357	Practicals related to Zoo 351 and Zoo 353	0	0	4	4	0	0	40	60	100	3
Zoo 358	Practicals related to Zoo 352 and Zoo 355	0	0	4	4	0	0	40	60	100	3
Zoo 359	Practicals related to Zoo 354 and Zoo 356	0	0	4	4	0	0	40	60	100	3
Zoo 361	Chordates III	3	1	0	4	40	60	0	0	100	3
Zoo 362	General Embryology	3	1	0	4	40	60	0	0	100	3
Zoo 363	Mammalian Histology and Physiology II	3	1	0	4	40	60	0	0	100	3
Zoo 364	Research Methodology	3	1	0	4	40	60	0	0	100	3
Zoo 365	Microtechnique	3	1	0	4	40	60	0	0	100	3
Zoo 366	A) Bioinformatics	3	1	0	4	40	60	0	0	100	3
	B) Sericulture	3	1	0	4	40	60	0	0	100	3
	C) Applied Zoology III (Vermiculture, Poultry and Fisheries)	3	1	0	4	40	60	0	0	100	3
Zoo 367	Practicals related to Zoo 361 and Zoo 363	0	0	4	4	0	0	40	60	100	3
Zoo 368	Practicals related to Zoo 362 and Zoo 365	0	0	4	4	0	0	40	60	100	3
Zoo 369	A) Practical related to Zoo 364, Zoo 366 and Project work	0	0	4	4	0	0	40	60	100	3

CA: College Assessment, UA: University Assessment

**NORTH MAHARASHTRA UNIVERSITY, JALGAON**  
**Syllabus Distribution : Hours per Semester**  
**Subject : Zoology**

Class	Course Code	Name of Course	Hours per Week	Total Hrs per semester
FYBSc	ZOO 111	Non chordate I	3	45
	ZOO 112	Cell Biology	3	45
	ZOO 113	Practical related to Zoo 111 and Zoo 112	4	45
	ZOO 121	Chordate I	3	45
	ZOO 122	Applied Zoology I (Goatary and Lac Culture)	3	45
	ZOO 103	Practical related to Zoo 121 and Zoo 122	4	45
SYBSc	ZOO 231	Non chordate II	4	60
	ZOO 232	Medical Zoology	4	60
	ZOO 233	Practical related to Zoo 231 and Zoo 232	4	60
	ZOO 241	Chordate II	4	60
	ZOO 242	Applied Zoology II ( Apiculture)	4	60
	ZOO 243	Practical related to Zoo 241 and Zoo 242	4	60
TYBSc	Zoo 351	Non-chordates III	4	60
	Zoo 352	Cell and Molecular biology	4	60
	Zoo 353	Mammalian Histology and Physiology I	4	60
	Zoo 354	Biochemistry	4	60
	Zoo 355	Systematics, Evolution and Palaeontology	4	60
	Zoo 356	A) Biotechnology	4	60
		B) Pest management	4	60
		C) Public health and hygiene	4	60
	Zoo 357	Practicals related to Zoo 351 and Zoo 353	4	60
	Zoo 358	Practicals related to Zoo 352 and Zoo 355	4	60
	Zoo 359	Practicals related to Zoo 354 and Zoo 356	4	60
	Zoo 361	Chordates III	4	60
	Zoo 362	General Embryology	4	60
	Zoo 363	Mammalian Histology and Physiology II	4	60
	Zoo 364	Research Methodology	4	60
	Zoo 365	Microtechnique	4	60
	Zoo 366	A) Bioinformatics	4	60
		B) Sericulture	4	60
		C) Applied Zoology III (Vermiculture, Poultry and Fisheries)	4	60
	Zoo 367	Practicals related to Zoo 361 and Zoo 363	4	60
Zoo 368	Practicals related to Zoo 362 and Zoo 365	4	60	
Zoo 369	A) Practical related to Zoo 364, Zoo 366 and Project work	4	60	

**NORTH MAHARASHTRA UNIVERSITY, JALGAON**  
**Syllabus Distribution : Credits per Semester**  
**Subject : Zoology**

<b>Class</b>	<b>Credit per semester</b>		<b>Total</b>	
<b>FYBSc</b>	<b>Semester I</b>	<b>ZOO 111</b>	<b>2</b>	<b>7</b>
		<b>ZOO 112</b>	<b>2</b>	
		<b>ZOO 113</b>	<b>3</b>	
<b>FYBSc</b>	<b>Semester II</b>	<b>ZOO 121</b>	<b>2</b>	<b>7</b>
		<b>ZOO 122</b>	<b>2</b>	
		<b>ZOO 103</b>	<b>3</b>	
<b>SYBSc</b>	<b>Semester III</b>	<b>ZOO 231</b>	<b>3</b>	<b>9</b>
		<b>ZOO 232</b>	<b>3</b>	
		<b>ZOO 233</b>	<b>3</b>	
<b>SYBSc</b>	<b>Semester IV</b>	<b>ZOO 241</b>	<b>3</b>	<b>9</b>
		<b>ZOO 242</b>	<b>3</b>	
		<b>ZOO 243</b>	<b>3</b>	
<b>TYBSc</b>	<b>Semester V</b>	<b>Zoo 351</b>	<b>3</b>	<b>27</b>
		<b>Zoo 352</b>	<b>3</b>	
		<b>Zoo 353</b>	<b>3</b>	
		<b>Zoo 354</b>	<b>3</b>	
		<b>Zoo 355</b>	<b>3</b>	
		<b>Zoo 356</b>	<b>3</b>	
		<b>Zoo 357</b>	<b>3</b>	
		<b>Zoo 358</b>	<b>3</b>	
		<b>Zoo 359</b>	<b>3</b>	
<b>TYBSc</b>	<b>Semester VI</b>	<b>Zoo 361</b>	<b>3</b>	<b>27</b>
		<b>Zoo 362</b>	<b>3</b>	
		<b>Zoo 363</b>	<b>3</b>	
		<b>Zoo 364</b>	<b>3</b>	
		<b>Zoo 365</b>	<b>3</b>	
		<b>Zoo 366</b>	<b>3</b>	
		<b>Zoo 367</b>	<b>3</b>	
		<b>Zoo 368</b>	<b>3</b>	
		<b>Zoo 369</b>	<b>3</b>	

# NORTH MAHARASHTRA UNIVERSITY, JALGAON

Syllabus Distribution : Credits per subject group

Subject : Zoology

Subject code	Semester						Total
	I	II	III	IV	V	VI	
ZOO 111	2	0	0	0	0	0	7
ZOO 112	2	0	0	0	0	0	
ZOO 113	3	0	0	0	0	0	
ZOO 121	0	2	0	0	0	0	7
ZOO 122	0	2	0	0	0	0	
ZOO 103	0	3	0	0	0	0	
ZOO 231	0	0	3	0	0	0	9
ZOO 232	0	0	3	0	0	0	
ZOO 233	0	0	3	0	0	0	
ZOO 241	0	0	0	3	0	0	9
ZOO 242	0	0	0	3	0	0	
ZOO 243	0	0	0	3	0	0	
ZOO 351	0	0	0	0	3	0	27
ZOO 352	0	0	0	0	3	0	
ZOO 353	0	0	0	0	3	0	
ZOO 354	0	0	0	0	3	0	
ZOO 355	0	0	0	0	3	0	
ZOO 356	0	0	0	0	3	0	
ZOO 357	0	0	0	0	3	0	
ZOO 358	0	0	0	0	3	0	
ZOO 359	0	0	0	0	3	0	
Zoo 361	0	0	0	0	0	3	27
ZOO 362	0	0	0	0	0	3	
ZOO 363	0	0	0	0	0	3	
ZOO 364	0	0	0	0	0	3	
ZOO 365	0	0	0	0	0	3	
ZOO 366	0	0	0	0	0	3	
ZOO 367	0	0	0	0	0	3	
ZOO 368	0	0	0	0	0	3	
ZOO 369	0	0	0	0	0	3	