SCIENCE FACULTY

NORTH MAHARASHTRA UNIVERSITY, JALGAON

SYLLABUS

FOR

T. Y. B. Sc.

Zoology

(With effect from June - 2014)

Sem-V. Paper I.
ZOO 351: NON CHORDATES- III

Unit No.	Topic	Period	Marks
I 1	Study of grasshopper w. r. t. following:- 1.1 Systematic position habit & habitat 1.2 External characters - Shape-size and color, Division of body – Head, thorax and abdomen, legs.	02	01
2	Digestive System - 2.1 Alimentary canal, 2.2.Digestive glands, 2.3. Feeding and Digestion.	04	04
3	Circulatory system of grasshopper – 3.1.Haemocoel, 3.2 Haemolymph, 3.3.Heart and aorta, 3.4. Circulation of blood.	03	03
4	Respiratory system of grasshopper – 4.1Spiracles, 4.2. Trachea.	02	02
5	Excretory System of Grasshopper.	02	02
6	Nervous system of grasshopper. 6.1. Central Nervous system. 6.2. Peripheral nervous system. 6.3. Autonomous nervous system.	03	04
7.	Reproductive system of grasshopper- 7.1.Male reproductive system 7.2 Female reproductive system. 7.3 Development	08	06
II 1	Study of sea star w. r. t. following 1.1 Systematic position, habit & habitat. 1.2 External characters – shape, size and color, body wall.	04	02
2.	Digestive System - 2.1 Alimentary canal, 2.2.Digestive glands, 2.3. Feeding and Digestion.	06	06
3.	Circulatory system: Haemal and perihaemal	04	04

4.	Nervous system	04	04
5.	Reproductive system: Gonad, Fertilization and development	06	06
III	General topics- 1. Canal system in sponges. 2. Larval forms in crustacean. 3. Foot in mollusca. 4 Water vascular system in Echinoderms.	12	16
	TOTAL	60	60

Practicals on ZOO 351

1. Study of external characters and sexual dimorphism of grasshopper
2. Study of digestive system of grasshopper
3. Study of heart and aorta of grasshopper
4. Study of nervous system of grasshopper
5. Study of male and female reproductive system of grasshopper
6. Study of haemocytes, mouthparts, trachea, spiracles, cornea and antenna of grasshopper
7. Study of external characters (Oral and aboral view)
8. Study of digestive system of Sea star
9. Study of various canal system in sponges
10. Study of crustacean larvae
11. Study of modification of foot in mollusca
12. Study of water vascular system in echinoderms.

REFERENCE BOOKS ON ANATOMY OF NON-CHORDATES

1. A text book of Zoology: Invertebrate Vol I- Marshall and William, C BS publishers, New Delhi.
2. The Invertebrates - Hymen L. H. , Mc. Graw Hill
3. The Invertebrates- Barnes R. O., W. B. Saunders & Co.
4. The Invertebrates- Jordan, E. L., S. C. chand, New Delhi.
5. The Invertebrates- Kotpal, R. L., Rastogi publications, Meerut
6. Life of Invertebrates- S. N. Prasad, Vikas publishing house, New Delhi
7. Modern Text book of Zoology- Kotpal, R. L., Rastogi publications, Meerut
8. A text book of Zoology- R. D. Visyarthi
9. Invertebrate Zoology- Dhami and Dhami

Sem- V. Paper II

ZOO 352: Cell and Molecular Biology

Unit	Particulars	Lectures	Marks
1.	Introduction to Cell biology and Molecular Biology	02	02
2.	Study of cell organelles with reference to ultra structure and functions of the - Mitochondria; Endoplasmic reticulum; Golgi complex; Lysosomes; Ribosomes and Nucleus	10	10
3.	3.1 Cell division – Mitosis and Meiosis 3.2 Cell Cycle – stages of cell cycle; regulation of cell cycle	06	06
4.	Cell Signaling - Intracellular signaling; Categories of signaling; Types of signal; Receptors; Signal transduction by hormones; Receptors of special importance.	06	06
5.	Nucleic Acid - Chemical composition of DNA and RNA; Watson and Crick model of DNA molecule; Different forms of DNA (B, A and Z-form); Properties of DNA (Acid-base, Viscosity, Sedimentation behavior, Denaturation and renaturation, Molecular weight); Mitochondrial and Chloroplast DNA; RNA: Genetic RNA- RNA tumor virus, RSV and HIV; RNA: Non genetic – mRNA, tRNA and rRNA their structure and functions; DNA replication – semi conservative;	10	10
6.	Gene and Genetic code - Introduction, Concept of gene, one gene one polypeptide theory; Genetic code, properties of genetic code, wobble hypothesis; Lac Operon	08	08
7.	Protein Biosynthesis – Eukaryotes – Transcription; Translation	08	08
8.	Tools and Techniques in Molecular Biology - Polymerase chain reaction (PCR); Electrophoresis- PAGE, SDS- PAGE and Agarose gel electrophoresis; Southern, Northern and Western blotting techniques; ELISA technique and DNA finger printing	10	10
	Total	**60**	**60**

Practical corresponding to Cell and Molecular Biology

(Any eight)

1) Study of different cell organelles by using microphotographs

2) 2.a Study of Mitosis by Suitable material

2.b Study of Meiosis by Suitable material

3) Cell fractionation

4) Preparation of Paper Model of DNA

5) Extraction of DNA from rat liver/ Spleen

6) Estimation of DNA from suitable material by Diphenylamine reagent.

7) Estimation of RNA from suitable material by Orcinol reagent.

8) Agarose gel electrophoresis staining and identification of DNA.

9) Vital staining of mitochondria by using Janus Green B stain.

10) Preparation of salivary gland chromosome from chironomus or Drosophila larva.

Reference Books

1) Lodish et al: Molecular and Cell Biology (Scientific American Book)

2) De Roberties and De Roberties: Cell and Molecular Biology (Saunders College)

3) A C Giese: Cell Physiology

4) Prescott, DM: Reproduction in eukaryotic cells (Academic Press)

5) Wilson, EB: Cell in Development and Inheritance (MacMillan)

6) Edward Gasque: Manual of Laboratory Exp. in Cell Biology (W.C. Brown Publishers)

7) Stryer, L: Biochemistry (Freeman)

8) Conn et al: Outline of Biochemistry (Wiley)

9) Watson J. D. et al: Molecular Biology of Gene (Benzamin/ Cummings)

10) P. S. Lohar. Cell and Molecular Biology, M.J.P. Publisher, Chennai.

Sem V Paper-III
ZOO 353: Developmental Biology

Unit 1 Introduction P-02,M-04

Definition and scope of Developmental Biology in human welfare.

Unit-2. Gametogenesis and Reproductive Cycles P-10,M-15

2.1 Definition and Types.

2.2 Spermatogenesis structure of typical mammalian sperm, Types of sperm.

2.3 Oogenesis, Types of egg - alecithal microlelithal, macrolecithal homolecithal,telolecithal and centrolecithal.

2.4 Reproductive cycle-oestrus and menstral.

Unit-3-Fertilization P-10,M-15

31.Definition , External fertilization and internal fertilization.

3.2 Process of fertilization, types of fertilization and significance.

3.3 Parthenogenesis - Definition, types and significance.

Unit-4-Cleavage P-08,M-12

4.1 Definition, characteristic, significance.

4.2 Patterns of cleavage – radial, bilateral and Spiral.

4.3 Types of cleavage – a) holoblastic equal and unequal b) Meroblastic - Discoidal and superficial c) Determinate and indeterminate.

Unit-5-Blastulation and Gastrulation P-06,M-08

5.1 Blastulation- Definition and Types of blastulae, blastulation in amphioxus and frog, significance.

5.2 Gastrulation - Definition, morphogenetic movement in amphioxus and frog.

Unit-6- Development of Chick P-10,M-15

6.1 Structure of hen's egg.

6.2 Cleavage and blastulation.

6.3 Gastrulation – development of primitive streak.

6.4 Formation of head fold and somites.

6.5 Development of chick upto 72 hours.

6.6 Extra embryonic membranes and their functions.

Unit-7-Placenta P-06,M-09

7.1 Definition and types of placenta in mammals.

7.2 Deciduate and indeciduate.

7.3 Diffuse, cotyledonary, zonary and discoidal.

7.4 Epitheliochorial, syndesmochorial, haemochorial, endotheliochorial and haemoendothelial.

Unit-8-General Topics P-08,M-12

8.1 Regeneration in invertebrates and vertebrates.

8.2 Metamorphosis - Amphibian metamorphosis.

8.3 Causes of sterility in male and female, Treatment of sterility, artificial insemination in man, Test tube baby: Technique, Advantages and disadvantages.

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ZOO – 322 PRACTICAL ON DEVELOPMENTAL BIOLOGY

1. Study of sperms of Amphioxus, frog, Bird and Mammal.
2. Study of types of eggs.
3. Study of blastulae and gastrulae of Amphioxus, frog, Bird.
4. Temporary mounting of chick embryo.
5. Study of whole mounts of chick embryos – primitive streak, 24 hrs, 33 hrs, 48 hrs, 72 hrs.
6. Study of different types of placenta with suitable histological slides or charts.
7. Study of metamorphosis in frog by suitable specimens/charts/models
8. Study of regeneration in any suitable animal.

Reference books

1. Developmental Biology, 1997, 3rd Edition, Gilbert S.F.Saunder, Associates Inc. U.S.A.
2. Developmental Biology, 1992, 3rd Edition, Browder L.W Erickson C.A and Williams, R.J Saunders college, publications, London.
3. A Text book of Embryology, Dr Puranik P.G, S.Chand and co.
4. Developmental Biology 1984, Browder L.W, Saunders college publications, U.S.A.
5. Development of chick embryo, 1972, Lillie.
6. Developmental Biology, 1991, 3rd Edition, sinaur Associates, Inc. U.S.A.
7. Developmental Biology, By Sastry and shukla Rastogi publication.
8. A Text book of Embryology, By Sandhu, Srivastava and Arora. Anmol publications pvt. Ltd. New Delhi.
9. An introduction to Embryology (1984) By Balinsky B.L. Saunders college, Philadelphia.
10. Principle of Developmental Biology By Suresh C. Goel. Himalaya publishing House.
11. Developmental Biology By Gilbert.
12. Chordate Embryology, Developmental Biology by P.S Verma and V.K Agrawal, S.Chand and Company Ltd.

SEM. V Paper-IV

ZOO 354 : BIOCHEMISTRY

Total P- 60, M- 60.

Unit 1: Introduction to biochemistry, objectives, scope and importance. P-1, M-0.

Unit 2: pH and Buffers P-5, M-6.

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

Unit 3: Molecular Interactions P-4, M-6.

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.

Unit 4: Carbohydrates P-8, M-8.

4.1 Definition, classification and their biological importance.

4.2 Isomerism: a) Structural – chain isomer, positional isomer, functional isomer.

b) Sterioisomerism- optical & geometrical isomerism, optical activity

4.3 Monosaccharides-

a) monosaccharides and their biological importance - trioses, tetraoses, pentoses, Hexoses, Aldo and Keto sugars.

b) Structure of glucose

c) Mutarotation.

d) Physical properties of glucose

e) Chemical properties- Oxidation and reduction reaction, ester formation, glycoside formation, osazone formation.

4.4 Disaccharides – Structure and significance of Maltose, Isomaltose, Lactose and Sucrose.

4.5 Polysaccharides- Starch, Glycogen, Cellulose and Chitin (Structural formulae not expected).

Unit 5: Lipids P-8, M-8.

5.1 Definition, classification with examples and their biological importance.

5.2 Fatty acids-

a) Saturated and Unsaturated.

b) Essential and Non-essential fatty acids.

c) Examples- Prostaglandins, Acyl glecerol and waxes.

d) Physical properties of fatty acids

e) Chemical properties- Saponification, hydrolysis, Rancidity, and antioxidant.

5.3 Occurrence and significance of

a) Phospholipids- Lecithin and Cephalin

b) Spingolipids

c) Glycolipids- Cerebrosides, gangliosides

d) Lipoproteins

e) Isoprenoids- steriosides (Cholesterol and sex hormones), Terepenoids.

5.4 Biological and clinical significance of lipids (Obesity, artherosclerosis, myocardial infarction).

Unit 6: Amino acids P-7, M-8.

6.1 Definition, basic structure, classification and biological importance of amino acids.

6.2 Essential, semi-essential and non-essential amino acids; Non-protein amino acids

6.3 Properties of amino acids-

a) Physical properties

b) Chemical properties- reactions of amino acids due to amino, carboxylic and R- groups.

Unit 7: Proteins P-9, M-8.

7.1 Definition, biological significance

7.2 Classification with examples-

According to solubility, structure based on fibrous and globular proteins

7.3 Increasing complexity into their structures- simple, conjugated and derived proteins

7.4 Structure of proteins- primary, secondary, tertiary and quaternary

7.5 Denaturation of proteins.

Unit 8: Enzymes P-8, M-8.

8.1 Definition, types and classification (Outline)

8.2 Properties of enzymes

8.3 Mechanism of enzyme action –

concept of active sites, lock and key model and induced fit model.

8.4 Factors affecting enzymatic activity

a) Substrate concentration,

b) Enzyme concentration,

c) pH,

d) Temperature,

e) Activators and Inhibitors (Competitive and non- competitive)

8.5 Coenzymes, cofactors and prosthetic groups.

8.6 Isoenzymes- Definition, Lactate dehydrogenase, significance.

8.7 Clinical significance of enzymes- SGOT and SGPT.

Unit 9: Vitamins (Structural formulae not expected) P-10, M-8.

9.1 Definition, classification- Fat and Water soluble.

9.2 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.

ZOO 314 PRACTICALS ON BIOCHEMISTRY

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 proteins and fats

Minor experiments (Any four)

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: Five 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- Ranganatha Rao, Prentice Hall of India.

Sem. V Paper V Course

ZOO 355: Research Methodology

Unit No.	Topic	Period	Weightage of Marks
1.	**Unit 1: Definition, Introduction and scientific approach of research** 1.1 Meaning and objectives of research 1.2 Motivation in research 1.3 Types of research 1.4 Significance of research 1.5 Research methods Versus methodology 1.6 Research and scientific methods 1.7 Research process 1.8 Criteria of good research 1.9 Need of research in developing countries	**10**	**14**
2.	**Unit 2: Research Design** 2.1 selection of Problem and suitable approach and methods 2.2Meaning of research design 2.3 Need of research design 2.4 Features of good design 2.5 Concepts of research design 2.6 Basic principles of experimental design	**10**	**10**

3.	**Unit 3: Data analysis and measurement** 3.1 Definition of sampling and need of sampling 3.2 Definition and importance of Scaling 3.3 Tabulation of data a)Frequency distribution b) Measurement of central tendency: Mean, Median and Mode c)Testing hypothesis (any one example)	**08**	**06**
4.	**Unit 4: Data presentation,** 4.1 Methods of data presentation a)The Bar chart b) Pie chart c) Histogram 4.2 Student –t- test 4.3 Chi-Square test 4.4 Standard deviation and standard error	**10**	**08**
5.	**Unit 5: Components of Research Report /paper / project** 5.1 Concept of scientific writing 5.2 Write a letter to editor of scientific journal for publishing a research Paper 5.2 Meaning of a scientific paper 5.3 Prepare an Abstract and Title 5.4 Project writing, writing of research paper - Acknowledgement, Introduction, Materials and	**18**	**20**

	Methods, Results and Discussion(IMMRAD), References, Advantages of scientific photographs		
6.	**6.1 Writing review of literature(book, paper etc)** 6.2 Sources of literature, Preparation of cue card. 6.3 Search engines – google, yahoo, Microsoft – etc. 6.4 How search engine works	**04**	**04**
	Total	**60**	**60**

Submission of research project is compulsory

REFERENCES BOOKS ON RESEARCH METHODOLOGY

1. Research Methodology, Methods and Techniques. C. R. Kothari

2. Hand book of Research methodology, modern methods and New Techniques. M. N. Borse

3. Research Methodology A Handbook. Prof. R. P. Misra

4. Writing good reports. John Bowden

5. How to write and publish a Scientific papers (4th edition). Robert A. Day.

6. Statistical methods for Research workers. M. L. Bansal

7. Better Thesis Writing. Tejinder Singh & N. G. Madhav.

8.Research writings and methodology- Ramdas

Paper VI : ZOO-356 (D)

Aquaculture and Fisheries

			Periods	Marks
Unit 1		Aquaculture: Introduction and importance		
Unit 2		Physiochemical and biological factors during aquaculture	**6**	**6**
		a. Physical condition of water: depth, temperature, turbidity and light b. Chemical conditions of water: Dissolved gases- O2, CO2, pH, total alkalinity, total hardness, dissolved solids c. Biological conditions of water: Aquatic vegetation and animal communities in various zones of water		
Unit 3		The Soil	**6**	**5**
		a. Types of soil b. Soil fertility c. Chemical conditions of soil d. Calcium carbonate-phosphorus system e. Iron-phosphorous system		
Unit 4		Productivity of fish pond	**5**	**5**
		a. Food chain b. Concept of productivity c. Methods of measuring productivity d. Classification of water bodies		
Unit 5		Economic importance of fishes in brief	**8**	**8**
		a. Fish as food of human b. Fish as feed of cattle c. Fish manure d. Fish oil e. Fish glue and Ising glass f. Fish leather g. Fish Fine h. Biological control		
Unit 6		Pond maintenance and improvement	**4**	**4**
		a. Controlling the vegetation b. Clearing the vegetation		

		c. Liming d. Fertilization e. Fish Food		
Unit 7	i) ii)	Construction and maintenance of fish farm Selection of site Excavation of ponds:- a) Hatchery b) Nursery pond c) Rearing pond d) Stock pond	**6**	**6**
Unit 8		Fish culture in fresh water:	**6**	**6**
		Growth, maturation & fecundity and breeding habits of Some cultivable species		
		a. Catla catla. b. Labio rohita c. Cirrhina mrigala. d. Cyprinus carpio e. Tilapia f. Clarias batrachus		
Unit 9		Fish preservation and processing	**6**	**6**
		a. Causes of spoilage of fish. b. Methods of preservation: i. Chilling, ii. Freezing, iii. Freeze drying, iv. Smoking, v. Drying, vi. Salting, vii. Canning & processing.		
Unit 10		Common diseases of fish and their cure	**7**	**8**
		a. Skin parasites &diseases: i. Fish louse Argulus ii. Anchor worm iii. Fish leech iv. *Yellow* grubs. b. Diseases of gills : i. Twin worm		

		ii. Ox-head Worm iii. Protozoan parasites. iv. Gill rot. c. Diseases caused by bacteria and viruses. i. Tail rot ii. Dropsy. d. Control of parasites		
Unit 11		Preparation and maintenance of Aquarium	**4**	**4**
Unit 12		Fishery Schemes: a. District Level Schemes b. State Level Schemes c. Centrally Sponsored Schemes	**2**	**2**
			Total **60**	**Total 60**

PRACTICALS				
	1.	Aquaculture instrumentation:		
		a. Nansen's bottle b. Reversing thermometer c. Secchi disc, d. BOD incubator e. Peterson dredge		
	2.	Study of different types of scales (E)		
	3.	Study of different types of fins (D)		
	4.	Study of maintenance of aquarium in laboratory (D)		
	5.	Principle fresh water cultivable fishes and their economic importance: (D) a. Catla catla b. Labeo rohita c. Cirrhina mrigala d. Cyprinus carpio e. Clarias batrachus f. Tilapia mossabica		
	6.	Fecundity of any local fish (E)		

	7.	Analysis of gut content (E)		
	8.	Visit to fish farm / fishery pond / water reservoir		

References:

1	Fish and fisheries of India: V.G. Jhingran., Hindustan Publishing orporation (India) Delhi
2	Inland fishes vol.I and II : P.K. Talwar and A.G. Jhingran, Oxford and IBM Publishing Co.PVt.Ltd
3	Economic Zoology : Vishwapremi K.K. , Akashdeep Publishing House 4374/413 Ansari Road, Darya Ganj, New Delhi ll0 002
4	A Text book of fish biology and Indian fisheries: R.P. Parihar., Central Publishing House. Allahabad.
5	An Introduction to fishes: S.S. Khanna, Central Book Depot, Allahabad.
6	Hypophysation of Indian Major carps : Chandar S., Satish Book Enterprise
7	The wealth of India (Vol.IV) CSIR, New Delhi

Sem- V. P-VI

ZOO 356 : Animal Behavior

Sr. No.	Syllabus	No of Period	Marks
1	**Introduction** Branches of Ethology; What is behavior? Behavioral Ecology, Sociology	**02**	**02**
2	**Feeding & Ant predator Behavior** Food preference – Feeding Techniques using tools in group, living Herbivorous, Social carnivorous, ant-prebel concealment ,camouflage, warning coloration & mimicry, freezing ,escape, social ant ipre behavior ,confusion effects ,Detection, the development of anti pre behavior	**04**	**04**
3	**Aggression** Forms of Aggressive behavior, Aggression & Competition, Types of Aggressive behavior, Social Use of Space ,Size Boundaries of Territory, Territorial Model, Dominance, Dominance Hierarchies, Dominance in Females, Dominance in Males, Advantage of Dominance, Factor affecting Aggression, Limbic System, Hormone, Genetic Control, External Factors in Aggression, Learning & Experience, Pain & Frustration, Xenophobia, Crowding, Breeding, Feeding, Restraint of Aggression, Displays, Evolutionary Model, Relevance for Humans, Social Control & Disorganization, Conclusion	**12**	**12**
4	**Learning** Forms of Learning, Habituation, Classical Conditioning, Operant Conditioning or instrumental Learning, Mechanisms of Learning, Phylogeny of learning, Learning of vertebrates, Neural Mechanism of Learning.	**06**	**06**
5	**Biological Communication** How Signals Convey Information, Discrete & Graded Signals, Distance & Duration, Composite Signals, Syntax & Context, Metacommunication, Information & Manipulation, Messages and their Meanings, Signals, Measurement of Communication, Observation, Quantification, Channels of Communication, Odor, Sound, Touch, Surface Vibration, Electric field and Vision	**12**	**12**

6	**Pheromones** Difference between pheromones & Hormones, Mode of Action of pheromones, Classification of Pheromones, Primer Pheromones, Releaser Pheromones, Sex attractant Pheromones, Maturation Pheromones, Source of Pheromones, Trail Substance, Some examples of Pheromones, Pheromones among Human	**04**	**04**
7	**Hormones & behavior** Dual system of relationship between Nervous & Endocrine System, Hormones of gonads; Hormones of Adrenal Gland; Hormones of pituitary; Survey of Hormonal effects on different Behavioural patterns; Maternal Behaviour; Mechanism of Hormone Action, Experimental Methods & their Effects,.	**06**	**06**
8	**Human behavior** Genes, Culture & Behavior ,The Evolution of cultures, The Evolution of Human Welfare, The Evolution of Human Reproductive behavior, Mate Selection, Female choice, Male choice, Adoption, Birth control, Intelligence & Problem in its measurement	**08**	**08**
9	**Birds Migration & Navigation** Introduction; Definition of migration; Types of migration, migratory Status ;Duration & Distance; Altitude; Speed; Cause of migration; Advantage of migration, Methods of studying migration. Navigation, **I**nternets, Topographic failure, Sun, Stellar, cues, Metrological cues olfa cues	**04**	**04**
10	**Circadian Rhythms** Circadian Rhythms, Endogenous Pacemaker, Zeitgeber's Model, Cyclic External stimuli& Physiological control of Circadian Rhythms in cockroaches	**02**	**02**

Total P-60, M-60.

Practicals-

1]Phototactic response in earthworm or Grain or Pulse pests

2] Effect of toxicants on opercular movements & surfacing in fish

3] Communication in Earthworm by Pheromones

4] Food preference in any suitable animal [Grain / Pulse pests]

5] Maternal behavior & pup retrieval in rats / mice

6] Fishing of all the animal found in and around your house / college/ university/ visit to a Zoo / Sanctuary / National Park

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References-

1] Evolution & Behaviour

Prof. Reena Mathur, Dr. B.S. Tomar, Dr .S. P. Singh – Rastogi Publications, Meerut

2]A Test Book of Animal Behaviour

Harjindra Singh – Anmol Publication, New Delhi

3] Animal Behaviour

Prof. Reena Mathur, Rastogi Publications, Meerut

4]Economic Zoology, Biostatics & Animal Behaviour

Prof.G.S.Shukla**,** Prof. Reena Mathur, Dr.V. B.Upadhyay Dr .S.G.Prasad – Rastogi Publications

5] Animal Behaviour

Prof.M.P.Arora – Himalaya Publication

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SEM-V **Paper-VI**

ZOO-356 A: BIOTECHNOLOGY

Unit 1: Introduction and Importance of Biotechnology **P-2, M-2.**

Unit 2: Animal cell and tissue culture **P-12, M-10.**

2.1 Definition and Types of culture media

2.2 Advantages and disadvantages of tissue culture

2.3 Laboratory facility for tissue culture

2.4 Culture procedures - coverslip culture, flask and Tube culture

2.5 Applications of animal cell and tissue culture

2.6 Primary culture

2.7 Cell lines

2.8 Somatic cell fusion

2.9 Tissue and organ cultures

Unit 3: Recombinant DNA technology **P-12, M-12**

3.1 Introduction

3.2 Restriction enzymes- classification with examples

3.3 Identification and isolation of desired gene

3.4 Vectors- plasmids, bacteriophage, cosmids, plasmids and molecular probe

3.5 Construction of Chimeric DNA

3.6 Construction of genomic and cDNA libraries

3.7 Expression of cloned DNA

3.8 Production of vaccines with rDNA technology

3.9 Application of genetic engineering e.g. production of human Insulin, Growth hormone

Unit 4: Transgenic animals **P-4, M-6**

4.1 Introduction toTransgenesis

4.2 Methods of Transfection (Physical, Chemical, Viral and Bacterial)

4.3 Applications of transgenic animals

Unit 5: Hybridoma technology **P-10, M-12**

5.1 Production of monoclonal and polyclonal antibodies

5.2 Significance of Monoclonal antibodies

5.3 Structure of immunoglobulin- G (IgG)

5.4 Genetics and molecular biology of production of antibodies

5.5 Vaccine development and immunization

Unit 6: Enzyme biotechnology **P-6, M- 6**

6.1 Introduction

6.2 Biological sources of enzymes

6.3 Immobilized enzymes and methods for immobilization of enzymes

6.4 Commercial production of immobilized enzymes

Unit 7: Industrial and Environmental Biotechnology **P-9, M-7**

7.1Fermentation technology (fermenters, selection of microbes and fermentation medium)

7.2Concept of bio-fuel, bio-ethanol and bio-diesel

7.3Cleaner technology for pollution control (Effluent Treatment)

7.4Biosensors and their significance

Unit 8: Advance Biotechnology **P-5, M-5**

8.1 Artificial Intelligence

8.2 Nanobiotechnology

8.3 Stem Cell biotechnology

Total P- 60, M-60.

ZOO 356 A: PRACTICALS IN BIOTECHNOLOGY

1. Estimation of DNA/ RNA by colorimetric method (E)

2. Study of working principle and application of laminar air flow and autoclave (D)

3. Isolation of microorganisms on nutrient agar by dilution plate method (E)

4. Ethanol production by fermentation using yeast.(E)

5. Culture of bacteria in liquid medium and agar plates.(E)

6. Preparation of primary culture media for cell, tissue, organ. (D)

7. Separation of serum proteins by agarose or polyacrylamide gel electrophoresis(E)

8. Study of Biogas plant/ model (D)

9. Visit to dairy / pharmaceutical / plant tissue culture laboratory and submission of report.

Reference books:

1. Gupta, P. K. 2000. Elements of Biotechnology, Rastogi publication, Meerut.

2. Jogdand S. N. 2007. Advances in Biotechnology, 6th Edn, Himalaya Publishing House.

3. Trehan Keshav, 'Cell Biotechnology', in *Biotechnology*, Wiley Eastern Ltd., New Delhi, (1990) 199-218.

4. Lewin, B., 2010 , *Genes VIII,* Oxford University Press, New York.
5. Lohar Prakash S. Text book of Biotechnology (ISSN 978-81-8094-104-7) MJP Publishers, Chennai

6. A Text Book of Biotechnology- R.C. Dubey, S. Chand & Company Ltd.

7. Kumar Sen, Biotechnology, Saras Publication, Kanyakumari

8. *Stem Cell Biology,* 2001 Cold Spring Harbor Laboratory Press

9. Biotechnology by Satynarayan, New Age Publication, New Delhi.

SEM. V **Paper-VI**

ZOO 356 B: SERICULTURE

Unit-I : Introduction (P-4,M-5)

1. Sericulture: Definition, history and present status.

2. Silkworms: Types of silkworms, their food plants and distribution.

3. Silk production: Mulberry and non-mulberry cocoon and yarn

4. Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture.

Unit-II : Silkworm taxonomy and distribution (P-7M, -6)

1. Classification and Taxonomic characters: Phylum, class, order, family, genus and species.

2. Moulting –structure of integument and cuticle, Formation and shedding of cuticle.

3. Distribution and Races: Geographical distribution in the world and India.

Unit III: Silkworm species (P-4, M- 4)

1. Taxonomy and distribution of Tasar, Muga, Eri and other species.

2. Domesticated species of silkworm: Bombyx mori, Antherarea species and their taxonomy.

Unit-IV: Life cycle of *Bombyx mori* (P-6, M- 8)

1. Egg: External and internal morphology and colour change.

2. Larvae: Mouth parts, legs, prolegs, spircles, eyes, claspers and integumentary hair and sexual markings.
3. Pupa: Male and Female Morphology and sexual dimorphism
4. Adult: Mouth parts, antenna, wings, external genitalia.
4. Life span and bionomics, circadian rhythm and behavior and growth rate.
5. Nutrition: Factors influencing –silkworm growth and development.

Unit-V: Anatomy of *Bombyx mori* **(P-12, M-13)**

1. Digestive system: Alimentary canal and physiology of digestion.
2. Silk glands: Structure, development and mechanism of silk synthesis.
3. Circulatory system: Dorsal vessel, haemolymph and haemocytes.
4. Reproductive system: Male and female systems, mechanism of egg development.

Unit-VI: Endocrine and Exocrine glands **(P-8, M-10)**

1. Endocrine system: Endocrine glands in larva and pupa and synthesis of hormone.
2. Hormonal control: on metamorphosis, dipause, silk synthesis and reproduction.
3. Exocrine glands: Structure, morphology and secretion of exocrine glands.
4. Pheromone: sex attractants and their role in mating.

Unit- VII: Rearing Technology **(P-3, M-4)**

1. Rearing House: Requirements for ideal rearing house –site selection –size of rearing house.

Orientation –Model rearing house -B Model –advantages and disadvantages rearing houses.

2. Harvesting of cocoons –time harvesting –hybrid crop of cocoons –preservation and transportation of cocoons.

3. Cocoon assessment –significance –cost of cocoon production cocoon ratio -maintenance of rearing records.

Unit- VIII: Mulberry cultivation. (P-4, M-6)

1. Definition of soil, different types of soils in India.

2. Importance of soils with reference to mulberry cultivation; soil analysis-soil sampling, soil pH, organic carbon and NPK level.

3. Propagation of mulberry-seedling, sapling, grafting and layering.

4. Raising of commercial nursery.

5. Application of root inducing hormones

Unit 9: Pests, Predators and Parasites of Silkworm (P-4, M-4)

Total P-60, M-60.

PRACTICALS ON SERICULTURE

1. 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.

2. Study of Digestives system of *Bombax mori.*

3. Mounting of Silk gland and Mouth parts of silkworm.

4. Study of Nervous system *Bombax mori.*

5. Reproductive system of silkworm.

6. Study of Rearing Technology:

Uzi control and use of nets, Incubation of silkworm eggs, Mulberry leaf estimation.

7. Study of equipment's in sericulture:

a) Rearing tray, b) Foam rubber string,

c) Chopping board, d) Chopping knives, mountages- Chandrikas etc.

8. Study of diseases, pets and predators

9. Filed visit/ Compulsory visit to sericulture.

BOOKS RECOMMENDED:

1. Muga Silk Industry by S. N. Choudhary, Directorate of Sericulture and weaving, Govt. of Assam, 1982.

2. The natures and property of soils (9^{th} edition) N. C. Brady (Mac Millan pub. Co. Inc., New York.

3. Studies on soils of India, S. V. Govind Rajan and H. G. Gopala Rao (1970), Vikas Publ.House Pvt. Ltd., Delhi.

4. Text books of Soil Sciences, T. D. Biswas and S. K. Mukherjee (1990). Tata -McGraw Hill Pub. Co. Ltd., Delhi.

5. Manual on Sericulture; Food and Agriculture Organisation Rome 1976.

6. Appropriate Sericultural Techniques Ed, by M. S. Jolly Director, CSR & TI, Mysore.

7. Handbook of Practical Sericulture : S.R. Ullal and M.N. Narasimhanna CSB, Bangalore 1987.

8. Manual of Silkworm Egg Production: M. N. Narasimhanna, CSB, Bangalore 1988.

9. Silkworm Rearing: Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.

10. A Guide for Bivoltine Sericulture: K. Sengupta, Director, CSR & TI, Mysore 1989.

11. Improved Method of Rearing Young age silkworm: S. Krishnaswamy, reprinted CSB, Bangalore, 1986.

12. The Principle of Insect Physiology: V. B. Wigglesworth: Pub. By English Language Book Soc., Chapman & Hall. 1972.

13. Economics of Sericulture under Irrigated Conditions: M.S. Jolly, CSR & TI, Mysore, 1982.

14. Silk from grub to Glamour: Mahesh M. Nanavathy, Pub. In Indian Paramount House, Bombay, 1965.

15. Principles of Insect Morphology: R. E. Snodgrass, Tata McGraw-Hill, Pub. Co., Ltd.,

Bombay, 1935.

16. China Sericulture, 1972, FAO, Rome.
17. Silk Production, Processing and Marketing: M. M. Nanavaty, V. S. Johari, Wiley Estern Ltd., Ansari Road, Dariyaganj, New Delhi.
18. Textiles (Fiber to Fabric): Bernard P. Corbman, Gregg Division : Mc Graw-Hill Book Company, New Delhi.
19. Principles of Sericulture: Hisao Aruga, Mohan Primlani for Oxford and IBH Publishing Co. Pvt. Ltd., 66, Janpath, New Delhi-110001.
20. Modern Entomology: D. B. Tembhare, Himalaya Publishing House, Bombay.

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Paper I **Sem. VI**

ZOO 361: Chordates - III

Unit No.	Name of Topic	Period	Marks
1.	Study of **Scoliodon** w.r.t. following	**08**	**04**
	1.1.Systematic position, 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.Locomotion. 1.5.Coelom.		
2.	Internal anatomy		
2.1	Digestive system - Alimentary canal, digestive glands, food, feeding and physiology of digestion.	**08**	**08**
2.2.	Respiratory system	**04**	**04**
	Respiratory organs, Mechanism and physiology of respiration.		
2.3.	Circulatory system	**10**	**10**
	a. Blood, structure and working of heart. b. Arterial system :- Ventral aorta and afferent branchial arteries, Efferent branchial and Epibranchial arteries, Hypobranchial blood plexus, Arteries of head, Dorsal aorta and its branches. c. Venous System :- Anterior cardinal system, posterior cardinal or renal portal system, sub intestinal or hepatic portal system, lateral abdominal system, cutaneous system.		
2.4.	Nervous System	**08**	**08**

	a.Central nervous system - Brain and Spinal cord. b.Peripheral nervous system - Cranial and spinal nerves. c.Autonomic nervous system.		
2.5.	Sense organs	**06**	**06**
	a.Olfactory organs. b.Photoreceptors. c.Statoacoustic organs. d.Lateral line receptors, Neuromast organs, Pit organs. e.Ampullae of Lorenzini.		
2.6.	Urinogenital System	**06**	**08**
	a..Male urinogenital sytem. b. Female urinogenital system. c. Reproduction : Copulation, Fertilization and Development		
3.	Study of Comparative account with reference to the following	**10**	**12**
	3.1. aortic arches – evolution 3.2. structure of heart of frog, calotes, igeon and rat 3.3. brain: morphological variations in the region of frog, calotes, igeon and rat 3.4. kidney: evolution of archionehros, ronehros, mesonehros, metanehros and their ducts		
	Total	**60**	**60**

Practical corresponding to ZOO 361

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) (D)

    a. Digestive system.

    b. Bronchial system.

    c. Brain (Dorsal and ventral view)

    d. 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 Heart—Calotes, Frog, Pigeon, Rat.

5. Comparative study of Brain—Calotes, Frog, Pigeon, Rat.

6. Visit to a sanctuary, seashore for the study of vertebrate animals.

REFERENCE BOOKS

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.

Sem. VI **Paper II**

ZOO 362: GENETICS

Sr. No.	Topic	Period	Marks
1.	Introduction to Genetics Introduction Scope and significance of genetics	02	02
2	Mendelian genetics Mendelian laws: Monohybrid, Dihybrid, back and test cross, Low of Dominance and Recessive, Co-dominance and Incomplete dominance.	04	04
3.	Gene interaction Definition- modifications in Mendelian phenotypic ratio like, Concept of gene Epitasis Supplementary factors (9: 3:4) Complementary factors (9:7) Inhibitory factors (13:1)	06	06
4.	Chromosomes Introduction to morphology and composition Classification based on the centromeric position Types of chromosome (autosomes and sex chromosome) Chromosomal banding pattern Human Karyotypes Molecular organization of chromosome. Special types of chromosomes - Polytene chromosomes, Lambrush	08	08

	chromosomes.		
5.	Lethal genes –Concepts and consequences	02	02
6.	Multiple Alleles: Concept, characteristics and importance of multiples alleles, ABO and Rh-factors and medicolegal importance of blood group Concept of polygenic inheritance with reference to skin color in man Coat Colour in rabbit.	08	08
7.	Linkage and Crossing over Complete and Incomplete Linkages. Mechanism of Crossing over. Cytological evidence of Crossing over. Significance of Linkage and Crossing over.	06	06
8.	Sex Determination Chromosome theory in sex determination Genic balance theory of sex determination Triploid intersexes and Gynandromorphs in *Drosophila.* Sex linked inheritance: X linked and Y linked	04	04
9.	Mutation : Brief introduction Gene mutation: - Definition and classification Chromosomal aberration (structural & numerical) Spontaneous & induced mutation Disorders related to chromosomal number- Turner syndrome, Klinefelter syndrome and Down syndrome	10	10
10	Population genetics Basic concepts in population genetics, gene pool, gene frequency and genetic drift. Hardy Weinberg equilibrium and its significance	04	04

11	Genetic disorders in human beings Introduction, purpose, hereditary diseases and disorders Haemoglobin disorders: Thalassemia and Sickle cell anaemia. Inborn errors of metabolism: albinism, phenylketonuria and alkaptonuria Eugenics, Genetic counselling and engineering Applied genetics: DNA fingerprinting, amniocentesis, sperm banks, karyotyping.	06	06
	Total	**60**	**60**

Corresponding Practicals

1. Detection of syndrome from chromosome spread picture (E).
2. Study of monohybrid ratio and dihybrid ratio by providing hypothetical data and deducing applicability of Mendelian laws (three examples of each ratio) (E)
3. Preparation of culture media and maintenance of *Drosophila* culture (E)
4. Study of *Drosophila*: External characters and sexual dimorphism (D)
5. Study of *Drosophila* mutants (any two eye and any two wing mutant) (D)
6. Study of genetic traits in human beings (tongue rolling, widow's peak, ear lobes, color blindness and PTC tasters/ nontasters) (E)
7. Study of blood groups in human (ABO and Rh) (E)
8. Genetic problem based on gene interaction
9. Genetic problem based on multiple alleles
10. Genetic problem based on population genetics.

Reference books

- Dobzhansky, T. Genetics of the Evolutionary process, Columbia Press
- C.B. Pawar: Genetics Vol I and II, Himalaya Publishing House, Mumbai
- M.W.Stricberger, Genetics, 4th Edition, macMillon public Com. Inc, New York
- B. Lewin: Genes Xth edition, Wiley Eastern Limited, New Delhi
- A. M. Winchester: Genetics
- Genetics – P.K.Gupta
- Kotpal and Kshetrpal: Concept of Genetics
- P.S.Verma & V.K.Agrawal: Cell Biology, Genetics, Molecular Biology, Evolution & Ecology

North Maharashtra University, Jalgaon

T. Y. B. Sc.

Paper III (ZOO-363) Systematics, Evolution and Palaeontology

Syllabus

Unit	Particulars	Lectures	Marks
1	**Systematics** 1.1 Introduction 1.2 Need for classification 1.3 Systems of classification- a) Artificial b) Natural and c) Phylogenetic 1.4 Nomenclature –a) Binomial nomenclature- its characteristics and advantages b) Trinomial nomenclature 1.5 Taxonomic hierarchy- a) Taxonomic characteristics b) Hierarchic classification of Frog, Pigeon and Rat. 1.6 Three domain system and six kingdoms of classification – General characters with examples of kingdom- Archaea, Bacteria, Protista, Fungi, Plantae and Animalia.	12	12
2	**Evolution** **Origin of life** 2.1 Introduction 2.2 Origin of Universe – cosmic evolution and origin of Solar system 2.3 Ancient theories of life cycle (four theories) 2.4 Oparin's theory /Chemical evolution- chemical evolution in 8 steps	12	12
3	**Theories of organic evolution** 3.1 Lamarkism- theory of acquired inheritance 3.2 Darwinism-theory of natural selection- a) Darwin-	10	10

	Wallace theory of natural selection b) Darwin finches 3.3 Neo-Lamarkism and Neo-Darwism 3.4 Modern synthetic theory 3.5 Weismans germplasm theory 3.6 Mutation theory		
4	**Evolution through ages** 4.1 Introduction 4.2 Geological time scale- era, periods and epochs 4.3 Evolution of Horse 4.3.1 Introduction, body contour and foot posture. 4.3.2 Characteristic features, origin and successive stages with reference to geological time scale regard to: 1. Hyracotherium 2. Eohippus 3. Orohippus 4. Mesohippus 5. Myohippus 6. Parahippus 7. Merychippus 8. Pliohippus 9. Plesihippus	12	12
5	**Palaeontology** 5.1 Introduction 5.2 Distribution and dispersal of animals- a) Means of dispersal b) Barriers of dispersal c) distribution of animals. 5.3 Zoogeographical realm –study of following reals with their distinctive animal distribution a) Palaeartic region	14	14

	b) Neartic region c) Neotropical region d) Ethiopian region e) Oriental region f) Australian region 5.4 fossils- a Process of fossilization and determination of age of rocks and fossils (radiometric dating) b) Nature of fossil-unaltered and altered fossils c) Types of fossils d) Significance of fossils.		
	Total	60	60

Practicals corresponding to ZOO 363

1. Identification of Zoogeographical realms using map
2. Study of fossils (Any five)
3. Study of geological time scale (Table format)
4. Hierarchic classification of Lizard and Pigeon
5. Identification / features of stages of horse evolution

Patki **Reference Books**

(P) Ltd. Kolkata, India.

1. A.T.B. of: Evolution, Dabhade D.S., Charjan A.P., Raja I. A., Gulhane R.A. A.K. and Patil P.S. Sanket Publication, Washim.
   Annual Reviews home page at www.AnnulReviews.org)

2. Barnes, C.W. 1988. *Earth, Time and Life*. John Wiley &Sons, NewYork (Module 2,3)
3. Bendall , D. S. (ed.)1983.*Evolution from Molecules to Man*. Cambridge University
4. Bull J.J. and Wilchman H.A. 2001. Applied Evolution. *Rev. Ecol. Syst.*- 217 (Visit the
5. Chattopadhyay Sajib, 2002. *Life Origin, Evolution and Adaptation*. Books and Allied
   Common Threads. Holiday Lectures on Science. Webcast or DVD available at www.hhmi.org/biointeractive/evolution. (Module 3 & 4)

   Ernst, Mayr. Systematics and the origin of species from the viewpoint of zoologist.

   Evalution and Ecology, S. Chand & Company New Delhi (Moldule 1-5)
6. Goodwin, B. 1996. *How the Leopard Changed its Spots: The Evolution of Complexity*. Simon & Schuster, NY, USA. (Module 4 & 5)
   Harvard University Press.
7. Jerry A.Coyne and H.Allen Orr.2004. *Speciation*. Sinauer Associates (Module 4)
   Press,U.K.(Module 2,3 and 5)

8. Rob Desalle and Ian Tattersall 2008. *Human Origins: What Bones and Genomes Tell*
9. Sean B. Carroll and David M. Kingsley. 2005 *Evolution: Constant Change and*
10. Strickberger, M.W.2000. *Evolution*. Jones and Bartlett, Boston. (Module 1-5)
    Us about Ourselves. Texas A&M University Press, USA. (Module 3 & 4)

11. Verma P.S. and Agarwal V.K 2007 *Cell biology, Genetics, Molecular Biology,*
12. Zoogeography – Dr M. C. Nayar, Sudarshan Publication, Cochin.

Syllabus Prepared by- Dr. S. S. Patole, Dr. M.Z. Chopda and Dr. Patel N.G.

Sem. VI Paper IV

ZOO 364: Economic Zoology

Unit No.	Topic	Period	Marks
1.	**Vermiculture** 1.1 Introduction and scope 1.2 Species of Earthworm 1.3 Characteristics features of earthworm 1.4 Methods of vermicomposting – small scale, large scale and precautions in vermiculture 1.5 Role of earthworm in solid waste management 1.6 Vermiwash – its importance 1.7 Vermicompost as biofertilizer 1.8 Economics of Vermicompost.	**20**	**20**
2.	**Apiculture** 2.1 Introduction and scope, 2.2 Taxonomy , Bee species and their distribution Taxonomic position Bee Species – 1. *Apis dorsata* 2. *Apis florea* 3. *Apis indica* 4. *Apis mellifera* 2.3 Honey bee- Morphology, Bee hive and caste differentiation (Queen, worker and drone). 2.4 Bee behavior and communication – Absconding, Round, Circular, DVAV, Cleaning massage and alarm dance. 2.5 Bee hive and swarm	**20**	**20**

	2.5.1. Bee hive 2.5.2. Swarm 2.5.3 Methods of swarm capturing 2.5.4 Hiving of colony 2.5.5 Handling the colony 2.6 Bee keeping equipments- Smoker, Bee veil, Hive tool, uncapping knive, honey extractor etc 2.7 Bee products- honey, bee wax, royal jelly, propolis, bee venom. 2.7 Honey bee and pollination		
3.	**Poultry** 3.1 Introduction 3.1.1 Definition and concept 3.1.2 Systematic position of an Indian foul, *Gallus gallus domesticus* 3.1.3 Habit, Habitat and external morphology 3.2 Types of poultry breeds 3.2.1 American breed – white Plymouth rock 3.2.2 Mediterranean breed – White leghorn 3.2.3 The English breed – White Cornish 3.2.4 Asiatic breed - Brahma 3.2.5 Indian breed - Assel 3.3 Brooding and rearing 3.3.1 Natural and artificial breeding 3.3.2 Housing and equipment of poultry	**20**	**20**

	3.3.3 Poultry house equipment 3.3.4 Poultry nutrition 3.3.5 Poultry diseases 3.4 Economics of poultry 3.4.1 Nutritive value of egg of hen 3.4.2 Economic importance of poultry manure 3.5 Poultry care management and marketing		

Practical on ZOO 364

1. Identification of any two species of earthworm (Ext. Morphology).
2. Identify and describe - a) Cocoon b) Vermicast.
3. Establishment of vermiwash unit.
4. Study of honey bee- a)Systematic position and external characters
   b) Study of Pollen basket and sting apparatus.
5. Study of honey bee caste differentiation (queen, worker and drone)
6. Study of bee keeping equipments- Bee hive, Smoker, Bee veil, Hive tool, uncapping knive, honey extractor.
7. Study of external morphology of Indian fowl and sexual dimorphism.
8. Study of poultry breeds: White Plymouth Rock, White Leghorn, White cornish, Brahma, Aseel.
9. Study of poultry equipments.

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Reference book

1. Poultry production – R. A. Singh. Kalyani publishers, New Delhi.

2. Animal Husbandry- G. C. Banerjee. Oxford and IBH publishing Co.
3. Poultry introduction- R. A. Singh. Kalyani publishers, New Delhi.
4. A textbook of Animal Husbandry – G. C. Banerjee. Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.
5. Economic Zoology- Manju Yadav. Discovery publishing house, New Delhi
6. Applied Entomology- Manju Yadav. Discovery publishing house, NewDelhi
7. Economic Zoology- Shukla and Upadhyay, Rastogi publication.
8. Economic Zoology vol. I & II - P. D. Srivastava and N. C. Pant. Commercial Publication Bureau, New Delhi.

Sem-VI **Paper- V**

ZOO 365: MITROTECHNIQUE

Unit 1: Introduction- Definition, Scope and Importance **P-2. M-2**

Unit 2: Collection of material and Fixation **P-12. M-10**

2.1 Collection of specimen or Tissue.

2.2 Kinds of preparation of Specimens or Tissue-

2.2.1 Whole mount, Sectioning, Teasing, and Smearing.

2.3 Preparation of whole mount of Amoeba.

2.4 Definition and Importance of Fixation.

2.5 Types of fixatives- Primary Fixative and compound fixatives.

2.5.1 Example of primary fixative- Formalin, Ethyl alcohol, Acetic acid.

2.6 Composition and uses of common fixatives- Bouin's, Zenker's fluids

2.7 Fixatives used for preservation of protein. Lipid and polysaccharides.

Unit-3 Washing, Dehydration and Clearing **P-8, M-9**

3.1 Theory and significance of washing.

3.2 Dehydration: Definition, Precautions, Significance

3.3 Clearing: Definition, Importance

3.4 Clearing agents, their merits and demerits- Xylene, Benzene, Toluene, Cedar-wood oil, clove oil.

Unit-4 Embedding and Block Making **P-12, M-10**

4.1 Cold and hot infiltration

4.2 Paraffin embedding- soft and hard paraffin wax and its duration.

4.3 Types of ovens.

4.4Embedding containers a) Paper trays b) L-shaped metal pieces c) Glass dishes

4.5 Block making, Labeling of block and storage of blocks.

4.6 Celloidin Embedding.

4.7 Advantages of Celloidin and Paraffin Embedding.

Unit-5: Trimming and Mounting **P-2, M-2**

Trimming and Mounting of Trimmed block.

Unit-6: Section cutting and affixing **P-10, M-10**

6.1 Microtome-Types, its uses, precautions and handling of Rotary and Rocking microtome.

6.2 Microtome knives- types care, sharpening, honing and stropping of knife.

6.3 Section cutting-Defects, possible causes and remedies during section cutting.

6.4 Mounting and spreading of ribbons i) Mayer's albumen ii) Slide warmers

Unit-7: Staining **P-10, M-10**

7.1 Types of stains-acid, basic, neutral and vital stain.

7.2 Preparation of Haematoxylin stain.

7.3 Double staining methods.

7.4 Processing of paraffin section during staining.

7.5 Special staining techniques for Golgi apparatus, Mitochondria and Chromosomes.

Unit-8: Clearing, mounting and Camera lucida **P-4, M-7**

8.1 Mounting media- DPX and Canada balsm.

8.2 Clearing, Labeling and Preservation of permanent slides.

8.3 Use of Camera Lucida and measurement of object by ocular-micrometer.

P-60, M-60

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Practicals related to Microtechnique

1. Preparation of permanent whole mounts of different kinds – 5 slides
2. Study of Rotary and Rocking Microtome.
3. Preparation of permanent slides of histological sections from different organs- 5 slides

(Mammalian tissue)

4. Vital staining of mitochondria by Janus green stain

5. Calibration of micrometer scale of cell diameter from the given permanent slide.

6. Sketching by Camera lucida and measurement of cell diameter from the sketches.

7. Submission of permanent slides (5 whole mount and 5 histological sections).

REFERENCE BOOKS OF MICROTECHNIQUE

1. An Introduction to Microtechnique – Patki, Bhalchandra and Jeevaji, S. Chand Publication.
2. Techniques in Life Sciences – D. B. Tembhahre
3. Microtechnique (Theory and Practical) – Pathak
4. Introduction to Medical Laboratory Technique- F. I. Baker & R. E. Silverton
5. Cytological Techniques- J.R. Baker
6. Introduction to Medical Laboratory Technique F.L. Baker & R.E. Silverton
7. General Zoological Microtechnique - F.M. Weesner
8. Handbook of Basic Micro technique – P. Gray
9. Histochemistry – Vol I & II – A.G.E. Pearse
10. Histopathogenic microtechniques – R.L. Lillie
11. Practical Course in Cytology – A.K. Indurkar
12. Staining Methods (Hisology & Histochemical) J.F.A. Me Manns and R.W. Mowry.
13. Histological and Histochemical technique – H.A. Devenport

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Sem. VI Paper- VI

Zoo-366 B: **Agricultural Pests and their Control**

Unit 1: Introduction, Concept of pest and Pest resurgence. P-2 M-02

Unit 2: General biology of important pests of crops cultivated in Maharashtra in particular and Indian in general w.r.t. habits, habitat, marks of identification, life cycle, nature of damage and control measures. P-20 M-22

a. Pests of Cotton (mention all pests and explain in details i. Red Cotton bug and ii. The Pink Ballworm)
b. Pests of Sugarcane (mention all pests and explain in details i. The Sugarcane stem borer and ii. Leaf hopper)
c. Pests of Pulses (mention all pests and explain in details i. Greavy Cut worm and ii. The Plume moth)
d. Pests of Vegetables (mention all pests and explain in details i. The potato tuber moth and ii. The Brinjal shoot and fruit borer)
e. Pests of Stored grains (mention all pests and explain in details i. The red flour beetle and ii. Rice moth)
f. Non-insect Pests (mention all pests and explain in details i. Deer and ii. Squirrel)

Unit 3: Important pests of forest trees and steps taken to check their infestation: Termites, forest defoliators, borers, sap suckers etc. P-04 M-04

Unit 4: Medical and Veterinary entomology with reference to important Vectors and their control measures. P-06 M-04

Unit 5: Household pests and their control. P-04 M-04

Unit 6: Role of insects in forensic science. P-03 M-04

Unit 7: Insect control measures. P-18 M-16

7.1 Physical and Mechanical control.

7.2 Chemical control and safe handling of pesticides.

7.3 Biological control.

7.4 Hormones and pheromones as control agents.

Unit 8: Integrated pests Management (I.P.M.). P-03 M-04

Practical's on Agricultural Pests and their Control

(Any four)

1. Mounting of mouthparts of insects: Biting and Chewing, Chewing and lapping, piercing and sucking, siphoning and sponging.
2. Study of House hold and Human insect pests: Rat flea, Bed bug, Housefly, Head louse.
3. Study of various stages of metamorphosis of following insects. Cockroach, Grasshopper, Red Cotton bug, Butterfly.
4. Study of non-insect animal pests :
    a. Rat
    b. Bird
    c. Monkey
    d. Boar
    e. Deer
5. Collection and Identification of agricultural insect pests from local area. (Minimum 10).
6. Study of common plant protection appliances like Sprayers and dusters.
7. Study of wing venation and modification of wings in insects.
8. Study of genetalia and ovipositor in insects.

(Compulsory)

9. Detection of digestive enzymes present in salivary glands and gut.
10. Detection of uric acid as end product of excretion in terrestrial insects.
11. Study of microtomy of 5 insect organs (Students should submit at least 10 slides of whole mounts and microtomy at the time of examination).
12. Study tour: At least two visits to the crop fields.

References:

1. Fundamental of Applied Entomology by R.E. Pfadt (Mac Millan, New York, 2nd Ed.1971)
2. Introduction to Applied Entomology by JRI Short (Longmans Green London 1963)
3. Entomology by D. N. Roy and A WA Brawn. The Bang lore Printing and Publ. Co. Ltd. 1970.
4. Insects and other Arthropods of Medical importance by KGV Simi Trustees of Britmus London, 1973.
5. Crop pests and how to fight them- Govt. of Maharashtra Pub. Bombay
6. Insect pests of crop by S. Pradhan (NBY, New Delhi 1969). Imm's text book of entomology by O. W. Richards and R. G. Davies (Mathuem and com, London 1977) vol. I and II Principles of insect morphology by R.E. Snodgrass (Tata Mc Graw Hill Bombay 1978)
7. Introduction to comparative Entomology by R. M. Foxz and J. W. Fox (Reinhold, New York 1964)
8. The Insect- Structure and Function by R. E. Chapman (ELBS and EUP London, 1972)
9. General Applied Entomology by K.K. Nayar, T.N. Anantha Krishan and B.V. David (TataMcGraw Hill, New Delhi, 1976).

Sem- VI Paper- VI
Zoo 366 A: Bioinformatics

Unit-1 P 2 M2

1.1 Bioinformatics **definition,** Objectives and scope of bioinformatics

1.2 **Application of Bioinformatics in various Fields.**

Unit-2 P 8 M8

2.1Computer generations

2.2Type of computer

2.3 Search Engines, Internet, and E-mail, World Wide Web and Web browsers

2.4 PERL and JavaScript.

Unit- 3 P 5 M5

3.1 Biological Databases – Concept and types of databases,

3.2 Database management system

3.3 Database retrieval with PubMed, ENTREZ, SRS, PIR, ExPAsy, Ensembl.

Unit -4 P 6 M6

4.1Pairwise Sequence alignment: Global alignment and Local alignment,

4.2 Searching sequence similarity search tools- FASTA, BLAST, Multiple sequence alignment.

Unit -5 P 4 M4

5.1 Computational methods for prediction of gene, promoter and regulatory elements

Unit -6 P15 M15

6.1 Proteomics- Protein structure visualization tools- RasMol, PDB viewer,

6.2 Protein sequence databases- PIR, SWISS-PROT, TrMBL, Uni-Prot, PROSITE,

6.3 Structural classification databases- SCOP, CATH,

6.4 Protein structure prediction- ROSETTA, Protein function prediction

Unit -7

7.1 Genomics- Gene, Genotype, Genome of *E.coli, S. cerevisiae, A. thaliana, C.elegans,* and *Homo sapiens* P5 M5

7.2 Single nucleotide polymorphisms (SNPs), DNA microarray, Commercial databases and software packages specializing in DNA analysis. P5 M5

7.3 Nucleotide sequence database (NCBI, EMBL and DDBJ), cDNA libraries and ESTs, databases of metabolic pathways- KEGG, TIGR. P5 M5

7.4 Genomics in medicine- disease monitoring, Drug designing and development. P5 M5

Practical

1. Practical application of PERL programming
2. Practical application of Java scripting language
3. Sequence alignment using Java Applet
4. Demonstrate dot plot method using any programming language
5. Visualization of PDB file using SPDBV software
6. Study of Ramchandran plot of any protein molecule
7. Study of Proteomics and Genomics using databases.
8. Interaction with NCBI and KEGG to study of genomics of any suitable organism
9. Collection of nucleotide database of any one chromosome of human.
10. Visit to any bioinformatics based laboratory/industry.
    (Perform any eight practical from above list)

References:

1) A.M. Campbell and L.J. Heyer. (2003) *Discovering Genomics, Proteomics, and Bioinformatics*, Cold Spring Harbor Laboratory Press
2) Attwood, T.K., Michie, A.D. and Jones, M.L. (1996): DbBrowser: integrated access to database worldwide. *TiBS*. Vol. 21(5), 191.
3) Prakash S Lohar (2010): *Bioinformatics* (ISSN 9788180940668), MJP Publishers Chennai.
4) Michael S. Waterman (1995) *Introduction to Computational Biology: Sequences, Maps and Genomes*. CRC Press,.
5) Curtis Jamison. (2003) Perl Programming for Biologists. By Hoboken, NJ: John Wiley & Sons, Inc.

Paper-VI, Sem. VI,

ZOO 366 C: TOXICOLOGY

Name of the unit	No. of periods	No. of marks
Unit 1: Introduction 1.1 Definition, basic divisions of toxicology- Environmental toxicology, Forensic toxicology, Economic toxicology, Clinical toxicology, Preventive toxicology. 1.2 Scope of toxicology.	05	05
Unit 2: Toxicants 2.1 Definition, classification of toxicants on the basis of the human organ/system affected – environmental carcinogens, cardio-toxicants, immuno-toxicants, teratogens, occupationally absorbed toxicants, hepato-toxicants, neurotoxicants and mutagenic toxicants. 2.2 Effects of toxicants – acute, chronic and sub-chronic.	07	07
Unit 3: Absorption, Translocation and Excretion 3.1 Routes of absorption- gastrointestinal tract, skin, lungs, parenteral administration. 3.2 Translocation, Biotransformation. 3.3 Excretion- principal organs - kidney, gastrointestinal tract, liver, lungs, sweat glands, mammary glands, salivary glands, and vagina.	07	06
Unit 4: Toxicity tests Definition. Types of toxicity tests- a) Acute toxicity tests, LC_{50}, LD_{50} and EC_{50}. b) Sub-acute toxicity test. c) Chronic toxicity test.	07	08
Unit 5: Selective and Sub cellular toxicity 5.1 Definition. 5.2 Need of selective toxicity. 5.3 Advantages of selective toxicity.	10	10

5.4 Cell injury-causes. 5.5 Injury to Mitochondria, Endoplasmic reticulum, Golgi complex, Nucleic acids.		
Unit 6: Toxicants of public health hazard 6.1 Effects of toxicants on human health- pesticides, carbon monoxide, Sulphur dioxide, Fertilizers, Food additives, psychoactive substances. 6.2 Metal toxicity- a) General principle of metal toxicity. b) Effects of toxic metals on humans and other animals- Mercury, Arsenic, Cadmium, Copper, Manganese, Cobalt.	12	12
Unit 7: Tissues and systems level toxicity Effects of toxicants at the tissues and systems- Dermatotoxicity, Respiratory tract toxicity, hepatotoxicity, gastrointestinal toxicity, Nephrotoxicty, Cardio toxicity, Haematotoxicity, Endocrine toxicity, Reproductive toxicity, Neurotoxicty.	12	12
Total	**60**	**60**

ZOO 366 PRACTICALS ON TOXICOLOGY

1. Effect of different concentrations of pesticide on the respiratory behaviour of any fish / mosquito larvae.

2. Measurement of opercular movements of fish, exposed to different concentration of any heavy metals.

3. Determine the LC_{50} value of any one pesticide by using fish / mosquito larvae.

4. Determine the LC_{50} value of one heavy metal salt by using fish/ mosquito larvae.

5. Study of toxicant damage in cells and tissue (Histopathological changes) with the help of permanent or prepared slides.

6. Study of toxicant damage in cells and tissue (Histopathological changes) with the help of microphotographs/Xerox copies.

7. Effect of any pesticides on biochemical changes in fish/ suitable material.

8. Effect of any heavy metals on biochemical changes in fish/ suitable material.

REFERENCE BOOKS ON TOXICOLOGY

1. Fundamentals of toxicology- Pande, Shukla and Trivedi.

2. Toxicology- Sharma P. D., Rastogi prakashan.

3. Toxicology: Principles and methods. By Dr. M. A. Subramanian, MJP publishers, Chennai.

4. Concept of toxicology,- Dr. omkar, Shoban Lan Nagin Chand & Co., M-5, Industrial area jalandhar.

5. Practical in Zoology Vl. III By Lal. Chand and Chand, N. Delhi.

Sem- VI **Paper-VI**

ZOO 366 D: Public Health and Hygiene

Unit-VI Communicable Diseases:	P-10	10
Introduction, transmission and control		
6.1 Measles		
6.2 Poliomyelitis		
6.3Tuberculosis		
6.4 STD		
6.5 Encephalitis		
Unit-VII Non Communicable Diseases:	P-8	08
7.1 Cancer		
7.2 Coronary Heart diseases		
7.3 Diabetes mellitus		
7.4 Mental illness		
7.5 Alcoholism and drug dependence.		
Unit-VIII Hygiene	P-8	10
9.1 Hygiene and health factors at home.		
9.2 Personal hygiene		
9.3 Oral Hygiene		
9.4 Mental Hygiene		
9.5 Social Hygiene-Accidents		

Total Periods= 60 Marks- 60.

PRACTICALS: Public Health and Hygiene

Practical 1: To detect adulterants in the food samples by appropriate tests. (E)

Practical 2: Methods used to make drinking water safe. (D)

Practical 3: Colorimetric estimation of blood sugar level.

Practical 4: Epidemiological study of measles, tuberculosis and poliomyelitis. (D)

Practical 5: Testing portability of water for human consumption by MPN method. (D)

Practical 6 : Biological control of mosquito larvae

Practical 7**:** Visit to sewage treatment plant / effluent treatment plant / Public health Laboratory/water purification (treatment) plant (D)

References

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

NORTH MARARASHTRA UNIVERSITY JALGAON

REVISSED SYLLABUS

T.Y.B.Sc.Z00LOGY(2014-15)

With course codes, skills, knowledge and job opportunities.

SEM-V

P- I Z00 311 Non-chordates-III

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

Knowledge-different characters ,classsifications,anatomyand physiology.

Job Opportunities- Public Health Department like malaria Irradication program.

P -II Z00 312 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.

P- III Z00 313 Developmental Biology

Skills- Development of different animals.

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

Job Opportunities-developmental biology depatrments,fisheries,Poultry etc.

P -IV Z00 314 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 .

P –V Z00 315 Research Methodology

Skills-Different methods of research.

Knowledge-Scientific basis of various research method.

Job Opportunities-Different research laboratories and surveys.

P -V I Z00 316
A)Biotechnology

Skills –Biotechnological methods .

Knowledge-Gene action , gene mutation ,gene manuculation.

Job Opportunties-Biotechnological laboratories , food and pharmaceutical industries .

OR

B) Sericulture

Skills – Life cycle of silk moth .

Knowledge-Life cycle,silk production .

Job opportunities-Sericulture department , industry and self employment.

OR

C)Animal Behaviour

Skills-Animal behaviour, its mod etc.

Knoledge-Behavior of different animal for betterment of human .

Job Opportunities-Animal breeding centers, Dairy industry,Poultry , Goatary ,fishriesetc.

OR

D)Aqua culture and fishery

Skills-Life in ponds ,lakes , rivers and ocean.

Knowledge –Aquatic life in fresh and marine water ,fishries.

Job Opportunities – Department of environment and fisheries department .

NORTH MARARASHTRA UNIVERSITY JALGAON

REVISSED SYLLABUS

T.Y.B.Sc.Z00LOGY(2014-15)

With course codes, skills, knowledge and job opportunities

SEM-VI

P-I Z00 361 Chordates-III

Skills-life of different chordates

Knowledge-Anatomy and physiology of different chordates .

Job Opportunities-Forest , animal husbandry and museum.

P-II Z00 362 Genetics

Skills- gene , gene expression , gene action etc.

Knowledge-Various types of inheritance , hereditary genetic abnormalities etc.

Job Opportunities-Genetic institutions , breeding technical labs , genetic counseling etc.

P-III Z00 363 Systematic Evolution and palaeontology

Skills-taxonomy of animals , evolution and study of fossils.

Knowledge-Classification , evolution of animal and fossils history.

Job Opportunities-Palaentological museum , forest etc.

P-IV Z00 364 Economic Zoology

Skills-Animals beneficial and harmful to mankind .

Knowledge-Beneficial animals provide useful products while harmful animals are to be controlled.

Job Opportunities-Public health , food , forest , aqua culture , fisheries etc departments.

P-V Z00 365 Microtechnique

Skills-Preparation of permanent microscopic slides and staining reactions.

Knowledge-Cell-tissue structure and functions helpful in life.

Jo Opportunities-Health institutes , hospitals ,pathological labs.

P-VI Z00 366

A)Agricultural pests and their control

Skills-Identifiction , nature of damage and control measures .

Knowledge-Pests in agriculture , damage caused and their control measure.

Job Opportunities-Public health , agriculture and environment department.

OR

B)Bio-informatics

Skilla-taxonomical knowledge and computer operations

Knowledge-Software development

Job Opportunities- Various bioinformatic companies.

OR

C)Toxicology

Skills- Poison and their mod of action.

Knowledge- Poison and their mod of action

Job Opportunities-toxicology labs and pesticide. Industries

OR

D) Public Health and hygiene

Skills –To overcome problem related to public health and hygiene.

Knowledge-Cleanliness , personal , hygiene , epidemic diseases , prevention and care.

Job Opportunities-Public health department , PHCs , sanitary inspectors , malaria irradication department etc.

Practical Z00 301

Practical Z00 302

Practical Z00 303

Skills , knowledge and job opportunities as mentioned in the theory courses.

NORTH MAHARASHTRA UNIVERSITY, JALGAON

T.Y B.Sc Zoology

Equivalence for old Syllabus 2009

Sem-V

Code: 2009(Old Syllabus)	Code: 2014(New Syllabus)
Z00 311	Z00 351
Z00 312	Z00 352
Z00 313	Z00 363
Z00 314	Z00 354
Z00 315	Z00 355
Z00 316	Z00 356

Sem-VI

Code: 2009(Old Syllabus)	Code: 2014(New Syllabus)
Z00 321	Z00 361
Z00 322	Z00 353
Z00 323	Z00 362
Z00 324	Z00 364
Z00 325	Z00 365
Z00 326	Z00 366

NORTH MAHARASHTRA UNIVERSITY,

JALGAON

SYLLABUS FOR

F.Y.B.Sc.

ZOOLOGY

(With effect from June 2015)

North Maharashtra University, Jalgaon.

Syllabus (with effect from June 2015)

F.Y.B.Sc. (Zoology) Paper I- Semester I

ZOO 111: Non Chordates – I

Total Marks- 60 Total Periods- 45

Unit	Particulars	Lectures	Marks
1.	**Type – study: *Palaemon malcolmsonii* (Prawn)**	06	10
	1.1 Systematic position, habit and habitat.		
	1.2 External morphology.		
	1.2.1 Shape, Size, Coloration and Body wall.		
	1.2.2 Division of body-cephalothorax & abdomen.		
	1.2.3 Exoskeleton- Appendages (Cephalic, Thoracic and Abdominal).		
	1.3. Economic Importance.		
2.	**Digestive System**	04	08
	2.1 Alimentary canal & Digestive gland (Hepatopancrease).		
	2.2 Food feeding & digestion.		
3.	**Respiratory System**	03	04
	3.1 Types of Gills		
	3.2 Mechanism of Respiration		
4.	**Blood Vascular System**	04	04
	4.1 Heart.		
	4.2 Haemocoel.		
	4.3 Blood Sinuses		
	4.4 Course of blood circulation		
5.	**Excretory glands**	04	06
	5.1 Antennary Glands.		
	5.2 Lateral ducts.		
	5.3 Renal Sac.		
	5.4 Integument.		
6.	**Nervous System**	08	08
	6.1 Central Nervous system.		
	6.2 Peripheral Nervous System.		
	6.3 Sympathetic Nervous System		
	6.4 Sense Organs - Compound eye, Statocyst, Tactile Setae, Olfactory Setae		
7.	**Reproductive System**	08	08
	7.1 Sexual dimorphism.		
	7.2 Male reproductive system.		
	7.3 Female reproductive system.		
8.	**General Topics**	08	12
	8.1 Gemmules & Spicules.		
	8.2 Coral reef.		
	8.3 Economic Importance of Molluscs.		
	8.4 Affinities of hemichordates with Chordates and Non-Chordates		
		45	60

North Maharashtra University, Jalgaon.

Syllabus (with effect from June 2015)

F.Y.B.Sc. (Zoology) Paper I- Semester I

ZOO 112: Cell Biology

Total Marks- 60 Total Periods- 45

Unit	Particulars	Lectures	Marks
1.	Introduction and scope of cell biology 1.1 General structure of animal cell 1.2 Prokaryotic, eukaryotic cell and archaeo bacteria structure.	04	06
2.	Structure and functions of Plasma membrane -Unit membrane- Danielii- Davson and Singer-Nicolson model. Osmosis and Diffusion- Biological importance.	04	08
3.	Study of cell organelles w. r. t. structure and functions. 3.1 Nucleus 3.2 Mitochondria 3.3 Endoplasmic reticulum 3.4 Golgi complex 3.5 Ribosome 3.6 Lysosomes	15	20
4.	4.1 Cell division - Mitosis, Meiosis 4.2 Cell cycle - G1,S,G2,M phase	12	14
5.	5.1 Cell aging 5.2 Cell death 5.3 Biology of cancer – definition – virulent, malignant and benign tumor	10	12
		45	60

Reference Books

1) Lodish et al: Molecular and Cell Biology (Scientific American Book)

2) De Roberties and De Roberties: Cell and Molecular Biology (Saunders College)

3) A C Giese: Cell Physiology

4) Prescott, DM: Reproduction in eukaryotic cells (Academic Press)

5) Wilson, EB: Cell in Development and Inheritance (MacMillan)

6) Edward Gasque: Manual of Laboratory Exp. in Cell Biology (W.C. Brown Publishers)

7) Stryer, L: Biochemistry (Freeman)

8) Conn et al: Outline of Biochemistry (Wiley)

9) Watson J. D. et al: Molecular Biology of Gene (Benzamin/ Cummings)

North Maharashtra University, Jalgaon.

Syllabus (with effect from June 2015)

F.Y. B. Sc. (Zoology) Paper I- Semester II

ZOO 121: CHORDATE – I

Total Marks- 60 Total Periods- 45

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Unit	Particulars	Lectures	Marks
1.	**Type study: *Calotes versicolor* (Garden lizard)** Systematic position, Habit, Habitat and distribution.	02	03
2.	External morphology and sexual dimorphism Division of body - Head, Neck, trunk and tail.	03	05
3.	Internal anatomy- i. Digestive system- Alimentary canal and digestive glands. ii. Food, feeding and mechanism of digestion.	06	08
4.	Respiratory system- Trachea and lung, Mechanism of respiration.	03	04
5.	Circulatory system- Heart – External and internal structure, working of heart. Arterial system, venous system, Course of blood circulation. Composition and functions of blood.	06	08
6.	Male urinogenital system, Female excretory and reproductive system. Copulation and Fertilization.	06	06
7.	Nervous system- central nervous system (Brain and spinal cord), Cranial nerves Sense organ- Eye.	04	06
8.	General topics . i. Scale and fins in fishes- Scales- Placoid, cycloid, ctenoid, rhomboid. Fins- Paired and unpaired fins in *Scoliodon/ Labeo*. ii. Metamorphosis in Amphibia (Frog). iii. Aerial adaption (Pigeon) iv. Dentition in mammals- Types of teeth, Homodont and heterodont. Dental formula in mammals – Rat, Cat, Dog, Camel and human.	15	20
		45	60

List of Reference books

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.

North Maharashtra University, Jalgaon.

Syllabus (with effect from June 2015)

F.Y. B. Sc. (Zoology) Paper II- Semester II

ZOO 122: Applied Zoology I: (Goatary and Lac Culture)

Total Marks- 60 Total Periods- 45

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Unit		Particulars	Lectures	Marks
1.	**Goatary**			
	1.1	Introduction and scope of Goatary.	01	02
	1.2	Indian breeds, distribution and characteristics A) North – west and Central region. i. Jamunapari ii. Barbari iii. Beetal (Amritsari) iv. Surti v. Marwari vi. Mehsana vii. Jhakrana. B) South Peninsular region- i. Osmanabadi ii. Malbari iii. Sangamneri C) Eastern region - i.Bengal ii. Ganjam D) Northern – temperate region- i. Gaddi. ii. Chigu	10	12
	1.3	Reproductive performance a. Reproductive system of Male and female goat; b. Feeding habits of goat; c. Nutrient requirement of goat; d. Feeding of pregnant goat f. Feeding of lactating goat; e. Feeding of kids	08	10
	1.4	Handling of Goats a. Castration, its advantages; b. Dehorning; c. Care of feet ; d. Housing / Goat shelter; e. Care of kids.	06	10
	1.5	Diseases and treatment - a. Mastitis; b. Foot rot; c. Brucellosis; d. Internal and External parasites; e. Bloat.	03	04
	1.6	Economics of Goatary.	02	02
2.		**Lac culture**		
	2.1	a) Introduction; b) Distribution and morphology of Lac insect; c) Life cycle of Lac insect; d) Host plants; e) Enemies of Lac	08	10
	2.2	Cultivation of Lac - Inoculation period; Inoculation- Natural and Artificial; Swarming ; Harvesting period ; Harvesting of lac	03	04
	2.3	a) Enemies of Lac cultivation; b) Composition and Properties of Lac; c) Lac industry in India; d) Economic importance	04	06
			45	**60**

REFERENCES BOOKS ON ECONOMIC ZOOLOGY

1. A textbook of Animal Husbandry – G. C. Banerjee. Oxford and IBH publishing Co. Pvt. Ltd. New Delhi.
2. Economic Zoology- Manju Yadav. Discovery publishing house, New Delhi
3. Applied Entomology- Manju Yadav. Discovery publishing house, NewDelhi
4. Economic Zoology- Shukla and Upadhyay, Rastogi publication.
5. Economic Zoology vol. I & II - P. D. Srivastava and N. C. Pant. Commercial Publication Bureau, New Delhi.

North Maharashtra University, Jalgaon.

Syllabus (with effect from June 2015)

F.Y. B. Sc. (Zoology) Paper II- Semester II

ZOO 103: Practicals

Practicals on ZOO 111: Non - Chordates – I - Sem- I

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1) Study of external characters of prawn
2) Study of various appendages of prawn.
3) With the help of diagram / Chart / Model.
   - Digestive System
   - Respiratory System
   - Nervous system
4) With the help of diagram / Chart / Model.
   - Blood Vascular System
   - Excretory System
   - Male & Female reproductive system
5) Study of permanent slides of spicules and gemmules.
6) Collection, identification and submission of Molluscan Shells (At least 5).
7) Classification of following phyla up to class level with help of charts/ models/ pictures/ simulations at least one example.
   i. Porifera, Coelenterata and Platyhelminthes
   ii. Nematohelminthes, Aschelminthes and Annelida
   iii. Arthropoda, Mollusca, Echinodermata and Hemichordata.

Practicals on ZOO 112: Cell biology - Sem- I

1) Study of animal cell and cell organelles by using microphotographs – Mitochondria, Endoplasmic reticulum, Golgi complex, Nucleus, Lysosomes and ribosomes
2) Study of mitosis from any suitable material (E).
3) Study of meiosis from any suitable material (E)
4) Vital staining of mitochondria by Janus green (E)
5) Preparation of blood smears to study various blood corpuscles.
6) Study of mammalian gametes-Sperm and ova
7) Study of RBC membrane fragility - Isotonic, Hypotonic and Hypertonic solutions.

Practicals on ZOO 121: Chordate – I - Sem- II

Practical -1: Systematic position and external morphology of *Calotes versicolor*
Practical - 2 (with the help of models / charts / pictures / simulations) (D)

a. Digestive system - Alimentary canal.
b. Respiratory system (Trachea and lung)
c. Circulatory system – Arterial and venous
d. Nervous system- Brain (Dorsal and ventral view)
e. Male urinogenital system
f. Female reproductive system

Practical -3: Study on general topics-

i. Body wall- *Calotes*- (D)
ii. Scales- placoid and cycloid (E)
iii. Fins- Homocercal and heterocercal (D)
iv. Aerial adaption – Pigeon (D)
v. Dental formula –Rat, Cat, Dog, Camel and Human (D)

Practical -4: Classification of chordate animals Super class- Pisces:

a) Chondrichthys- Scoliodon/ Saw fish/ Ray fish (Any two)
b) Osteichthys- Labeo/Catla/ Cyprinus/ Cirrhina (Any two)

Practical-5: Classification of Amphibians -

i. Apoda- Ichthyophis, ii. Anura- Rana and Toad, iii. Urodela- Salamander.

Practical-6: Classification of Reptiles – Wall lizard, Chelone, Cobra, Rat snake
Practical -7: Classification on Aves- Sparrow, Parrot, Crow, King fisher.
Practical-8: Classification on Mammals- Echidna, Rat, Bat, Kangaroo.
Practical-9: Compulsory visit to any ecosystem/ forest/ museum/ sea shore etc.

Practicals on ZOO 122: APPLIED ZOOLOGY – I - Sem- II

1. Identification of at least any four Indian Goatary breed with reference to their distribution and breed characteristics (D).
2. Diseases and treatment of Goats.
3. Observation of Lac insect life cycle (with adult Male and female) (D).
4. Scrapping of raw Lac from branches (D).
5. Isolation of seed lac from raw lac (Scrapped) (D).
6. Compulsory Visit to Goatary / Lac industry and submission of report.

Achievements:

Knowledge – Fundamental of cell biology for animal tissue culture technique.

Skill – 1) Microscope handling & care.

Applications- 1) Importance and biology of various biological fields.
2) Pathology
3) Research in oncology
4) Pharmacological approach

NORTHMAHARASHTRAUNIVERSITY, JALGAON

F. Y. B.Sc. - ZOOLOGY

Equivalence for old Syllabus 2012-13 to New Syllabus 2015-16

Old	New (Equivalence)
ZOO 111: Non-Chordates-I.	ZOO – 111: Non-chordates – I
ZOO 112: Parasitology.	ZOO – 112: Cell biology
ZOO 121: Chordates -I.	ZOO – 121: Chordate-I
ZOO 122: Ecology.	ZOO – 122: Applied Zoology -I
ZOO 103: Practical Course	ZOO – 103: Practical Course

NORTH MAHARASHTRA UNIVERSITY,

JALGAON

(NAAC Re-Accredited)
"A" Grade

FACULTY OF SCIENCE

SYLLABUS FOR

S.Y.B.Sc.
(ZOOLOGY)

To Be Implemented From

Academic Year 2016-17

North Maharashtra University, Jalgaon
S. Y. B. Sc. Zoology Syllabus w.e.f. June 2016

Semester	Paper	Paper code	Course Title	Marks	
				U.A.	C.A.
I	I	ZOO 231	Non-Chordates - II	60	40
	II	ZOO 232	Medical Zoology	60	40
	III	ZOO 233	Practical	60	40
II	I	ZOO 241	Chordates – II	60	40
	II	ZOO 242	Applied Zoology	60	40
	III	ZOO 243	Practical	60	40

North Maharashtra University, Jalgaon
S. Y. B. Sc. Zoology Syllabus w.e.f. June 2016
Sem – I Paper –I – ZOO 231: Non Chordates –II

Unit	Topic	Period	Marks
	Animal Type Study: Asterias –A Sea star w.r.t. following		
1	Introduction, Systematic Position Habit and Habitat {Ecology} External Characters - Shape, Size and Colour, Symmetry Oral Surface, Aboral Surface Pedicellariae- Straight and Cross type Body Wall, Endoskeleton , Coelom	6	**6**
2	Digestive System – Alimentary canal Food and Feeding Mechanism Digestion, Absorption and Egestion	6	**6**
3	Locomotion; Water Vascular or Ambulacral System Structure, Function and Significance,	5	**5**
4	Circulatory System – Haemal and Perihaemal System	3	**3**
5	Respiratory System	2	**2**
6	Excretion	1	**1**
7	Nervous System- A] Superficial or ectoneural nervous system B] Hyponeural nervous system C] Aboral or coelomic nervous system D] Visceral nervous system Sense organs- Neurosensory cells, Eyes	6	**6**
8	Reproductive System- Gonads Life History and Development- Fertilization, Embryogeny Structure of Dipleurula larva or Early bipinnaria, Bipinnaria larva and Brachiolaria larva Metamorphosis, Regeneration and Autotomy	7	**7**
	General Topics		
9	**i] Mouth parts in Insects** a] Biting and Chewing type b] Piercing and Sucking type c] Siphoning type d] Chewing and Lapping type	6	**6**
10	**ii] Canal System in Sponges** a) Ascon type, b) Sycon type, c) Leucon type and d) Rhagon type	6	**6**
11	iii] **Locomotion in Protozoa** Locomotary organelles- Pseudopodia, Flagella & Cilia Amoeboid movement, Flagellar movement, Ciliary movement	6	**6**
12	iv] **Foot in Mollusca** Amphineura, Scaphopoda, Gastropopda, Pelecypoda and Cephalopoda	6	**6**
	Total	**60**	**60**

ZOO 233 – Practicals corresponding to ZOO 231

To study the following with the help of charts/ models/ diagrams/ specimens:

1. Study of External character [Oral and Aboral View]
2. Study of Digestive System of Sea star
3. Study of Water vascular system of sea star
4. Study of various Canal System in Sponges
5. Study of Locomotion in Protozoa
6. Study of Modification of foot in Mollusca
7. Mounting of Mouth Parts of Grasshopper /Cockroach / Anopheles etc
8. Visit to any Ecosystem

Suggested Books

1. A Test Book of Zoology - Invertebrates, Vol- I, Marshall and William
2. The Invertebrate- Hymen L.H. McGraw Hill
3. The Invertebrates – Barnes R.O. W.B. Saunders & Co
4. The Invertebrates **–** Kotpal R.L. Rastogi Publication Meerut
5. Life of Invertebrates – J. N. Prasad Vikas Publishing House New Delhi
6. Modern Test Book of Zoology- Kotpal R.L. Rastogi Publication
7. A Test Book of Zoology – R.D.Vidyarthi
8. A Test Book Invertebrate Zoology – Dhami and Dhami

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North Maharashtra University, Jalgaon
S. Y. B. Sc. Zoology Syllabus w.e.f. June 2016
Sem – I Paper –II – ZOO 232: Medical Zoology

Units	Topic	Periods	Marks
1	Introduction, Scope and branches of Medical Zoology: Medical Protozoology, Medical helminthology, Medical Entomology, Forensic Entomology.	3	3
2	**Parasites and Host** **2.1** Definition **2.2** Types of parasites **2.2.1** Ectoparasite **2.2.2** Endoparasite - Gut parasite, Haemoparasites, Tissue parasites and Lymph parasite **2.3** Types of host: Definitive, Intermediate, Paratenic or carrier, reservoir host and vectors. **2.4** Sources of infection: Soil, water, air, food, insect vectors, domestic and wild animals **2.5** Mode of Transmission: Oral, Skin, Vector	10	10
3	**Health and Diseases** Brief account of life cycle, mode of transmission pathogenicity, prevention and control w.r.t. Human **3.1** Viral diseases : Swine flu and Chikungunya **3.2** Bacterial diseases : Anthrax and tetanus **3.3** Protozoon diseases: Amoebiasis and Malaria **3.4** Helminthes diseases: Ascariasis and Taeniasis	12	12
4	**Major insect vectors of public health importance** **4.1** House fly, **4.2** Flea, **4.3** Bed bug, **4.4** Head louse	6	6
5	**Insect vectors of medical importance** **5.1** *Culex* – Filariasis **5.2** *Anopheles* – Malaria **5.3** *Aedes* – Dengue w.r.t . their distinguishing characters, mode of transmission of pathogen, sign and symptoms, prevention and control of diseases. **5.4** Biological and chemical control of mosquitoes	8	8
6	**Epidemic diseases** Source of infection, sign and symptoms, prevention and control of - **6.1** Typhoid and **6.2** Cholera	8	8
7.	**Introduction and importance of medical diagnostics** **7.1** Hb estimation, **7.2** Cholesterol level, **7.3** Blood and Urine sugar level, **7.4** Sonography, **7.5** Angiography, **7.6** CT scan, **7.**7 M.R. I.	8	8
8	**Forensic Entomology** **8.1** Introduction and importance **8.2** Post mortem changes **8.3** Role of Insects	5	5
	Total	**60**	**60**

ZOO 233 – Practical corresponding to ZOO 232

1. Study of permanent slides or microphotographs of the following: Chikungunya virus, Swine flu, Anthrax virus, Tetanus.
2. Study of the following parasite w.r.t. life cycle and pathogenicity: *E. histolytica*, *Ascaris* male/ female, *Taenia solium*,
3. Study of following insect vector with the help of permanent slide / photographs: Head Louse, Flea, House fly, Bed bug.
4. Comparative study of mosquitoes: *Aedes, Culex* and *Anopheles*.
5. Study of epidemic diseases: Typhoid and Cholera w.r.t. sign and symptoms, source of infection, prevention and control measures.
6. Study of the following (E):
    i. Hb estimation.
    ii. Urine sugar level tests

Suggested Books

1. Epidemiology and Fundamental of infectious diseases – M.L.Volvskaya.
2. Natural history of infectious diseases – Burnet M & D (1972) Cambridge University press Cambridge London.
3. Introduction to parasitology 10 th Ed.Chandle A.C. & C.P. Real (1970).
4. The biology of animal parasitology 3rd Ed. Latey E.A.
5. General parasitology – Dogiel V.A. London.
6. A modern text book of parasitology Dr. A. N. Latey, Narendra Prakashan.
7. Textbook of medical parasitology - CK Jayaram Panikar, Jaypee Brothers, New Delhi
8. A Textbook of Medical Technology – Vol I and II - Darshan P. godkar Praful B. Godkar, Bhalani Publishing House; 3rd edition (2014)
9. Medical Laboratory Technology - VOL 1, 2/E, K. L. Mukherjee, Tata McGraw-Hill Education

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North Maharashtra University, Jalgaon
S. Y. B. Sc. Zoology Syllabus w.e.f. June 2016
Sem – I Paper –I – ZOO 241: Chordates-II

Units	Topic	Periods	Marks
	Animal Type:*Columba livia domestica*		
1	I) Introduction: ***Columba livia*** II) a) Systematic position; b) Habits and Habitat; c) distribution.	2	2
2	External Morphology: a) Shape & Size; b) Colouration; c) Body division- Head, Neck, Trunk and Tail d) Skin: Histology of skin.	4	4
3	Exoskeleton: a) claws and Beak; b) Feathers-Structure of a Typical feather and Types	4	4
4	**Internal Anatomy:** A) Digestive system: i) Alimentary canal and Digestive glands; ii) Food, Feeding and digestion	6	6
	B) Respiratory system: i) Respiratory tract ii) Respiratory organs: Lungs and Air sacs; functions of air sacs.	6	6
	C) Circulatory system: i) Heart: External and Internal structure; ii) Working of heart; iii) Arterial system; iv) Venous system; vi) Blood. v) Mechanism of blood circulation (double circulation).	6	6
	D) Nervous system: i) Central nervous system : Brain (Dorsal & ventral view), ventricles of brain and Spinal cord; ii) Peripheral Nervous system: Cranial nerves (Mention only names, types, origin, insertion, function) iii) Autonomous nervous system; iv) Spinal nerves; v) Sense organ; Ear and Eye.	6	6
	E) Urinogenital system: i) Male urinogenital system; ii) Female Urinogenital system, iii) Significance of one ovary iv) Copulation.	6	6
	F) Economic Importance of *Columba livia domestica*	2	2
	General topics		
5	1) Accessory respiratory organs in fishes: a) Air bladder, b) Air Chambers, c) Bucco-pharyngeal epithelium, d) Alimentary canal, e) Saccular organs, f) Labyrinthine organs, g) Arborescent organ, h) Branchial chamber. 2) Reptiles of Mesozoic era. 3) Adaptations in aquatic Mammals , Ex. Whale and Seal	18	18
	Total	**60**	**60**

ZOO 243 Practicals corresponding to ZOO 241

To study the following with the help of charts/ models/ diagrams/ specimens:

1. External characters of *Columba livia* and Study of exoskeleton: a) Claws and Beak; b) Study of a structure of typical feather (paste a feather in journal of any bird) & Types (D).
2. Study of internal anatomy
    a) Digestive system of *Columba livia* (D)
    b) Respiratory system of *Columba livia* (D)
    c) Arterial system of *Columba livia* (D)
    d) Venous system of *Columba livia* (D)
3. Study of internal anatomy
    a) Nervous system: Brain (Dorsal and Ventral view) *Columba livia* (D)
    b) Excretory system of *Columba livia* (D)
    c) Male reproductive system of *Columba livia* (D)
    d) Female reproductive system of *Columba livia* (D)
4. Temporary mountings of scales: Placoid and Ctenoid scales (E).
5. Study of Fins : Scoliodon and Anabas (E)
6. Study of dinosaurs *Brontosaurs, Tyranosaurs, Stegosaurs, Triceratops, Pteranodon.* (D).
7. Adaptations in aquatic Mammals, Ex. Whale and Seal. (D).

Suggested Books

1. A life of Vertebrate – K. Z. Young, ELBS Oxford University Press.
2. Modern Text Book of Zoology Vertebrate – R. L. Kotpal, Rastogi Publication Meerut.
3. A Text Book of Chordate Zoology – R. C. Dalela –Jaiprakashnath Publication Meerut.
4. Chordate Zoology – E. L. Jordan and P. S. Verma, S. Chand and Company New De
5. Zoology- S. A. Miller and J. B. Harley, Tata McGraw Hill.
6. Biological Science, 3rd Ed. D. J. Taylor, N. P. O. Green and G. W. Stout,
7. Cambridge Univ. Press. Low priced Ed.
8. Verma and Agarwal- Chordate Embryology – S. Chand publication.

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North Maharashtra University, Jalgaon
S. Y. B. Sc. Zoology Syllabus w.e.f. June 2016
Sem – I Paper –II – ZOO 242: Applied Zoology-II

Units	Topic	Periods	Marks
1	**Introduction to apiculture** 1.1.Introduction and Scope 1.2. History of bee keeping- a) Bee keeping in India b) Bee keeping in Maharashtra	**2**	**2**
2	**Systematic Position of bee species** 2.1. Classification of honey bee 2.2. Habit and habitat 2.3. Honey bee species and their distribution- a) *Apis dorsata*, b) *Apis florae*, c) *Apis cerana indica* d) *Apis mellifera*, e) Dammer bees f) Wild bees	**3**	**3**
3	**Morphology of worker bee** 3.1. Head – Eyes, antennae, mouth parts and salivary gland 3.2. Thorax – Legs and wings 3.3. Abdomen- sting apparatus and Wax gland	**8**	**8**
4	**Anatomy of bee** 4.1. Digestive system 4.2. Circulatory system 4.3. Respiratory system 4.4 Nervous system 4.5. Reproductive system – a) Reproductive organs of male (Drone) bee, b) Reproductive organs of female (Queen) bee.	**12**	**12**
5	**Colony organization and life cycle** 5.1. Colony organization and polymorphism – a) the queen b) the drone and c) the worker (division of labour) 5.2. Life cycle of honey bee- a) nuptial flight b) metamorphosis and caste determination	**6**	**6**
6	**Bee behavior and communications** 6.1. Nesting behavior and nest architecture 6.2. Communication in bees- a) Round dance b) Wagtail dance c) Cleaning dance d) DVAV (Joy dance) e) Massage dance f) Alarm dance	**6**	**6**
7	**Bee keeping equipments and apiary management** 7.1. Introduction 7.2. Bee hive (box) - a) Langstroth hive b) Newton hive c) I.S. I. (A and B) type hive. 7.3. Bee keeping equipments – a) the bee veil b) the smoker c) the hive tool d) Gloves e) queen cage f) Comb foundation sheet g) the queen excluder h) wire entrance guard i) the queen cell protector j) dummy board k) the feeder l) the uncapping knife m) the honey extractor n) the bee brush o) Overall p) ant barrier q) the honey tank r) the drone trap. 7.4. Procurement and hiving of colonies. 7.5. Routine management – a) Cleaning, b) feeding and c) watering	**10**	**10**

	7.6. Seasonal management- a) Rainy season, b) Winter, c) Spring and d) Summer management. 7.7. Migration, Division and Uniting of colonies. 7.8. Queen rearing- Natural and artificial method		
8	**Bees and agriculture** 8.1. Importance of bee flora and floral calendar 8.2. Bee pollination 8.3. Role of bee in sustainable agriculture	**3**	**3**
9	**Bee diseases and enemies** 9.1. Bee diseases – a) Viral b) Fungal - Chalk brood and Stone brood c) Bacterial – American foul brood, European foul brood, Septicaemia, d) Protozoan disease. 9.2. Bee Parasites – a) External parasites – Mite, Louse. b) Internal parasites – Acarine disease. 9.3. Bee pest and predators	**6**	**6**
10	**Bee products** 10.1. Honey – Chemical composition, adulteration of honey and economic importance. 10.2. Other products and their uses - a) Pollen, b) Propolis (bee glue) c) Bee wax d) Bee venom and e) Royal jelly.	**4**	**4**
	Total	**60**	**60**

ZOO 243 – Practicals corresponding to ZOO 242

1. Study of systematic position and external morphology of honey bee D
2. Study of Apis species of honey bee and Study of life cycle of honey bee. D
3. Temporary mountings of pollen basket, sting apparatus and mouth parts. E
4. Study of architecture of honey comb and Study of bee box (Langstroth hive). D
5. Study of diseases, pests, parasites and predators of honey bee D
6. Study of bee keeping equipments and their uses D
7. Study of honey bee products and their uses D
8. Study of honey adulteration detection test E
9. Compulsory visit to an apiary

Suggested Books

1. Apiculture (6th edition, reviewed and updated). Pierre Jean-Prost and Paul Medori. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, Culcutta, Bombay.
2. Beekeeping. E. F. Phillips., Published by Agrobios (India), Jodhpur
3. Bees and Beekeeping in India. Dr. D. P. Abrol, Kalyani Publishers, Ludhiana, New Delhi, Hyderabad, Chennai, Calcutta.
4. Bee keeping for pleasure and profit. Mohammad Naim, Kalyani Publishers, Ludhiana.

5. Bee-Keeping and Man. T. B. Nikam and B. M. Deoray., Nirali Prakashan, Pune.
6. Applied Entomology. Manju Yadav., Discovery publishing house, New Delhi.
7. A text book of Applied Entomology. Vol. II. K. P. Srivastava., Kalyani Publishers, Ludhiana, New Delhi, Hyderabad, Chennai, Culcutta.
8. Economic Zoology. 4th Edition. Dr. G. S. Shukla and Dr. V. B. Upadhyay., Rastogi Publication, Meerut.
9. Honey: The most nutritious food. Dr. O. P. Chaudhari, Central Bee Research and Training Institute, Pune.

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Equivalence: Theory and Practicals

Class: S. Y. B. Sc.

Subject : Zoology

Paper	Old Course (W.E.F. From 2013-14)	Paper	New Courses (to be implemented from June 2016
Semester I			
ZOO 231	**Nonchordates – II**	**ZOO 231**	**Nonchordates – II**
ZOO 232	**Mammalian Histology**	**ZOO 232**	**Medical Zoology**
Semester II			
ZOO 241	**Chordates – II**	**ZOO 241**	**Chordates – II**
ZOO 242	**Mammalian Physiology**	**ZOO 242**	**Applied Zoology**
PRACTICAL			
ZOO 203	**Based on ZOO 231, ZOO 232, ZOO 241 and ZOO 242**	**ZOO 233**	**Based on ZOO 231 and ZOO 232**
		ZOO 243	**Based On ZOO 241 and ZOO 242**

North Maharashtra University, Jalgaon
S. Y. B. Sc. Zoology Syllabus w.e.f. June 2016
Sem – I Paper –II – ZOO 233: PRACTICAL

ZOO 233 – Practicals corresponding to ZOO 231

To study the following with the help of charts/ models/ diagrams/ specimens:

1. Study of External character [Oral and Aboral View]
2. Study of Digestive System of Sea star
3. Study of Water vascular system of sea star
4. Study of various Canal System in Sponges
5. Study of Locomotion in Protozoa
6. Study of Modification of foot in Mollusca
7. Mounting of Mouth Parts of Grasshopper /Cockroach / Anopheles etc
8. Visit to any Ecosystem

ZOO 233 – Practical corresponding to ZOO 232

1. Study of permanent slides or microphotographs of the following: Chikungunya virus, Swine flu, Anthrax virus, Tetanus.
2. Study of the following parasite w.r.t. life cycle and pathogenicity: *E. histolytica*, *Ascaris* male/ female, *Taenia solium*,
3. Study of following insect vector with the help of permanent slide / photographs: Head Louse, Flea, House fly, Bed bug.
4. Comparative study of mosquitoes: *Aedes, Culex* and *Anopheles*.
5. Study of epidemic diseases: Typhoid and Cholera w.r.t. sign and symptoms, source of infection, prevention and control measures.
6. Study of the following (E):
    i. Hb estimation.
    ii. Urine sugar level tests

North Maharashtra University, Jalgaon
S. Y. B. Sc. Zoology Syllabus w.e.f. June 2016
Sem – I Paper –II – ZOO 243: PRACTICAL

ZOO 243 Practicals corresponding to ZOO 241

To study the following with the help of charts/ models/ diagrams/ specimens:

1. External characters of *Columba livia* and Study of exoskeleton: a) Claws and Beak; b) Study of a structure of typical feather (paste a feather in journal of any bird) & Types (D).
2. Study of internal anatomy
    a) Digestive system of *Columba livia* (D)
    b) Respiratory system of *Columba livia* (D)
    c) Arterial system of *Columba livia* (D)
    d) Venous system of *Columba livia* (D)
3. Study of internal anatomy
    a) Nervous system: Brain (Dorsal and Ventral view) *Columba livia* (D)
    b) Excretory system of *Columba livia* (D)
    c) Male reproductive system of *Columba livia* (D)
    d) Female reproductive system of *Columba livia* (D)
4. Temporary mountings of scales: Placoid and Ctenoid scales (E).
5. Study of Fins : Scoliodon and Anabas (E)
6. Study of dinosaurs *Brontosaurs, Tyranosaurs, Stegosaurs, Triceratops, Pteranodon.* (D).
7. Adaptations in aquatic Mammals, Ex. Whale and Seal. (D).

ZOO 243 – Practicals corresponding to ZOO 242

1. Study of systematic position and external morphology of honey bee D
2. Study of Apis species of honey bee and Study of life cycle of honey bee. D
3. Temporary mountings of pollen basket, sting apparatus and mouth parts. E
4. Study of architecture of honey comb and Study of bee box (Langstroth hive). D
5. Study of diseases, pests, parasites and predators of honey bee D
6. Study of bee keeping equipments and their uses D
7. Study of honey bee products and their uses D
8. Study of honey adulteration detection test E
9. Compulsory visit to an apiary

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
V	I	Zoo 351	Non-chordates III	60	60	40
	II	Zoo 352	Cell and Molecular biology	60	60	40
	III	Zoo 353	Mammalian Histology and Physiology I	60	60	40
	IV	Zoo 354	Biochemistry	60	60	40
	V	Zoo 355	Systematics, Evolution and Palaeontology	60	60	40
	VI	Zoo 356	A) Biotechnology	60	60	40
			B) Pest management	60	60	40
			C) Public health and hygeine	60	60	40
	VII Practical I	Zoo 357	Practicals related to Zoo 351 and Zoo 353	60	60	40
	VIII Practical II	Zoo 358	Practicals related to Zoo 352 and Zoo 355	60	60	40
	IX Practical III	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) Practicals 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.	**Leech- As an animal type *Hirudinaria granulosa*** 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	**Digestive system** 2.1 Alimentary canal 2.2 Food, feeding and digestion		
3	**Haemocoelomic System** 3.1 Haemocoelomic fluid 3.2 Haemocoelomic channels 3.3 Capillary system 3.4 Course of circulation		
4	**Excretory System** 4.1 Testicular nephridia 4.2 Pre- testicular nephridia 4.3 Physiology of excretion		
5	**Nervous System** 5.1 Central nervous system 5.2 Peripheral nervous system 5.3 Sense Organs –Free nerve endings, Annular receptors, Segmental receptors and Eyes		
6	**Reproductive System** 6.1 Male reproductive System 6.2 Female reproductive system 6.3 Copulation and Fertilization 6.4 Cocoon formation and development		
7	**Economic importance** 7.1 As a Food, Predator, Pest, Transmitter of diseases, Surgical agent etc.		

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

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. Invertabrate Zoology Practical- K. Pande and J.P. Shukla.
10. Invertabrate Zoology Practical- S. M. Lall.
11. A Textbook of Zoology: Invertebrates Vol I, Marshal and William CBS Publishers, New Delhi.

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.	**Introduction to Cell biology and Molecular Biology**	**02**	**02**
2.	**Prokaryotic and eukaryotic cells** 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.	**Cell cycle and cell divisions** a. Stages of cell cycle – G_1, S, G_2 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.	**Cell Signaling and Cancer** 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.	**Nucleic Acid** 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;		
6.	**Gene and Genetic code** 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	**08**	**08**
7.	**Protein Biosynthesis:** Transcription and Translation in eukaryotes	**06**	**06**
8.	**Tools and Techniques in Molecular Biology.** 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	**09**	**09**
	Total	**60**	**60**

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. 4th 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

Unit	Topic	Periods	Marks
1	**Introduction** Definitions of Histology & Physiology, History, methods of study.	2	2
2	**Tissue and Muscle physiology** 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.	13	13
3	**Skin**, **Thermoregulation and control.** 3.1 Stucture 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.	10	10
4	**Digestive system & Digestion** 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	14	14

	digestion. 4.7 Intestinal digestion- Pancreatic secretion, bile juice & digestion of small intestine. 4.8 Digestion & absorption in large intestine. 4.9 Definitions of Ulcer, Constipation, colitis & Cirrhosis.		
5	**Respiratory system and Respiration.** 5.1 Histological structure of Trachea and Lung. 5.2 Definition- Inspiration & expiration (ventilation). 5.3 Respiratory pigments- Hb, myoglobin. 5.4 Transport of gases-Oxygen and Co2. 5.5 Chloride shift. 5.6 Nervous control of ventilation. 5.7 Respiratory quotient. 5.8 Definitions of acidosis, alkalosis, asphyxia, hypoxia, anoxia & cyanosis.	**9**	**9**
6	**Circulatory system and Circulation.** 6.1 Structure and function of blood vessels- Artery, Vein and Capillary. 6.2 Blood-composition, types of blood cells and their functions. 6.3 Heart beat and its hormonal control. 6.4 Cardiac cycle-Systole, Diastole (double circulation), Blood pressure, Pace maker & its role. 6.5 Neurogenic and Myogenic heart. 6.6 Mechanism of Blood coagulation. 6.7 Definition of- ECG, Eco-cardiograph, Color Doppler, Angiography, Angioplasty, Angina pectoris, Heart attacks.	**12**	**12**
	Total	**60**	**60**

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 preaparation 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 stomuch
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 histilogy 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. Texbook 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 Tex book og General Physiology- P. H. Mistechell.
9. Introduction of Physiology-Davson (I & II).
10. A Tex book of Animal Physiology- M. Arora.
11. General Endocrinology- Turner &Bungera.
12. A Tex book of Physiology- Chaterjee.
13. A Tex book of Physiology- Nagabhushnum.
14. A Tex book of Physiology & Biochemistry- G. H. Bell; C. R. Paterson & E. Smith.

15. Physiology of Reproduction- Austin & Austin.
16. A Tex book of Animal Physiology- Harkat & Mathur.
17. An Introduction of general & comparative Physiology- Barrington.
18. Endocrinology: Hormones and Human Health- Prakash Lohar.
19. A Tex 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.

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

Units	Topic	Periods	Marks
1	**Introduction to biochemistry, objectives, scope and importance.**	**01**	**02**
2	**pH and Buffers** **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	**04**	**06**
3	**Molecular Interactions** **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.	**04**	**05**
4	**Carbohydrates** **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)	**08**	**07**
5	**Lipids** **5.1** Definition, classification with examples and their biological importance.	**8**	**7**

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

	8.3 Mechanism of enzyme action –concept of active sites, lock and key model and induced fit model. **8.4** Factors affecting enzymatic activity a) Substrate concentration, b) Enzyme concentration, c) pH d) Temperature, e) Activators and Inhibitors (Competitive and non-competitive) **8.5** Coenzymes, cofactors and prosthetic groups. **8.6** Isoenzymes- Definition, Lactate dehydrogenase, significance. **8.7** Nucleotides as coenzymes (NAD, NADH, FAD, FMN) **8.8** Industrial applications of enzymes – Enzymes involved in the production of glucose from starch & cellulose		
9	**Vitamins** (Structural formulae not expected) **9.1** Definition, classification- Fat and Water soluble. **9.2** Study of Fat- soluble- A, D, E, K vitamins, Water soluble vitamins - B- complex (B1, B2, B6and B12) nicotinic acid, folic acid, pantothenic acid and Vitamin C with respect to sources, daily requirements, principle role in metabolism and Deficiency diseases. **9.3** Vitamins as Coenzymes	**08**	**07**
10	**Minerals:** **10.1** Definition and general functions of minerals **10.2** Major or macro minerals: Calcium, Prosperous, sodium, chlorides, potassium, magnesium and sulphur w.r.t. sources, functions and deficiency diseases	**4**	**5**
	Total	**60**	**60**

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

	3.3 Darwinism: Natural selection theory and Darwin finches		
	3.4 Neo-Darwinism: Industsrial melanism **3.5 Modern synthetic theroy: concepts** **3.6 Mutation theory of de Vries**: Experiment, features and Examples		
4	**Evolution through ages** **4.1 Introduction** **4.2 Geological time scale**: Era, periods and epochs - Characters and examples **4.3 Antiquity of Man** 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, Sinantrhopus - Peking man 7. Neanderthal man 8. Cromagnon man 9. Homo sapiens (Modern man)	**12**	**12**
5	**Palaeontology** **5.1 Introduction** **5.2** a) Fossils- Definition, process of fossilization and evidences b) Determination of age of rocks and fossils (radiometric dating) i) Uranium-Lead method ii) Radioactive carbon method **c) Nature of fossils- unaltered and altered fossils** **d) Types of fossils**- i) Actual remains ii) Petrified fossils, iii) Moults and casts, iv) Foot prints and trails v) Coprolites **e)Significance of fossils**	**12**	**12**

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

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

1. **Hierarchic classification of any two animals from Nonchordates (Cockraoch 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. **Evidances 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 Humanevolution**

1. Australopithecus 2. Pithecanthropus
3. Neanderthal man 4. Cromagnon amn

6. **Study of fossils**

a) Trilobite
b) Archaeopteryx
c) Spenodon
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, NewYork (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 atwww.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, Evalution and Ecology,* S. Chand & Company New Delhi (Moldule 1-5)

11. Ernst, Mayr. Systematics and the origin of species from the viewpoint of zoologist. Harvard University Press.

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

Unit	Topic	Period	Marks
1	**Introduction, scope and significance of Biotechnology**	**02**	**02**
2	**Animal cell and tissue culture** 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	**Recombinant DNA technology** 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	**Transgenic animals** 4.1 Introduction 4.2 Methods of Transfection (Physical, Chemical, Viral and Bacterial) 4.3 Examples and significance of transgenic animals	**04**	**06**
5	**Hybridoma technology** 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	**Enzyme biotechnology** 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**

7	**Industrial and Environmental Biotechnology** 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	**09**	**07**
8	**Stem Cell Biotechnology** 8.1 Introduction 8.2 Types of Stem Cell and their uses 8.3 Now and Future of Stem cell Biotechnology	**05**	**05**
	Total	**60**	**60**

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_2 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
1	**Introduction to Pest** 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	**05**	**05**
2	**Study of insect pest w. r. t. their Marks of identification, Life cycle, Nature of damage and Control measures.** 2.1 Banana – Banana stem borer- *Odoiporus longicollis* 2.2 Cotton-Red cotton bug- *Dysdercus cingulatus* 2.3 Sugarcane-Sugarcane leafhopper- *Pyrilla perpusilla* 2.4 Mango-Mango stem borer- *Batocera rubus* 2.5 Jowar- Jowar stem borer- *Chilo zonellas* 2.6 Brinjal-Brinjal shoot borer- *Leucinodes orbonalis guenee* 2.7 Store grain –*Sitophilus oryzae* 2.8 Wood-White ants –Termite- *Odontotermes obesus*	**15**	**15**
3	**Primary Control Measures** 3.1 Mechanical measures 3.2. Physical measures 3.3. Cultural measures 3.4. Legislative measures 3.5. Quarantine measures	**05**	**05**
4	**Chemical Control** 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	**05**	**05**

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

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

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.

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	**Scope and Importance.**	**1**	**1**
2	**Health Education** 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	**Food** 3.1 Introduction and classification of food 3.2 Balanced diet 3.3 Food adulteration 3.4 Food Sanitation	**8**	**5**
4	**Environment and health** 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	**Sanitation** 5.1 Disposal of Human and animal Excreta. 5.2 Solid waste, sewage and their management	**4**	**4**
6	**Communicable Diseases:** Introduction, transmission and control 6.1 Measles 6.2 Poliomyelitis 6.3Tuberculosis 6.4 STD: AIDS, Gonorrhea, Syphilis 6.5 Encephalitis	**9**	**9**
7	**Non Communicable Diseases:** 7.1 Coronary Heart diseases	**9**	**9**

	7.2 Diabetes mellitus 7.3 Mental illness 7.4 Alcoholism and drug dependence		
8	**Insect Born diseases** 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	**4**	**4**
9	**Hygiene** 9.1 Hygiene and health factors at home. 9.2 Personal hygiene 9.3 Oral Hygiene 9.4 Mental Hygiene	**8**	**8**
	Total	**60**	**60**

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

1. To detect adulterants in the food samples by appropriate tests. (E)
2. Epidemiological study of measles, tuberculosis and poliomyelitis. (D)
3. 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.)
4. Biological control of mosquito larvae
5. 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

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

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

Units	Topic	Periods	Marks
1.	**Study of Scoliodon w.r.t. following:** 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	**08**	**04**
2.	**Internal anatomy of Scoliodon** **2.1 Digestive system** i)Alimentary canal ii) Digestive glands. Food and physiology of digestion. **2.2 Respiratory system** i) Respiratory organs. ii) Mechanism of respiration. iii) Physiology of respiration. **2.3 Blood vascular system** 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. **2.4 Nervous System** i) Central nervous system - Brain and Spinal cord. ii) Peripheral nervous system - Cranial and spinal	**42**	**44**

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

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.

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	**Concept of embryology** **1.1** Growth, Differentiation, De-differentiation, **1.2** Regeneration, Induction, Organizer, **1.3** Totipotency, Fate-map.	**03**	**04**
2	**Gametogenesis** **2.1** Spermatogenesis including spermatogenesis **2.2** Oogenesis **2.3** Difference between spermatogenesis and oogenesis **2.4** Significance of gametogenesis	**04**	**06**
3	**Structure of Gametes** **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	**Fertilization** **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		
5	**Cleavage** **5.1** Definition, characteristics and significance **5.2** Planes of cleavage, Types - i] Holoblastic - Equal and unequal. ii] Meroblastic – Discoidal, Superficial, Determinate and Indeterminate cleavage **5.3** Patterns of cleavage with examples - Radial, Spiral, Bilateral and Asymmetrical **5.4** Blastulation –Definition and types	**06**	**08**
6	**Gastrulation** **6.1** Definition and concept **6.2** Basic cell movement in gastrulation – Epiboly - Convergence, Emboly - Invagination, Involution, Ingression, Infiltration, Delamination, Divergence, constriction and elongation with reference to Amphioxus and frog.	**03**	**04**
7	**Chick Embryology** **7.1** Structure of Hen's egg [freshly-laid] **7.2** Egg-membranes **7.3** Fertilization, cleavage and blastulation **7.4** Gastrulation - Formation of primitive ectoderm **7.5** Development of primitive streak **7.6** Head - Process, somites, regression of primitive streak **7.7** Development of brain upto72 hours. **7.8** Development of heart and main blood vessels upto 72 hours. **7.9** Development of digestive system upto 72 hours. **7.10** Development of extra-embryonic membranes **7.11** Significance or uses of chick - embryology in developmental biology.	**20**	**15**

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

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	**Excretory system and Excretion** **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	**Nervous system and Nervous Physiology** 2.1 Brain meninges - structure and function. 2.2 Spinal cord- structure and function. 2.3 Neurotranmitters- 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	**Sense Organs** 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	**Reproductive system and Reproduction** 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	**Endocrine system and Endocrine glands.** 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.		
Total		**60**	**60**

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 vain

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 overy

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. Texbook 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 og General Physiology- P. H. Mistechell.
9. Introduction of Physiology-Davson (I & II).
10. A Tex book of Animal Physiology- M. Arora.
11. General Endocrinology- Turner &Bungera.
12. A Tex book of Physiology- Chaterjee.
13. A Tex book of Physiology- Nagabhushnum
14. A Tex book of Physiology & Biochemistry- G. H. Bell; C. R. Paterson & E. Smith.
15. Physiology of Reproduction- Austin & Austin.
16. A Tex book of Animal Physiology- Harkat & Mathur.
17. An Introduction of general & comparative Physiology- Barrington.
18. Endocrinology: Hormones and Human Health- Prakash Lohar.
19. A Tex 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.

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

Units	Topic	Periods	Marks
1	**Definition , introduction and scientific approach of research** 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	**10**	**12**
2	**Research design** 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	**10**	**12**
3	**Data analysis and measurements** 3.1 **Sampling** – Definition and needs 3.2 **Scaling** – Definition and importance 3.3 **Tabulation of data**- a) **Variables** – Definition, types with example b) **Frequency distribution** - Definition, types and example c) **Measurement of central tendency** –Definition, types of average – mean, median, mode with example d) **Testing hypothesis** – Null hypothesis (H0), Alternative hypothesis (H1), Level of significance and degree of freedom with example	**10**	**06**

4	**Data presentation (with examples)** 4.1 **Method of data presentation** – a) Bar chart (diagram), b) Pie chart c) Histogram 4.2 **Standard deviation** (SD) 4.3 **Standard error** (SE) 4.4 **Chi-square test** 4.5 **Student-t test**	**08**	**06**
5	**Component of research report/paper/project** 5.1 Prepare Title, Author and Addresses, key words and Abstract (summary and synopsis) 5.2 **Writing of research paper and project**- IMMRAD 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.	**18**	**20**
6	**Parameters of research** 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	**04**	**06**
	Total	**60**	**60**

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 ± SD
1	Labeo rohita	1.25 ± 0.75
2	Cirrhina mrigal	2.10 ± 0.64
3	Catla catla	2.33 ± 0.66
4	Cyprinus carpio	1.12 ± 0.23
5	Tor tor	3.40 ± 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

T.Y.B. Sc. (Zoology) Syllabus w.e.f. June 2017
Semester VI , Paper -V ZOO- 365
Microtechnique

Units	Topic	Periods	Marks
1	**Introduction**-Definition, Scope and Applications of Microtechnique.	2	2
2	**Collection of material- Norcotization / Anesthetization.** 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	**Washing** 3.1 Theory of washing 3.2 Significance of washing	2	2
4	**Dehydration** 4.1 Definition , Dehydrating agents-Ethanol, Methanol, Acetone 4.2. Significance and use of dehydrating agents.	2	2
5	**Clearing** 5.1 Definition and importance 5.2 Clearing agents their merits and demerits- Xylene, Toluene, Benzene, Cedar wood oil, Clove oil.	4	4
6	**Embedding and Block making** 6.1 Cold and hot infiltration. 6.2 Paraffin 6.3 Selection of paraffin according to need.	10	10

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

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 microtechniqes-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.

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 *E. coli, S. cerevisiae, C. elegans*, and *Homo sapiens*. 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**
	Total	**60**	**60**

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

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	**Introduction** 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	**Mulberry silk worm (*Bombyx mori*)** 2.1 Classification, systemic position and distribution. 2.2 Nutrition – factors influencing silkworm growth and development 2.3 Circulatory system of *Bombyx mori* 2.4 Male reproductive system of *Bombyx mori* 2.5 Female reproductive system of *Bombyx mori* 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	**Other Silkworm Species.** 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	**Endocrine and Exocrine glands** 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, dipause, 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	**Rearing Technology** 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.		
6	**Mulberry cultivation.** 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	**12**	**12**
7	**Pests, Predators and Parasites of Silkworm** 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.	**4**	**4**
8	**Economical and Commercial importance of sericulture**	**2**	**2**
	Total	**60**	**60**

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.

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	**1.1 Vermiculture: Introduction and scope** **1.2 Species of earthworm (Classification)** *Eisenia foetida* (Savigny) *Eudrilus eugeniae* (Kinb.) **1.3 Establishment of vermicomposting and Vermiwash unit:** i) Biologically degradable material :–Agricultural waste and agro-industry waste ii) Feeding vermicomposting materials :- Materials which should not feed to earthworm, Quantity of material eat by earthworm; Feeding procedure iii)Vermicomposting types: Small scale or Indoor vermicomposting, Large scale or outdoor vermicomposting iv) Physical requirement for vermicomposting : Air; moisture and temperature v) Construction of vermiculture unit: Bedding material; steps of prepration of vermin bed – KISS (Keep It simple and Save) Plan . vi) Set up of vermiwash unit: **1.4 Factor affecting growth of earthworm:** Earthworm and Insect; Tilling and Earthworm population Earthworm and Come Drowning. **1.5 Earthworm's Parasites and predators** - Mites, Leech, Nematodes, Ciliates, Sporozoans. Economic importance of vermicompost and vermiwash	**20**	**20**
2	**2.1 Poultry: Introduction and Scope** **2.2 Species of Hens (Classification)** *a. Asil (Aseel)* *b. Brahma* **2.3 Housing and equipment of poultry** (Feeders; Heaters or Brooders; Incubator with Controller; Egg Tray; Ventilation Fan; Laying Nest; Egg Washer; Water Pots and Drinkers; Cages and Coops; Dressing Machine;	**20**	**20**

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

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 ll0 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.

NORTH MARARASHTRA UNIVERSITY JALGAON
Revised Syllabus of T.Y.B.Sc. Zoology (Academic Year 2017-18)

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 Histoloty 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 vermitechnology 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

Codes : 2014 old syllabus	Codes : 2017 new syllabus
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

Codes : 2014 old syllabus	Codes : 2017 new syllabus
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 strructure 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 hygeine	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) Practicals 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 hygeine	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) Practicals related to Zoo 364, Zoo 366 and Project work	4	60

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

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

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	

NORTH MAHARSHTRA UNIVERSITY, JALGAON

Syllabus for FYBSc ZOOLOGY under CBCS Pattern

(wef June 2018)

Examination Pattern 60:40

Semester	Core Course	Structure	Code & Title of the paper	Credit
I	CC A-I	Theory	ZOO 101 Animal Diversity I	02
		Theory	ZOO 102 Animal Diversity II	02
		Practical	ZOO 103 Animal Diversity I & II	02
II	CC A-II	Theory	ZOO 201 Comparative Anatomy of Vertebrates	02
		Theory	ZOO 202 Developmental Biology of Vertebrates	02
		Practical	ZOO 203 Comparative Anatomy & Developmental Biology of Vertebrates	02
Total Credits Sem I & II= 12				

1 Credit = 15 Periods = 25 Marks

FYBSc Zoology Semester I

Core Course A-I

ZOO 101 : ANIMAL DIVERSITY I

CREDITS 2

Unit 1: Kingdom Protista **4**
General characters and classification up to classes; Locomotory Organelles and locomotion in Protozoa

Unit 2: Phylum Porifera **3**
General characters and classification up to classes; Canal System in *Sycon*

Unit 3: Phylum Cnidaria **3**
General characters and classification up to classes; Polymorphism in Hydrozoa

Unit 4: Phylum Platyhelminthes **3**
General characters and classification up to classes; Life history of *Taenia solium*

Unit 5: Phylum Nemathelminthes **4**
General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations

Unit 6: Phylum Annelida **3**
General characters and classification up to classes; Metamerism in Annelida

Unit 7: Phylum Arthropoda **4**
General characters and classification up to classes; Vision in Arthropoda, Metamorphosis in Insects

Unit 8: Phylum Mollusca **3**
General characters and classification up to classes; Torsion in gastropods

Unit 9: Phylum Echinodermata **3**
General characters and classification up to classes; Water-vascular system in Asteroidea

SUGGESTED READINGS

- Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
- Kotpal R L (2009): Modern textbook of Zoology Invertebrates,Rastogi Publication. .
- Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.

FYBSc Zoology Semester I

Core Course A-I

ZOO 102 : ANIMAL DIVERSITY II

CREDITS 2

Unit 1: Protochordates **3**
General features and Phylogeny of Protochordata

Unit 2: Agnatha **3**
General features of Agnatha and classification of cyclostomes up to classes

Unit 3: Pisces **4**
General features and Classification up to orders; Osmoregulation in Fishes

Unit 4: Amphibia **5**
General features and Classification up to orders; Metamorphosis in frog, Parental care,

Unit 5: Reptiles **5**
General features and Classification up to orders; Extinct reptiles, Poisonous and non-poisonous snakes, Biting mechanism in snakes

Unit 6: Aves **5**
General features and Classification up to orders; Flight adaptations in birds

Unit 7: Mammals **5**
Classification up to orders; Origin of mammals

SUGGESTED READINGS

- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- Kotpal R L (2009): *Modern textbook of Zoology Vertebrates*,Rastogi Publicationa. .
- Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.
- Lal S.S. (1996): Textbook of Practical Zoology Vertebrates, Rastogi Publications

FYBSc Zoology Semester I

Core Course A-I

Practical: ZOO 103

ANIMAL DIVERSITY I & II

CREDITS 2

1. Study of the following specimens (Invertebrates):

Amoeba, *Euglena, Plasmodium, Paramecium, Sycon*, *Hyalonema,* and *Euplectella,Obelia, Physalia, Aurelia, Tubipora, Metridium, Taenia solium,* Male and female *Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer*, *Limulus*, *Palamnaeus, Scolopendra*, *Julus*, *Periplaneta, Apis, Chiton, Dentalium, Pila, Unio,Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria* and *Antedon.*

2. Study of the following permanent slides:

T.S. and L.S. of *Sycon*, Study of life history stages of *Taenia,* T.S. of Male and female *Ascaris*

3. Study of the following specimens (Vertebrates):

Balanoglossus (Hemichordata), *Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo,Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone,Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis,* Any six common birds from different orders, *Sorex*, Bat, *Funambulus, Loris*

4. **Key for Identification of poisonous and non-poisonous snakes**

An "**animal album**" containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

FYBSc Zoology Semester II

Core Course A-II

ZOO201: COMPARATIVE ANATOMY OF VERTEBRATES

CREDITS 2

Unit 1: Integumentary System **4**
Derivatives of integument w.r.t. glands and digital tips

Unit 2: Skeletal System **3**
Evolution of visceral arches

Unit 3: Digestive System **4**
Brief account of alimentary canal and digestive glands

Unit 4: Respiratory System **5**
Brief account of Gills, lungs, air sacs and swim bladder

Unit 5: Circulatory System **4**
Evolution of heart and aortic arches

Unit 6: Urinogenital System **4**
Succession of kidney, Evolution of urinogenital ducts

Unit 7: Nervous System **3**
Comparative account of brain

Unit 8: Sense Organs **3**
Types of receptors

SUGGESTED READINGS

- Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education.
- Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.
- Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley and Sons.
- Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.

FYBSc Zoology Semester II

Core Course A-II

ZOO 202 : DEVELOPMENTAL BIOLOGY OF VERTEBRATES

CREDITS 2

Unit 1: Early Embryonic Development **12**

Gametogenesis: Spermatogenesis and oogenesis w.r.t. mammals, vitellogenesis in birds; Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and humans (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula);types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.

Unit 2: Late Embryonic Development **10**

Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation.

Unit 3: Control of Development **8**

Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death

SUGGESTED READINGS

- Gilbert, S. F. (2006). *Developmental Biology*, VIII Edition, Sinauer Associates, Inc.,Publishers, Sunderland, Massachusetts, USA.
- Balinsky, B.I. (2008). *An introduction to Embryology*, International Thomson C. Press.
- Carlson, Bruce M (1996). *Patten's Foundations of Embryology*, McGraw Hill, Inc.

FYBSc Zoology Semester II

Core Course A-II

Practical: ZOO 203

COMPARATIVE ANATOMY & DEVELOPMENTAL BIOLOGY OF VERTEBRATES

CREDITS 2

1. S**tudy of bones (Osteology)**:
    a) Disarticulated skeleton of fowl and rabbit
    b) Carapace and plastron of turtle /tortoise
    c) Mammalian skulls: One herbivorous and one carnivorous animal.

2. **Frog Embryology** - Study of developmental stages - whole mounts and sections through permanent slides – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.

3. **Study of the different types of placenta**- histological sections through permanent slides or photomicrographs.

4. **Examination of gametes** - frog/rat - sperm and ova through permanent slides or photomicrographs.

Kavayitri Bahinabai Chaudhari

NORTH MAHARASHTRA UNIVERSITY

JALGAON 425001, INDIA

SYLLABUS UNDER

FACULTY OF SCIENCE & TECHNOLOGY

UNDER CBCS

FOR COURSES RELATED TO SUBJECT

ZOOLOGY

S.Y.B.Sc. (Semester I and II)

WITH EFFECT FROM

ACADEMIC YEAR 2019-2020

KBC NORTH MAHARSHTRA UNIVERSITY, JALGAON

Syllabus for SYBSc ZOOLOGY under CBCS Pattern

(wef June 2019)

Examination Pattern 60:40

Semester	Core Course	Structure	Code & Title of the paper	Credit
III	DSC 1-C CC A-III	Theory	ZOO 301 Physiology	02
		Theory	ZOO 302 Biochemistry	02
		Practical	ZOO 303 Physiology & Biochemistry	02
	SE Course I	Section I	SEC I Apiculture	02
	AEC III	Section I	English/Marathi Communication (2 periods per week)	02
IV	DSC 1-D CC A-IV	Theory	ZOO 401 Genetics	02
		Theory	ZOO 402 Evolutionary Biology	02
		Practical	ZOO 403 Genetics & Evolutionary Biology	02
	SE Course II	Section II	SEC II Medical Diagnostics	02
	AEC IV	Section II	English/Marathi Communication (2 periods per week)	02
Total Credits Sem III & IV= 16+4=20				

DSC = Discipline selective course
SEC= Skill Enhancement Course
AEC = Ability Enhancement course
Credit 2= 2 hrs/ week = 30 periods per semester

CORE COURSE III

SYBSc Zoology Semester III

ZOO 301 PHYSIOLOGY

THEORY **(CREDITS 2)**

Unit 1: Nerve and muscle (5)
Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction

Unit 2: Digestion (3)
Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids

Unit 3: Respiration (5)
Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood

Unit 4: Excretion (4)
Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism

Unit 5: Cardiovascular system (5)
Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle

Unit 6: Reproduction and Endocrine Glands (8)
Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle, Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal

ZOO 302 BIOCHEMISTRY

THEORY **(CREDITS 2)**

Unit 1: Carbohydrate Metabolism (8)
Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain

Unit 2: Lipid Metabolism (6)
Biosynthesis and β oxidation of palmitic acid, Lipogenesis, Lipolysis

Unit 3: Protein metabolism (8)
Biosynthesis of amino acid, Transamination, Deamination, Decarboxylation and Urea Cycle

Unit 4: Enzymes (8)
Introduction, Classification of Enzymes, Mechanism of action, Enzyme Kinetics, Factors affecting rate of enzyme mediated reactions, Inhibition and Regulation

ZOO 303 PHYSIOLOGY AND BIOCHEMISTRY

PRACTICAL **(CREDITS 2)**

1. Preparation of hemin and hemochromogen crystals
2. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland
3. Study of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage
4. Qualitative tests to identify functional groups of carbohydrates in given solutions (Glucose, Fructose, Sucrose, Lactose)
5. Estimation of total protein in given solutions by Lowry's method.
6. Study of activity of salivary amylase under optimum conditions

SUGGESTED READINGS

- Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008) *Vander's Human Physiology*, XI Edition., McGraw Hill
- Guyton, A.C. and Hall, J.E. (2011). T*extbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). *Biochemistry*. VI Edition. W.H Freeman and Co.
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). *Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.
- Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). *Harper's Illustrated Biochemistry*. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.
- Prakash S.Lohar (2008)Endocrinology:Hormones and Human Health, MJP Publshers , A unit of Tamilnadu Book House, Triplicane, Chennai

Skill Enhancement Course I (Section I)

SEC I

Apiculture

Credit 2

Unit 1: Biology of Bees (4)

History, Classification and Biology of Honey Bees, Social Organization of Bee Colony

Unit 2: **Rearing of Bees** (12)

Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth Bee Pasturage Selection of Bee Species for Apiculture, Bee Keeping Equipment Methods of Extraction of Honey (Indigenous and Modern)

Unit 3: **Diseases and Enemies** (5)

Bee Diseases and Enemies Control and Preventive measures

Unit 4: **Bee Economy** (4)

Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis, Pollen, etc)

Unit 5: **Entrepreneurship in Apiculture** (5)

Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens

SUGGESTED READINGS

- Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
- Bisht D.S., Apiculture, ICAR Publication.
- Singh S., Beekeeping in India, Indian council of Agricultural Research, NewDelhi.

CORE COURSE IV
SYBSc Zoology Semester IV

ZOO 401 GENETICS

THEORY **(CREDITS 2)**

Unit 1: Introduction to Genetics (4)
Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information

Unit 2: Mendelian Genetics and its Extension (10)
Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and co dominance, Polygenic inheritance, Multiple alleles, Lethal genes, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance

Unit 3: Linkage, Crossing Over and Chromosomal Mapping (6)
Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, definition of gene mapping.

Unit 4: Mutations (6)
Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations

Unit 5: Sex Determination (4)
Chromosomal mechanisms and methods

ZOO 402 EVOLUTIONARY BIOLOGY

THEORY **(CREDITS 2)**

Unit 1: History of Life (2)
Major Events in History of Life

Unit 2: Introduction to Evolutionary Theories (4)
Lamarckism, Darwinism, Neo-Darwinism

Unit 3: Direct Evidences of Evolution (4)
Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse

Unit 4: Processes of Evolutionary Change (8)
Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

Unit 5: Species Concept (4)
Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)

Unit 6: Macro-evolution (4)
Macro-evolutionary Principles (example: Darwin's Finches)

Unit 7: Extinction (4)
Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution

ZOO 403 GENETICS AND EVOLUTIONARY BIOLOGY

PRACTICAL **(CREDITS 2)**

1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test.
2. Study of Linkage, recombination, gene mapping using the data.
3. Study of Human Karyotypes (normal and abnormal).
4. Study of fossil evidences from plaster cast models and pictures
5. Study of homology and analogy from suitable specimens/ pictures
6. Study of Picture/Charts with reference to:
   a) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
   b) Darwin's Finches with diagrams/ cut outs of beaks of different species
7. Visit to Natural History Museum and submission of report

SUGGESTED READINGS

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.
- Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings.
- Russell, P. J. (2009). *Genetics- A Molecular Approach.* III Edition. Benjamin Cummings.
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.
- Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
- Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
- Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers
- Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates

Skill Enhancement Course II (Section II)

SEC II

Medical Diagnostics

THEORY **Credit 2**

Unit 1: **Introduction to Medical Diagnostics and its Importance** (2)

Unit 2: **Diagnostics Methods Used for Analysis of Blood** (10)

Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.)

Unit 3: **Diagnostic Methods Used for Urine Analysis** (6)

Urine Analysis: Physical characteristics, normal and abnormal constituents

Unit 4:**Non-infectious Diseases** (6)

Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/ diagnostic kit

Unit 5: **Infectious Diseases** (3)

Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis

Unit 6: **Tumours** **(**3)

Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).

SUGGESTED READINGS

- Park, K. (2007), Preventive and Social Medicine, B.B. Publishers
- Godkar P.B. and Godkar D.P. Textbook of Medical Laboratory Technology
- Edition, Bhalani Publishing House Cheesbrough M., A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses
- Guyton A.C. and Hall J.E. Textbook of Medical Physiology, Saunders
- Robbins and Cortan, Pathologic Basis of Disease, VIIIEdition, Saunders
- Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.

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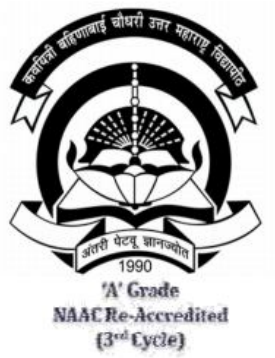

Proposed Structure of Syllabus for B.Sc.

T. Y. B. Sc. (ZOOLOGY)

Choice Based Credit System (CBCS)

2020-21

T. Y. B. Sc. ZOOLOY (CBCS Structure)

(With Effect from June 2020)

Semester V and VI

Preamble:

The choice based credit system (CBCS) was introduced at FYBSc since academic year 2018-19. It was then opted for SYBSc during academic year 2019-20 and CBCS system shall be effective for third year students form 2020-21. The contents have accommodated the widening horizons of the discipline of Biological Sciences. They reflect the current changing needs of the students; specifically, the subjects on biotechnology, bioinformatics and research methodology have been incorporated.The well organized curricula including basic as well as advanced concepts in Zoology from first year to third year. The course content also lists the new practical exercises so that the students get a hands-on experience of the latest techniques that are in current usage. The curricula shall inspire the students for pursuing higher studies in Zoology and for becoming an entrepreneur and also enable students to get employed in the Biological research Institutes, Industries, Educational Institutes and in the various concerning departments of State and Central Government based on subject Zoology.

Introduction:

At first year of under-graduation the topics related to the fundamentals of zoology, including exposure to diversity of animals, comparative anatomy of vertebrates and developmental biology are coveredin semester I and II. The practical course is aimed at to equip the students with skills required for animal identification, morphological, technical description, classification,anatomical, developmental phenomenon and also applications of zoology in the various fields.

At second year under-graduation, insemester III and IV coursessuch as Physiology, Biochemistry, Genetics and Evolutionary Biology, the level of the theory and practical courses increased one step ahead of the first year B.Sc.

At third year under-graduation: Theory and practical courses in semester Vshall deal with the further detailed studies of the various disciplines of the Zoology inform of core courses such as Reproductive biology, Cell and Molecular Biology, Mammalian Histology, and

Animal Biotechnology. Skill based course on Public health and hygiene is included as well as students can select either Pest Management or Apiculture as discipline elective course. Semester VI shall cover the theory and practical courses such as Comparative study of representative of invertebrate and vertebrate, Chick embryology, Applied Zoology, Microtechnique as core courses. Research Methodology shall skill enhancement course that shall help students for research in Zoology and students can also select either Bioinformatics or Sericulture as discipline elective course.

Learning Objectives:

- To provide thorough knowledge about animal classification and associated taxonomic groups various animal sciences from primitive to highly evolved animal groups.
- To develop an understanding of and ability to apply basic zoological principles.
- To provide quality education in different specializations in Zoology.
- To facilitate higher education and research in zoology.
- To make the students aware of applications of Zoology subject in various industries
- To equip the students with skills related to laboratory as well as field based studies.
- To make the students aware about conservation and sustainable use of biodiversity.
- To inculcate interest and foundation for further studies in Zoology.
- To address the socio-economical challenges related to animal sciences.
- To provide quality education offering skill based programs and motivate the students for self employment in applied branches of Zoology.

Program specific objectives (PSO)

- To achieve excellence in academic and scientific research in the field of Zoology.
- To develop and implement ways and means to ensure quality performance and outputs of Zoology program.
- To use modern technology in education and scientific research in Zoology.
- To implement advanced training to improve the skills of graduates in Zoology and related fields.
- To create academic and scientific environment to attract outstanding faculty, researchers and students.
- To improve the national and international partnerships with academic institutions and research centres.

Program outcome (PO)

- To possess a good command of fundamentals in Zoology and its relationship to other disciplines.
- To know the theories and scientific facts in the sections of Zoology and interrelations among organisms and their biosphere
- To memorize the concepts of laboratory management, organization and evaluation.
- To recognize the management and concepts of bio-systems, organization and evaluation.
- To outline the policy and legislation of animal Science and ethics.
- To design and conduct experiments in Zoology
- To communicate effectively through writing reports, giving presentations, and participating in discussions.
- To demonstrate skill in the usage of computers, networks, and software packages relevant to Zoology
- To learn the principles of research methodology.

Course outcome (CO)

- Describe the diversity in form, structure and habits of invertebrates and vertebrates
- Explain the reproductive patterns in animal world
- Develop deeper understanding of life is and how it functions at cellular level as well as histological structure of tissues.
- Understand applications of animal biotechnology, bioinformatics and research methodology
- Familiar with various stages involved in the developing embryo
- Acquire skills in the microtechniques, apiculture, sericulture and other applied branches of Zoology.

Duration: The duration of B.Sc. degree program shall consists of three years.

Medium of instruction: The medium of instruction for the courses shall be English.

Examination pattern

- Each theory and practical course will be of 100 marks comprising of 40 marks internal and 60 marks external examination.
- Theory examination (60 marks) will be of three hours duration for each theory course. There shall be 5 questions each carrying equal marks (12 marks each).
- Internal examination (40 marks) and
- Practical examination (CA of 40 marks and UA of 60 Marks)

Structure of curriculum of TYBSc (Zoology) Semester V

Discipline	Course Type	Course Code	Course title	Credits	Hours/ week (Clock Hours)	Total Teaching hours	Marks (Total 100)	
							CA	UA
Discipline Specific Course (DSC)	Core l	Zoo-501	Reproductive Endocrinology	3	3	45	40	60
	Core I	Zoo-502	Cell and Molecular Biology (CMB)	3	3	45	40	60
	Core III	Zoo-503	Mammalian Histology	3	3	45	40	60
	Core IV	Zoo-504	Animal Biotechnology	3	3	45	40	60
DSC Skill Enhancement Course [SEC]	Skill Based	Zoo-505	Public health and hygiene	3	3	45	40	60
DSC Elective Course	Elective Course (Any one)	Zoo-506 (A)	Pest Management	3	3	45	40	60
		Zoo-506 (B)	Aquarium Fish Keeping					
DSC	Core (Practical)	Zoo-507	Practical related to Zoo-501& Zoo502 (CB)	2	4 (Per batch)	60	40	60
		Zoo-508	Practical related to Zoo 502 (MB)& Zoo 503	2	4 (Per batch)	60	40	60
		Zoo-509	Practical related to Zoo504	2	4 (Per batch)	60	40	60
Non Credit Audit Course	Elective audit course (Any one)	AC-501A	NSS	No credit	2	30	100	----
		AC-501 B	NCC					
		AC-501 C	Sports					

Structure of curriculum of TYBSc (Zoology) **Semester VI**

Discipline	Course Type	Course Code	Course title	Credits	Hours/ week (Clock Hours)	Total Teaching hours	Marks (Total 100)	
							CA	UA
Discipline Specific Course(DSC)	Core l	Zoo-601	Study of Leech & Calotes	3	3	45	40	60
	Core I	Zoo-602	Chick Embryology	3	3	45	40	60
	Core III	Zoo-603	Applied Zoology	3	3	45	40	60
	Core IV	Zoo-604	Microtechnique	3	3	45	40	60
DSC Skill Enhancement Course [SEC]	Skill Based	Zoo-605	Research Methodology	3	3	45	40	60
DSC Elective Course	Elective Course (Any one)	Zoo-606(A)	Bioinformatics	3	3	45	40	60
		Zoo-606 (B)	Sericulture					
DSC	Core (Practical)	Zoo-607	Practical related to Zoo-601	2	4 (Per batch)	60	40	60
		Zoo-608	Practical related toZoo 602 & Zoo 603	2	4 (Per batch)	60	40	60
		Zoo-609	Practical related toZoo 604	2	4 (Per batch)	60	40	60
Non Credit Audit Course	Elective audit course (Any one)	AC-601 A	Soft skill	No credit	2	30	100	----
		AC-601 B	Yoga					
		AC-601 C	Practicing Cleanliness					

CA: Class assessment {Internal examination}; UA: University assessment

Semester V

DSC Core Courses			
Zoo - 501: Reproductive Endocrinology			
	Course objective • To learn about the various aspects of reproductive biology and endocrinology. • To acquire a broad understanding of the hormonal regulation of physiological processes. • To create awareness of new technologies in assisted reproduction as well as contraceptive methods.	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes After successful completion of this course, students are expected to: • understand the functioning of male and female reproductive systems particularly in humans. • comprehension of the interplay of various hormones in the functioning and regulation of the male and female reproductive systems • know about modern contraceptive devices.		
Unit	**Topics**	**Lectures 45**	**Marks 60**
Unit I	Introduction: Definition and Scope of Reproductive endocrinology	**02**	**05**
Unit II	Structure, Morphology, Histology and Reproductive functions of - Pituitary gland, Thyroid and Adrenal gland.	**10**	**13**
Unit III	**Male and Female Gonads:** 3.1 **Testis:** 3.1.1 Structure (Histology) and Endocrine Regulation. 3.1.2 Hypophysical Control (Testicular androgens). 3.1.3 Role of testosterone in the foetal development. 3.1.4 Effect of testosterone on development of sexual characteristics. 3.2 **Ovary:** 3.2.1 Structure (Histology) and Endocrine Regulation. 3.2.2 Hypophysial Control.	**13**	**17**
Unit IV	**Female Reproductive Cycle:** 4.1 a)Oestrous cycle, b)Menstrual cycle, c) Endocrine Regulation of female Sexual cycle. 4.2 Function of Ovarian Hormone. 4.3 Regulation of Endometrial cycle by ovarian Hormone. 4.4 Hypophysial Control.	**10**	**13**
Unit V	Hormonal Control on Pregnancy, Parturition, Lactation and Fertility	**10**	**12**

Suggested Readings	1) Austin C. R. and R. V. Short, 1972 Reproduction in Mammals, Vol-1-8, Cam. Uni. Press. 2) Copenhaver Wilfred M., Douglas E. Kelly and Richard L. Wood- Bailey's text book of histology, Williams and Wilkins, Baltimore / London. 3) Gibian P. and E. J. Platz, eds, 1970, Mammalian Reproduction, Springer Verlag. 4) Guide to learning in Reproductive Endocrinology and Infertility ABO+ G. First in women health. The American Board of Obstetrics and Gynaecology, Inc. 2915, Vine Street: Dallas, TX 75204 Fellowship @ obog. org.www.obog.org. 5) Hogarth P. J., 1978- Biology of Reproduction Wiley, New York. 6) Lohar Prakash S. - 2012- Endocrinology-Hormones and Human Health, MJP Publishers, Chennai. 7) Perry J. S., 1971, The Ovarian cycle of animals, Oliver and Boyed. 8) Williams Robert H., 1981, Text Book of Endocrinology, W. B. Saunders Company.		

DSC Core Courses			
Zoo - 502: Cell and Molecular Biology (CMB)			
	Course objective: • To understand the basic structure of cells, tissues and their working system. • Know the handling skill in laboratory methods of estimation, determination, working of cells and their molecules. • Use of binocular research microscope and bioinstrumentation in laboratory.	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes: After successful completion of this course, students are expected to: • achieve the knowledge of cell structure and cellular system. • predict the outcome of various cellular reactions carried out in cell and cellular system under various conditions. • predict the role of genes and its relevance to human genetics and diseases.		
Unit	**Topics**	**Lectures 45**	**Marks 60**
Unit I	**Introduction to Cell and Molecular Biology:** a) Cell Biology. b) Molecular Biology. c) Prokaryotic and Eukaryotic cells, Virus, Mycoplasma. d) Structure of plasma membrane: i) Bilayer model of Danielli and Devon, ii) Fluid mosaic model. e) Study of cell organelles with reference to ultrastructure and functions of: Nucleus, Endoplasmic Reticulum, Golgi bodies, Lysosomes and Mitochondria	**12**	**15**
Unit II	**Cell Division and Cell Signaling:** a) Cell division – Definition, Stages of mitosis and meiosis. b) Stages of cell cycle – G1, S, G2 and M- Phase. c) G-Protein coupled receptor and role of second messenger (cAMP)	**10**	**10**
Unit III	**Nucleic Acid:** a) Salient features of DNA and RNA b) Watson and Crick model of DNA molecule. c) Forms of DNA and Types of RNA(Genetic & non genetic) d) DNA replication in Prokaryotes and Eukaryotes.	**10**	**12**

Unit IV	**Protein Biosynthesis:** a) Transcription in Eukaryotes: RNA polymerase, Transcriptional Unit, Mechanism of transcription, Processing of m-RNA and r-RNA. b) Translation: Genetic Code, Wobble hypothesis, Synthesis and charging of t-RNA.	**08**	**15**
Unit V	**Gene Regulation:** Principles of transcriptional regulation in Eukaryotes: Activators, Enhancer, Gene silencing, Genetic imprinting	**05**	**08**
Suggested Readings	1) Conn et al: Outline of Biochemistry (Wiley) 2) De Roberties and De Roberties: Cell and Molecular Biology,Saunders College. 3) Edward Gasque: Manual of Laboratory Exp. in Cell Biology,W.C. Brown Publishers. 4) Geoffrey M. Cooper and Robert E. Housman: The Cell – A Molecular Approach. 4th edition. 5) Lodish et al: Molecular and Cell Biology,Scientific American Book. 6) Lohar Prakash S. (2014) Cell and Molecular biology, MJP Publishers, Chennai. 7) Prescott, DM: Reproduction in eukaryotic cells,Academic Press. 8) Strickberger, M.W.: Genetics, 2nd edition, Macmillan Publishing Co. Inc. New York. 9) Verma P. S. and V. K. Agrawal: Cytology 10) Watson J. D. et al: Molecular Biology of Gene (Benzamin / Cumming) 11) Wilson, EB: Cell in Development and Inheritance (MacMillan)		

DSC Core Courses			
Zoo - 503: Mammalian Histology			
	Course objective: • To study the Histology of different tissues and systems of mammals.	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes: After successful completion of this course, students are expected to: • enrich themselves with histology of different tissues and systems for research and job opportunities in Pathology and Cancer research centers.		
Unit	**Topics**	**Lectures 45**	**Marks 60**
Unit I	**Tissue and Skin:** 1.1 Definitions of Histology. Differentiation and derivative of three germinal layers 1.2 Tissue: Types and Characteristics (Definition and location only). 1.3 Types – 1.3.1 Epithelial tissues- a) Simple epithelial tissues, b) Compound epithelial tissues, 1.3.2 Connective tissue, 1.3.3 Muscular tissue and 1.3.4 Nervous tissue- a) Structure and types of neurons (nerve cell), b) Medullated and non-medullated nerve fibres. 1.4 Skin: Structure and function. 1.5 Derivatives of skin - Horns, Nails, Hair, Sweat and Sebaceous gland.	**13**	**12**
Unit II	**Digestive and Respiratory system:** 2.1 Histology of tooth and tongue: Structure and functions. 2.2 Histology of alimentary tract: histological structure of oesophagus, stomach, duodenum, colon and rectum. 2.3 Histology of digestive glands – salivary gland, liver, pancreas (exocrine and endocrine). 2.4 Histological structure of trachea and lung.	**08**	**12**
Unit III	**Circulatory, Excretory system:** 3.1 Structure and function of blood vessels: Artery, Vein and Capillary. 3.2 Blood: Composition, types of blood cells and their functions. 3.3 Histology of Kidney: L.S. of Kidney, microscopic structure of uriniferous tubules, Juxtra Glomerular complex (JG complex), Bowman's capsule & Glomerulus.	**08**	**12**

Unit IV	**Nervous system and Sense Organs:** 4.1 Brain meninges:Structure and function. 4.2 Spinal cord:Structure and function. 4.3 Eye: Structure- V. S. of eye ball. 4.4 Ear: Structure of external, middle and internal ear	**08**	**12**
Unit V	**Reproductive and Endocrine system:** 5.1 Histological structure of Testis, Structure of sperm 5.2 Histological structure of Ovary, Structure of ovum 5.3 Histological structure of Pituitary gland. 5.4 Histological structure of Thyroid and Parathyroid gland. 5.5 Histological structure of Adrenal gland	**08**	**10**
Suggested Readings	1) Arthur W. Ham: Ham's Histology, 9th ed. Philadelphia: Lippincott, 1987.Freeman W. H:, An advanced atlas of Histology 2) Muzammih Ullah: Histology and Genetics 3) Roy O. Greep.: Histology 4) Turner and Bungera: General Endocrinology 5) William F.Windle: Text book of Histology		

DSC Core Courses			
Zoo - 504: Animal Biotechnology			
	Course objective: • Studying animal cell and tissue culture techniques • Developing genetically engineered products for human animal welfare, • Developing gene transfer technologies, cloning, transgenic animals • Studying hybridoma technique and production of antibodies • Impart knowledge about stem cell research	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes: After successful completion of this course, students are expected to: • acquire knowledge about animal cell and tissue culture techniques. • become familiar with genetically engineered products for human animal welfare. • developing embryo - transfer technology, cloning, transgenic animals. • understand applications of hybridoma technique and functions of antibodies. • acquire knowledge about stem cell research and its ethical issues.		
Units	**Topics**	**Lectures 45**	**Marks 60**
Unit I	1.1 Introduction, scope and significance of Biotechnology 1.2 Animal cell and tissue culture 1.2.1 Definition and Types of culture media 1.2.2 Advantages and disadvantages of animal cell/tissue culture 1.2.3 Laboratory facility for animal tissue culture 1.2.4 Applications of animal cell and tissue culture 1.2.5 Primary culture, Examples of Cell lines 1.2.6 Applications of somatic cell fusion 1.3 Examples of Tissue and organ cultures	**12**	**15**
Unit II	**Recombinant DNA technology** 2.1 Introduction 2.2 Restriction enzymes- classification with examples 2.3 Identification and isolation of desired gene 2.4 Types and properties of vectors 2.5 Construction of genomic and cDNA libraries 2.6 Application of genetic engineering e.g. production of human Insulin, Growth hormone, TPA and vaccines	**12**	**15**

Unit III	**Transgenic animals** 3.1 Introduction 3.2 Methods of Transfection (Physical, Chemical, Viral and Bacterial) 3.3 Examples and significance of transgenic animals	**08**	**10**
Unit IV	**Hybridoma technology** 4.1 Introduction 4.2 Methods for production of monoclonal and polyclonal antibodies 4.3 Significance of Monoclonal antibodies 4.4 Types and significance of immunoglobulin	**08**	**12**
Unit V	**Stem Cell Biotechnology** 5.1 Introduction 5.2 Types of Stem Cell and their uses 5.3 Now and Future of Stem cell Biotechnology 5.4 Ethical issues in stem cell technology	**05**	**08**
Suggested Readings	1) Brooks G (ed.) (2002) Gene therapy. *The use of DNA as a drug*. Pharmaceutical Press, London. 2) Gerald C., (1996) *Cell and Molecular Biology – Concept and Experiment,* John Wiley and Sons, Inc., U.S.A. 3) Lewin, B., (2004), *Genes VIII*, Oxford University Press, New York 4) Lohar Prakash S. (2012) Textbook of Biotechnology ISBN: 9788180941047 MJP Publishers, Chennai 5) Sing, B.D.(2014) Biotechnology Expanding horizons. Kalyani Publishers, Delhi. 6) Stem Cell Biology (2001) Cold Spring Harbor Laboratory Press 7) Watson, J.D. *et al,* (1987) *Molecular Biology of Gene*, 4th ed., The Benjamin / Cummings Publishing Company, Inc. U.S.A.		

DSC Skill Enhancement Course [SEC]			
Zoo - 505: Public Health and Hygiene			
	Course objective • To provide knowledge and understanding regarding life style diseases. • To promote an understanding of the value of good life style practices, physical fitness and healthy food habits for life style disease management. • To motivate them to practice yoga and meditation in day-to-day life	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes After successful completion of this course, students are expected to: • get familiarised with various aspects of environmental risks and hazards. • acquire knowledge regarding epidemiology, prevention, control and management of diseases of public health importance. • learn about diagnosis of various diseases and methods to prevent them.		
Units	**Topics**	**Lectures 45**	**Marks 60**
Unit I	**Public Health and Hygiene:** 1.1 Introduction and scope, 1.2 Nutrition and health, 1.3 Classification of food, 1.4 Nutritional deficiencies, 1.5 Vitamin deficiencies, 1.6 Hygiene: Introduction, definition and types of hygiene.	**10**	**12**
Unit II	**Environment and health hazards:** 2.1 Environmental degradation, 2.2 Pollution and associated health hazards	**08**	**12**
Unit III	**Sanitation and Diseases:** 3.1 Definition and concept, 3.2 Disposal of human & animal waste, refuse sewage.	**08**	**12**
Unit IV	**Communicable disease and their control measures:** 4.1 Malaria 4.2 Typhoid 4.3 Hepatitis-types 4.4 Tuberculosis 4.5 Chikungunya 4.6 Dengue and 4.7 AIDS.	**10**	**12**
Unit V	**Non-communicable diseases** and **their preventive measures:** 5.1 Hypertension, 5.2 Coronary Heart disease,	**09**	**12**

	5.3 Stroke, 5.4 Obesity and 5.5 Mental ill health		
Suggested Readings	1) Basu, S.C. Preventive and Social Medicine. 2) Cliford Anderson R., Your Guide to Health. 3) Gibney, Clinical Health, Blackwell. 4) Gibney, Public Health Nutrition, Blackwell. 5) Goel, S.O.L. Public Health Administration. 6) Mahajan B.K., M.C. Gupta, Preventive and social medicine in India, 2013, 4th Edn.,JaypeeBroyhers Medical Publishers, New Delhi, India. 7) Park K. and Park S, 1995, Text Book of Preventive and Social Medicine. Banarsidas Bhanot Publishers, 1167 Prem Nager, Jabalpur – 482001. 8) Sanitarians Hand Book. Theory and Administrative Practice. Pearles Publications, New Orleans, USA. 9) Seshu Babu V.V.R, Review of community medicine, 2006, 2nd Edn.,Paras Medical Books Pvt. Ltd., Hydrabad. 10) Shoryock Harold and Hubert O. Swartout You and Your Health illustrated Dealing with Diseases.. 11) Sobti R. C., Medical Zoology and Medical Technology, Shobanlal and Co., Jalandher.		

DSC Skill Enhancement Course [SEC]			
DSC ELELCTIVE COURSE (Any one from 506 A or 506 B)			
Zoo – 506 (A): Pest Management			
	Course objectives: • To acquire basic skills in the observation and study of nature. • To inculcate interest in adopting biological control strategies for pest control. • To know various pests affecting our local crops and select the best method for their control. • To acquire basic knowledge and skills in agriculture management to enable the learner for self-employment.	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes: After successful completion of this course, students are expected to: • impart basic awareness regarding pest problem and crop loss due to their dominance. • understand various pests affecting our local crops and select the best method for their control. • acquire basic knowledge and skills in agriculture management to enable the learner for self-employment		
Unit	**Topics**	**Lectures 45**	**Marks 60**
Unit I	**Introduction** 1.1 Definition of pest 1.2 Classification of pest w.r.t. Systematic position, Marks of identification, Life cycle, Nature of damage and Control measures. 1.2.1 Agricultural pests: a) Pest of Cotton – *Dysdercus cingulatus* b) Pest of Banana – *Odoiporus longicollis* c) Pest of Vegetable (Brinjal) – *Leucinodes or bonalis guenee* d) Pest of Sugarcane – *Pyrilla perpusilla* e) Pest of Onion- *Thrips tabaci* 1.2.2 Stored grain pest – *Sitophilu soryzae* 1.2.3 Veterinary pest - *Flea* 1.2.4 Public health pest – C*imex* 1.2.5 Structural pest – *Odontotermes obesus*	**13**	**15**
Unit II	**Insect Vector:** 2.1 Definition of vector 2.2 Types of vector (Mosquito, house fly, cockroach)	**07**	**10**
Unit III	**Control Measures:** 3.1 Primary control and their types.	**09**	**13**

	3.2 Chemical control and their types. 3.3 Biological control and their types. 3.4 Concept of IPM		
Unit IV	**Types of Pesticides and Their Mode of Action:** 4.1 Stomach poison 4.2 Contact poison 4.3 Systemic poison 4.4 Fumigants 4.5 Pesticide appliances: a) Sprayer and b) Duster	**08**	**12**
Unit V	**Non Insect Pests:** Study of Non insect pests with reference to habit, habitat, Breeding potential, Nature of Damage and control techniques. 5.1 Rat 5.2 Birds. 5.3 Snail	**08**	**10**
Suggested Readings	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., New Delhi 9) Shukla and Upadhyay: Economic Zoology, Rastogi publication. 10) Tembhare D.B.: Text Book of Modern Entomology.		

DSC Skill Enhancement Course [SEC]			
DSC ELELCTIVE COURSE (Any one from 506 A or 506 B)			
Zoo – 506 (B): Aquarium Fish Keeping			
	Course objective • To impart basic knowledge of ornamental fish Industry and inculcate its scope as an Avenue for career development in Entrepreneurship or as an Aquariculturist. • To equip the students with self-employment capabilities. • To acquire basic knowledge and skills in aquarium management	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes After successful completion of this course, students are expected to: • Acquire knowledge about different kinds of fishes, their compatibility in aquarium. • Know the basic needs to set up an aquarium and the ways to make it cost-effective. • Become aware of Aquarium as commercial, decorative and of scientific studies. • Develop personal skills on maintenance of aquarium.		
Unit	**Topics**	**Lectures 45**	**Marks 60**
Unit I	**Introduction to Aquarium Fish Keeping:** 1.1 Introduction to Aquarium Fish Keeping 1.2 The potential scope of Aquarium Fish Industry as a Cottage Industry, 1.3 Varieties of aquarium fishes - Exotic and Endemic	**10**	**12**
Unit II	**Biology of Aquarium Fishes:** Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes: Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish.	**15**	**18**
Unit III	**Food and feeding of Aquarium fishes:** 3.1 Use of live fish feed organisms. 3.2 Preparation and composition of formulated fish feeds.	**06**	**10**
Unit IV	**Fish Transportation:** 4.1 Live fish transport – Fish handling, packing and forwarding techniques.	**05**	**8**
Unit V	**Maintenance of Aquarium:** 5.1 Maintenance of Aquarium: 5.1.1 Aquarium maintenance;	**09**	**12**

	5.1.2 Equipments, 5.1.3 Water analysis 5.1.4 Aquarium fish diseases and treatment 5.2 Budget for setting up an Aquarium Fish Farm as a Cottage Industry;		
Suggested Readings	1) Bailey Mary, Gina Sandford; The Complete Guide to Aquarium Fish Keeping (Practical Handbook) Publishers: Lorenz Books. 2) Dawes, J. A. (1984), The Freshwater Aquarium, Roberts Royee Ltd.London. 3) Gunther, A. (1980), An Introduction to the Study of Fishes. A and C. Black Edinburgh. 4) Jhingran, V.G.(1982),Fish and Fisheries in India. Hindustan publ.Corp, India. 5) Mills, Dick; Keeping Aquarium Fish (Teach Yourself General) Publisher : Teach Yourself 6) Pandey, K and J.P. Shukla (2013),Fish and Fisheries, Rastogi Publication.		

DSC Core Practical			
Zoo - 507: Corresponding practical to DSC Zoo 501& Zoo502 (CB)			
	Course objective • To learn the various aspects of reproductive biology and endocrinology. • To know the basic structure of cells, tissues and their working system.	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes After successful completion of this course, students are expected to: • understand the functioning of male and female reproductive systems particularly in humans. • achieve the Knowledge of cell structure and cellular system.		
	Reproductive Endocrinology		
Practical	**Major Experiments:**		
1	Estimation of total gonadal cholesterol from Ovary / Testis.		
2	Estimation of Ascorbic acid from Ovary / Testis.		
3	Estimation of Protein from Ovary / Testis by Lowry's method		
4	Estimation of Glycogen from Ovary / Testis by Anthrone Method		
	Minor Experiment:		
5	Study of Histological Structure of Ovary, Testis and Fallopian tube with the help of Permanent slide.		
6	Demonstration of various endocrine glands from Rat / Mice with the help of chart / model / figure.		
7	Cellular structure of Pituitary, thyroid and Adrenal gland with the help of permanent slide.		
8	Pregnancy test (any suitable method)		
	Cell Biology		
9	Preparation of permanent slide to show the presence of Barr body in human female Blood / Cheek cells. (E)		
10	Preparation of temporary stained squash of onion root tip to study various stages of Mitosis. (E)		
11	Study of various stages of Meiosis. (D)		
12	Study of cell organelles from photomicrographs (D)		
Suggested Readings	1) Austin C.R. and R.V. Short, 1972, Reproduction in Mammals, Vol-1-8, Cam. Uni. Press. 2) De Roberties and De Roberties: Cell and Molecular Biology (Saunders College) 3) Lohar Prakash S., 2012, Endocrinology, MJP Publishers, Chennai		

Zoo - 508: Corresponding practical to DSC Zoo 502 (MB)& Zoo503			
	Course objective • To know the handling skill in laboratory methods of estimation, determination, working of cells and their molecules. • To study the histology of different tissues and systems of mammals.	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes After successful completion of this course, students are expected to: • predict the outcome of various cellular reactions carried out in cell and cellular system under various conditions. • enrich with Histology of different tissues and systems for research and job opportunities in Pathology and Cancer research centers.		
Practical	**Molecular Biology**		
1	Quantitative estimation of RNA from suitable material by Orcinol reagent. (E)		
2	Quantitative estimation of DNA from suitable material by Diphenylamine reagent. (E)		
3	Preparation of Polytene chromosome from Chironomus /Drosophila larva. (E)		
4	Study and interpretation of electron micrographs/photographs showing. (D) a) DNA replication, b) Transcription, c) Split genes.		
	Mammalian Histology		
5	**Study of following tissue with the help of chart / 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.		
6	**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.		
7	**Study of histological permanent slide of mammalian skin.**		
8	**Study of following histological permanent slide of digestive and respiratory organs. (D)** a) V. S. of Tooth b) V. S. of Tongue c) C. S. of Salivary gland(Parotid gland) d) T. S. of oesophagus e) T. S. of stomach f) T. S. of duodenum g) T. S. of rectum		

	h) T. S. of pancreas i) C. S. of liver j) C. S. of trachea k) C. S. of lung		
9	**Study of following histological permanent slide of blood vessels, excretory and reproductive systems. (D)** a) T. S. of artery b) T. S. of vein c) T. S. of capillary. d) L. S. of kidney e) T. S. of testis f) L. S. of ovary		
10	**Study of following histological permanent slide of endocrine glands. (D)** a) T. S. of pituitary gland b) T. S. of adrenal gland c) C. S. of thyroid gland		
Suggested Readings	1) De Roberties and De Roberties: Cell and Molecular Biology (Saunders College) 2) Freeman W. H., An advanced atlas of Histology 3) Lodish et al: Molecular and Cell Biology (Scientific American Book) 4) Lohar Prakash S. (2014) Cell and Molecular biology, MJP Publishers, Chennai 5) Pearse A.G.E., Histochemistry – Vol. I and II 6) Tembhare D.B., Techniques in Life Sciences. 7) William F.Windle, Text book of Histology		

DSC Core Practical			
Zoo - 509: Corresponding practical to DSC Zoo 504			
	Course objective • Studying animal cell and tissue culture techniques • Developing genetically engineered products for human animal welfare, • Developing gene transfer technologies, cloning, transgenic animals • Studying hybridoma technique and production of antibodies • Impart knowledge about stem cell research.	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes After successful completion of this course, students are expected to: • acquire knowledge about animal cell and tissue culture techniques • become familiar with genetically engineered products for human animal welfare, • developing embryo - transfer technology, cloning, transgenic animals • understand applications hybridoma technique and functions of antibodies • acquire knowledge about stem cell research and its ethical issues.		
Practical	**Animal Biotechnology**		
1	Estimation of DNA in a given sample by Diphenylamine method		
2	Estimation of RNA in a given sample by Orcinol method		
3	Working principle and application of laminar air flow and autoclave (D)		
4	Isolation of microorganisms on nutrient agar by streak plate/dilution plate method (E)		
5	Production ethanol by fermentation using yeast.(E)		
6	Culture of bacteria in liquid medium and agar plates.(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 (D)		
10	Visit to dairy / pharmaceutical / tissue culture laboratory and submission of report.		

Suggested Readings	1) Brooks G (ed.) (2002), Gene therapy. The use of DNA as a drug. Pharmaceutical Press, London. 2) Gerald C., (1996),Cell and Molecular Biology – Concept and Experiment, John Wiley and Sons, Inc., U.S.A. 3) Lewin, B., (2004), *Genes VIII*, Oxford University Press, New York 4) Lohar Prakash S. (2012), Textbook of Biotechnology ISBN: 9788180941047 MJP Publishers, Chennai 5) Sing, B.D.(2014), Biotechnology Expanding horizons.Kalyani Publishers, Delhi. 6) Stem Cell Biology (2001), Cold Spring Harbor Laboratory Press 7) Watson, J.D. *et al*, (1987),Molecular Biology of Gene,4th ed., The Benjamin / Cummings Publishing Company, Inc. U.S.A.		

SEMESTER VI

DSC Core Courses			
Zoo - 601: Study of Leech And Calotes			
	Course objective • To understand habit, habitat and taxonomic status of Leech as invertebrates and Calotes as vertebrates • To explain the basic aspects of structural and functional details of Leech and Calotes	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes After successful completion of this course, students are expected to: • understand the systematic position, habit and habitat of Leech and Calotes • acquire the knowledge about structural and functional details about Leech as invertebrates and Calotes as vertebrates • compare structural and functional details in Leech and Calotes.		
Unit	**Topics**	**Lectures 45**	**Marks 60**
Unit I	**Study of Leech:** a) Systematic position, habit, habitat external characters, body wall. b) Digestive system, food, feeding and digestion. c) Excretory system	**10**	**12**
Unit II	d) Nervous system and sense organs. e) Reproductive system, copulation, f) Fertilization, cocoon formation, and development.	**10**	**14**
Unit III	**Study of Calotes** a) Systematic position, habit, habitat external characters, b) Digestive system, food feeding and digestion	**05**	**10**
Unit IV	c) Respiratory system and respiratory mechanism d) Excretory system and physiology of excretion	**10**	**12**
Unit V	e) Nervous system and sense organs f) Reproductive system, copulation, fertilization and development.	**10**	**12**
Suggested Readings	1) Hall B.K. and Hallgrimsson B. (2008),Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc. 2) JordenE. L., Invertebrate Zoology, S.C.Chand, New Delhi. 3) JordanE.L. and P.S.Verma, Chordate Zoology, S.Chand and Company New Delhi. 4) Kotpal R.L (1991), Zoology phylum Annelida,		

	Rastogi publication. Meerut. 5) Kotpal R.L. (2016), Modern text book Vertebrate zoology. Fourth edition. Rastogi Publication, Meerut 6) Lal S.S. (1996), Textbook of Practical Zoology Invertebrates, Rastogi Publications. 7) Lal S. S. (1996), Textbook of Practical Zoology Vertebrates, Rastogi Publications. 8) Prasad S. N., Life of Invertebrates**.** 9) Young, J. Z. (2004),The Life of Vertebrates. III Edition. Oxford university press.		

DSC Core Courses			
Zoo - 602: Chick Embryology			
	Course objective • To study the various stages involved in the developing embryo • To study the initial developmental procedures involved in chick • To know the processes involved in embryonic development and practical applications of studying the chick embryology.	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes After successful completion of this course, students are expected to: • Understand various stages involved in the developing embryo • Understand the initial developmental procedures involved in chick. • Understand the processes involved in embryonic development and practical applications of studying the chick embryology.		
Unit	**Topics**	**Lectures 45**	**Marks 60**
Unit I	**Embryology:** 1.1 Definition and Concept of embryology **1.2** Spermatotogenesis and 1.3 Oogenesis.	**05**	**08**
Unit II	**Fertilization:** 2.1 General mechanism of fertilization 2.2 Eggs:Structure of Hen's egg	**05**	**08**
Unit III	**Cleavage:** 3.1 Patterns of cleavages. 3.2 Blastulation 3.3 Gastrulation	**10**	**12**
Unit IV	**Development of Chick Embryo:** 4.1 18 hours chick embryo - (Primitive streak formation, mesogenesis, somite formation) 4.2 24 hours chick embryo 4.3 33 hours chick embryo 4.4 48 hours chick embryo 4.5 72 hours chick embryo	**15**	**18**
Unit V	**Extra-embryonic membranes:** 5.1 Yolk Sac, structure and its functions. 5.2 Amnion, structure and its functions. 5.3 Chorion, structure and its functions. 5.4 Allantois, structure and its functions	**10**	**14**

Suggested Readings	1) Agarwal, V.K. and UshaGuptha, S (1998). Chand's simplified course in Zoology, Chordate Embryology and Histology. S. Chand & Co Ltd. 2) Balinsky. B.I. (2004). An Introduction to Embryology. W.B. Saunders & Co. 3) Berry, A.K. (2008). An Introduction to Embryology. Emkay Publications. 4) Boby Jose et al., Developmental biology, Experimental biology, Manjusha Publications, Calicut. 5) Gibbs. (2006).Practical Guide to Developmental Biology. Oxford University Press. 6) Gilbert. S.F. (2000). Developmental Biology. Sinauer Associates, Inc. Publishers. 7) Goel, S.C. (1984). Principles of animal developmental biology. Himalaya Publ. House, Bombay. 8) Huettner,A.F. (1959). Comparative Vertebrate Embryology. MacMillan. 9) Mc Even. (1970). Vertebrate Embryology. Oxford-IBH 10) Nelson. (1960). Comparative Embryology of Vertebrates. MacMillan. 11) P.C.Jain. (2007). Elements of Developmental Biology, 6th Edn. Rastogi Publications. 12) Rough. (1960). Frog- Reproduction and development. Oxford University Press. 13) Verma, P.S. and V.K. Agarwal (2007). Chordate Embryology. S. Chand and Co. Ltd.		

DSC Core Courses			
Zoo - 603: Applied Zoology			
	Course objective: • To acquire basic knowledge and skills in applied branches of zoology • To equip the students with self-employment capabilities. • To provide scientific knowledge of profitable farming. • To get technical awareness of vermitechnology and vermicomposting technique. • To convert unwanted, organic matter, particularly food scraps and paper into fertile soil. • To learn about all aspects of raising poultry for their meat and eggs. • To know the economics, problems and prospects of Vermicomposting and Poultry.	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes: After successful completion of this course, students are expected to: • practice of vermicomposting,vermiculturing and poultry farming. • aspire to work in preparing bio compost, vermicomposting and vermiculturing and get employment accordingly. • start business for rearing and production of birds and get employment accordingly.		
	Topics	**Lectures 45**	**Marks 60**
Units	**Vermiculture**		
Unit I	1.1 Introduction and scope 1.2 Characteristics features of earthworm 1.3 Species of Earthworm – *Eisenia foetida* and *Eudrilus eugeniae*	**05**	**08**
Unit II	2.1 Methods of vermicomposting – Small and Large scale. 2.2 Set up of Vermiwash unit. 2.3 Role of earthworm in solid waste management. 2.4 Economic importance of vermicompost and vermiwash	**10**	**12**
Unit III	3.1 Introduction : Definition and concept 3.2 Study of Indian fowl, *Gallus gallus domesticus* w.r.t. a) Systematic position b) Habits and Habitat c) External Morphology	**05**	**05**
	Poultry		
Unit IV	4.1 Types of Poultry breeds: with respect to origin, characters and standard weight.	**20**	**30**

	a) American breed – White Plymoth rock b) Mediterranean breed – White Leghorn c) The English breed – White Cornish d) Asiatic breed – Brahma e) Indian breed – Assel, Kadaknath 4.2 Brooding and Rearing : a) Natural and artificial breeding b) Housing and Equipment of poultry c) Poultry house equipment d) Poultry Nutrition 4.3 Poultry Diseases: a) Viral Diseases – Fowl pox, Infectious bronchitis (IB) and Infectious bursitis (IBD), b) Bacterial Diseases - Pullorum and Chronic Respiratory Disease (CRD), c) Fungal Diseases – Aspergillosis, Thrush, d) Parasitic Diseases – i) Ectoparasites – Lice and Ticks, ii) Endoparasites – Round worm and Caecal worm, e) Protozoal Diseases – Coccidiosis – Caecal and Intestinal.		
Unit V	5.1 Economics of poultry : a) Nutritive value of egg of hen b) Economic importance of poultry manure 5.2 Poultry care management and marketing	**05**	**05**
Suggested Readings	1) Banerjee, G. C., A textbook of Animal Husbandry, Oxford and IBH publishing Co. Pvt. Ltd. New Delhi. 2) Banerjee, G. C., Animal Husbandry, Oxford and IBH publishing Co. 3) Gupta P.K., Vermicomposting for sustainable agriculture - Publisher - Agrobios, Jodhpur (India). 4) Shukla and Upadhyay, Economic Zoology, Rastogi publication. 5) Singh, R. A., Poultry introduction, Kalyani publishers, New Delhi. 6) Singh, R. A., Poultry production, Kalyani publishers, New Delhi. 7) Srivastava P. D. and N. C. Pant, Economic Zoology Vol. I and II, Commercial Publication Bureau, New Delhi. 8) YadavManju, Applied Entomology, Discovery publishing house, New Delhi 9) YadavManju, Economic Zoology, Discovery publishing house, New Delhi		

DSC Core Courses			
Zoo - 604: Microtechnique			
	Course objectives: To prepare the whole mounts microscopic slides and staining reactions.	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes: Cell tissue structure, histology of tissues and details of morphology of animals. Job opportunities in Health institutes, Hospitals and Pathological labs.		
Unit	**Topics**	**Lectures 45**	**Marks 60**
Unit I	**Introduction, Collection and Fixation** 1.1 Definition, Scope and Applications of Microtechnique. 1.2 Collection of specimen or tissue. 1.3 Kinds of preparation of specimen or tissue: 1.3.1 Whole mounts, Teasing and smearing. 1.4 Preparation whole mounts: Euglena, Paramoecium, Chick embryo. 1.5 Fixation: Definition and Importance and Theory of fixation. 1.6 Qualities of good fixative. 1.7 Types of fixative – 1.7.1 Primary-- Formaline, Ethyl alcohol.(Ethanol) 1.7.2 Compound fixatives- Bouin's fluid, Zenker's Fluid and Carnoy's fluid.	**10**	**12**
Unit II	**Washing, Dehydration, Clearing** 2.1 Washing: 2.1.1 Theory of washing 2.1.2 Significance of washing 2.2 Dehydrating agents: 2.2.1 Definition and types - Ethanol, Methanol, Acetone 2.2.2 Significance and use of dehydrating agents. 2.3 Clearing: 2.3.1 Definition and importance of clearing. 2.3.2 Clearing agents their merits and demerits - Xylene, Toluene, Benzene, Cedar wood oil, Clove oil. 2.4 Cold and hot infiltration.	**08**	
Unit III	**Embedding, Block making, Trimming and Mounting** 3.1 Cold and hot infiltration 3.2 Paraffin 3.2.1 Selection of paraffin according to need. 3.2.2 Melting and handling of paraffin. 3.3 Types of ovens and its uses.	**10**	**12**

	3.4 Embedding: 3.4.1 Embedding containers: a) Paper trays b) L-shaped metalPiecesc) Glass dishes/Lids. 3.4.2 Embedding procedure, multiple embedding and embedding faults. 3.5 Block making, labelling of block and storage of block. 3.6 Trimming 3.7 Mounting of trimmed block on microtome peg.		
Unit IV	**Section cutting and affixing** 4.1 Microtome:Types, its uses, precautions and handling of Rotary and Rocking microtome. 4.2 Microtome knives: Types, care, sharpening, honing and stropping of knife. 4.3 Section cutting: Defects, Possible causes and remedies during section cutting. 4.2 Affixing and processing of sections: i) Mayer's albumen, ii) Slide warmers.	**08**	**12**
Unit V	**Staining, Mounting, Clearing and camera lucida** 5.1 Theory of staining. 5.1.1 Types of stain: Acidic, basic, neutral and vital stain. 5.1.2 Preparation of Haematoxylin and Eosin stain. 5.1.3 Mordants: Definition, importance and common mordants. 5.1.4 Double staining: Processing of paraffin section during staining. 5.1.5 Special staining methods for Mitochondria and chromosomes. 5.2 Mounting media: DPX and Canada balsam. 5.3 Clearing, labelling and preservation of permanent slides. 5.4 Use of camera lucida and Micrometer scale.	**09**	**12**
Suggested Readings	1) Baker F.I and R.E Silverton, Introduction to Medical Laboratory Technique. 2) Baker J. R, Cytological Techniques 3) Davenport H.A., Histological and Histochemical Technique. 4) Gray P., Hand book of basic Microtechnique. 5) Indurkar A.K., Practical course in Cytology. 6) Lillie R.D., Histopathogenic Microtechniqe. 7) Me Mann J.F.A and R.W Mowry, Staining Methods (Histology and Histochemical) 8) Pathak, Microtechnique (Theory and Practical) 9) Patki, Bhalchanda and Jeevaji, Introduction to Microtechnique, S. Chand Publication. 10) Pearse A.G.E., Histochemistry – Vol. I and II		

DSC Skill Enhancement Course [SEC]			
Zoo - 605: Research Methodology			
	Course objective • To understand some basic concepts of research and its methodologies. • To select and define appropriate research problem and parameters. • Understand the various techniques of Data Collection- Observation, Questionnaire, Interview Schedule; Case Study, Social Survey, Content Analysis. • Describing various types of Sampling • Elaborate on Data Processing and Data Analysis • Writing of dissertations, project proposals, project reports, research papers.	**Total Hours: 45**	**Credits: 3**
	Learning outcomes After successful completion of this course, students are expected to: • understand some basic concepts of research and its methodologies. • differentiate between the Quantitative and Qualitative Research and understand different types of Research Design • select and define appropriate research problem and parameters. • organize and conduct research project in a more appropriate manner. • writing of dissertations, project proposals, project reports, research papers. • understand intellectual Property Rights – Biopiracy, copyrights, patent and traditional knowledge and plagiarism.		
Unit	**Topics**	**Lectures 45**	**Marks 60**
Unit I	**Foundations of Research** 1.1 Meaning of research 1.2 Objectives ofresearch 1.3 Motivation inresearch 1.4 Research methods versusmethodology 1.5 Types ofresearch a) Analytical *vs* Descriptive b) Quantitative *vs* Qualitative c) Basic *vs* Applied d) Conceptual *vs* Empirical	**06**	**06**

Unit II	**Research Design** 2.1 Meaning of research design 2.2 Need of research design 2.3 Features of good design 2.4 Importance concepts of research design a) Observation and Facts b) Prediction and Explanation c) Development of Models 2.5 Developing a research plan by using a) Problem identification b) Experimentation c) Determining experimental and sample designs	**10**	**15**
Unit III	**Data Collection, Analysis and Presentation** 3.1 Observation and Collection of Data 3.2 Methods of data collection - Sampling Methods 3.3 DataProcessing and AnalysisStrategies a) Tabulation of data: i. Variables(Definition, types withexample); Frequency distribution(Definition, types and example); ii. Measurement of central tendency(Definition, types of average – mean, median, mode withexample); iii. Standard deviation(SD) and iv. Standard error**(**SE) b) Data AnalysisStrategies i. Testing hypothesis ii. Chi-square test iii. Student 't' test 3.4 Data presentation using MS Excel application of MS office. a) Charts: Types of Charts i) Column charts, ii) Line charts iii) Pie charts iv) Bar charts v) Area charts vi) Scatter charts vii) Stock charts viii) Surface charts ix) Radar charts x) Tree charts xi) Sunburst charts xii) Histogram xiii) Box and whisker charts xiv) Water fall charts xv) Funnel charts b) Elements of Bar charts c) Creation of Bar Charts using MS Excel application d) Creation of Sparkline Charts using MS Excel.	**12**	**18**

Unit IV	**Technical Reports and Thesis writing** 4.1Prepare Title, Author and Addresses, key words and Abstract (summary andsynopsis) 4.2 Writing of technical report and thesis - IMMRAD system (Introduction, Material methods, Result and Discussion), Acknowledgement, Summary, Conclusion andreferences. 4.3 Concept of scientificwriting 4.4 Meaning of scientificpaper 4.5 Write a letter to Editor of scientific journal for publishing a research paper.	**12**	**15**
Unit V	**Ethical Issues** 5.1 IntellectualpropertyRights, 5.2 Commercialization, 5.3 CopyRight, 5.4 Royalty, 5.5 Patentlaw, 5.6 Plagiarism, 5.7 Citation, 5.8 Impact factor 5.9 h-index	**05**	**06**
Suggested Readings	1) Anthony,M,Graziano,A.M.andRaulin,M.L.200 9. Research Methods:A Process of Inquiry, Allyn and Bacon. 2) Coley,S. M. and Scheinberg, C. A.1990,"Proposalwriting".StagePublications. 3) Gurumani, N. Research methodology for biological science, MJP publisher, Chennai. 4) Kothari C. R. Research Methodology, New Age International,2009 5) Robert A. Day, How to write and publish a Scientific papers (4th edition). 6) Tejinder Singh and N. G. Madhav, Better Thesis Writing 7) Wadhera, B. L. Law Relating to Patents, Trade Marks, Copyright Designsand Geographical Indications, 2002, Universal Lawpublishing 8) Walliman,N.2011.ResearchMethods - TheBasics. Taylor and Francis, London, New York.		

DSC ELELCTIVE COURSE (Any one from 606 A or 606 B)			
Zoo – 606 (A) Bioinformatics			
	Course objective • To get introduced to the basic concepts of Bioinformatics and its significance • Explain generation and different types of computers with basic programing languages. • Overview about types of Biological data and database search tools. • To get exposed to computational methods, tools and algorithms employed for proteomics and genomics	**Total Hours: 45**	**Credits: 03**
	Learning outcomes After successful completion of this course, students are expected to: • understand the basic concepts of Bioinformatics and its significance • apply their knowledge of generations, types of computers and programming languages • understand the process of sequence alignment methods using web resources • Appreciate the tools used in proteomics and genomics their significance		
Unit	**Topics**	**Lectures 45**	**Marks 60**
Unit I	1.1 Definition, Objectives and scope of Bioinformatics 1.2 Application of Bioinformatics in various Fields.	**04**	**5**
Unit II	2.1 Computer generations and Type of computer 2.2 Programming Languages: PERL and Java.	**07**	**10**
Unit III	3.1 Biological Databases- Concept and types of databases 3.2 Sequence alignment 3.2.1 BLAST, types and applications. 3.2.2 FASTA, format and application	**10**	**10**
Unit IV	4.1 **Proteomics:** Definition, Protein structure visualization tools-RasMol and SwissPDB viewer 4.2 Protein sequence databases- PIR, SWISS-PROT, TrMBL 4.3 Structural classification databases- SCOP, CATH, 4.4 Protein folding and disorders 4.5 Applications of Proteomics	**12**	**15**
Unit V	5.1 **Genomics:** Gene, Genotype, Genome of *E. coli, S. cerevisiae, C. elegans*, and *Homo sapiens*.	**12**	**20**

	5.2 Single nucleotide polymorphisms (SNPs), Structure and application of DNA microarray. 5.3 Nucleotide sequence database, GenBank (NCBI, EMBL and DDBJ), cDNA libraries and ESTs, Databases of metabolic pathways- KEGG. 5.4 Genomics in medicine- disease monitoring, Drug designing and development.		
Suggested Readings	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		

DSC ELELCTIVE COURSE (Any one from 606 A or 606 B)			
Zoo – 606 (B) Sericulture			
	Course objective • To give scientific knowledge about mulberry cultivation, silkworm rearing techniques to the students. • To train the students in compressive silk production techniques.	**Total Hours: 45**	**Credits : 03**
	Learning outcomes After successful completion of this course, students are expected to: • develop an expert manpower to handle the own sericulture units/entrepreneurship/corporate sector units. • Provide gainful employment, economic development and improvement in the quality of life to the people in rural area.		
Unit	**Topics**	**Lectures 45**	**Marks 60**
Unit I	**Introduction** 1.1 Sericulture: Definition, history, present Status 1.2 Scope of sericulture 1.3 Silk producing centres 1.4 Taxonomic position 1.5 Types of silkworms and their Distribution (Muga, Eri, Tussar, Mulberry)	**09**	**12**
Unit II	**Biology of Silkworm:** 2.1 Life cycle of *Bombyx mori* w. r. t. external and internal morphology of Egg, larva, Pupa, adult 2.2 Structure and function of silk gland and secretion of silk 2.3 Digestive system of *Bombyx mori*	**09**	**12**
Unit III	**Cultivation of Mulberry:** 3.1 a) Selection of mulberry variety, b) Propagation, c) Climate, d)Soils, e)Planting, f)Raising of commercial nursery, g) Manuring, h) Interculture, i) Water management, j) Prunning and k) Quality of leaves 3.2 Harvesting of mulberry- a) Shoot Cutting b) Leaf plucking and c) Bud plucking. 3.3 Advantages and disadvantages of shoot rearing	**09**	**12**
Unit IV	**Silkworm Rearing:** 4.1 Rearing technique: a) Selection of quality seeds, b) Brushing, c) Quality of food, d) Shape and size of leaves, e)	**09**	**12**

	Preparation of feed bed for different rearing methods, f) Bed Cleaning methods, g) Spacing, moulting, mounting, h) Environmental conditions and care during spinning, i) Harvesting of cocoons, j) Sorting of cocoons and k) Post harvest processing of cocoons. 4.2 Rearing house 4.3 Rearing Appliances: a) Rearing stand, b) Ant wells,c) Rearing trays, d) Paraffin paper, e) Foam rubber strip, f) Chopsticks, g) Feathers, h) Leaf chamber, i) Chopping board, j) Chopping knives, k) Mats, l) Cleaning nets, m) Mountages, n) Feeding stand and o) Miscellaneous appliances		
Unit V	**Important Diseases and Pests:** 5.1 Protozon disease: Pebrine 5.2 Viral disease: Nuclear Polyhedrosis Virus (NPV) 5.3 Fungal disease: Muscardine - White, green, yellow 5.4 Pests of silkworm: Uzi flies, dermestid beetles, ants and vertebrates 5.5 Prevention and control of diseases and pests	**09**	**12**
Suggested Readings	1) Handbook of silkworm rearing: Agricultural and Technical manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan1972. 2) Jolly Ed.M.S., Appropriate Sericulture Techniques; Director, CSR & TI Mysore. 3) Krishnaswamy S., Improved Method of Rearing Young age silkworm; reprinted CSB, Bangalore, 1986. 4) Narsimhanna M.N., Manual of Silkworm Egg Production; CSB, Bangalore 1988. 5) Sengupta K., A Guide for Sericulture; Director, CSIR & TI, Mysore1989. 6) Silkworm Rearing; Wupang- Chun and Chen Da-Chung, Pub. By FAO, Rome 1988. 7) Ullal S.R. and M.N. Narsimhanna Handbook of Practical sericulture: CSB, Bangalore		

Zoo - 607: Corresponding practical to DSC Zoo 601			
	Course objective • To understand habit, habitat and taxonomic status of Leech as invertebrates and Calotes as vertebrates	**Teaching Hours :45**	**Credits : 03**
	• To explain the basic aspects of structural and functional details of Leech and Calotes		
	Learning outcomes After successful completion of this course, students are expected to: • understand the systematic position, habit and habitat of Lee Calotes • acquire the knowledge about structural and functional details about Leech as invertebrates and Calotes as vertebrates • compare structural and functional details in Leech and Calo		
Practical	**Zoo - 601: Study of Leech and Calotes**		
1	Study of systematic position and external charactersof leech with the help of chart or diagram.		
2	Study of Digestive system of leech with the help of chart or diagram.		
3	Study of Nervous system of leech, with the help chart or diagram.		
4	Study of reproductive system of leech, with the help chart or diagram.		
5	Study of systematic position and external characters of calotes, with the help chart or diagram.		
6	Study of Digestive system of Calotes, with the help chart or diagram.		
7	Study of Nervous system of Calotes, with the help chart or diagram.		
8	Study of Reproductive system of Calotes, with the help chart or diagram.		
Suggested Readings	1) Jordan E. L. and P. S. Verma, Chordate Zoology, S.Chand and Company New Delhi. 2) Kotpal R.L (1991), Zoology Phylum Annelida, RastogiPublication. Meerut. 3) Kotpal R.L. (2016), Modern text book Vertebrate Zoology. Fourth edition. Rastogi Publication, Meerut 4) Lal S.S. (1996): Textbook of Practical Zoology Invertebrates, Rastogi Publications 5) Lal S.S. (1996): Textbook of Practical Zoology Vertebrates, Rastogi Publications. 6) Young K.Z., A life of Vertebrate, ELBS Oxford University Press.		

Zoo - 608: Corresponding practical to DSC Zoo 602 and Zoo 603			
	Course objective • To get technical awareness of vermitechnology, and poultry farming technique. • To learn the stages of embryology through permanent slides/charts. • To know the processes involved in embryonic development and practical applications of studying the chick embryology.	**Teaching Hours :45**	**Credits : 03**
Practical	**Learning outcomes** After successful completion of this course, students are expected to: • Practice of vermicomposting, vermiculturing and poultry farming. • Aspire to work in preparing bio compost, vermicomposting and get employment accordingly. • Rearing and production of birds and get employment accordingly.		
	Zoo - 602: Chick Embryology		
1	Study of Hens egg With the help of Chart/ Model/ Permanent slides (D)		
2	Study of Cleavage, Blastula and Gastrula: With the help of Chart/ Model/ Permanent slides (D)		
3	Study of Whole mounts of 18, 24, 33, 48, 72 and 96 hours of chick embryos with the help of Permanent slides / Chart / Model (D)		
4	Temporary mounting of chick embryo (E)		
	Zoo-603 Applied Zoology		
5	Study of External morphology of Earthworm		
6	Study of species of Earthworm		
7	Establishment of Vermicompost unit		
8	Establishment of Vermiwash unit		
9	Study of External morphology of Indian fowl and sexual dimorphism		
10	Study of Poultry breeds		
11	Study of Poultry equipment's		
12	Compulsory visits to a Vermiculture unit / Poultry farm		
Suggested Readings	1) Shukla and Upadhyay, Economic Zoology, Rastogi publication. 2) Singh, R. A., Poultry production, Kalyani publishers, New Delhi. 3) Srivastava P. D. and N. C. Pant, Economic Zoology Commercial Publication Bureau, New Delhi.		

DSC Core Practical			
Zoo - 609: Corresponding practical to DSC Zoo 604			
	Course objectives: To prepare the whole mounts microscopic slides and staining reactions.	**Teaching Hours :45**	**Credits : 03**
	Learning outcomes: Cell tissue structure, histology of tissues and details of morphology of animals. Job opportunities in Health institutes, Hospitals and Pathological labs.		
Practical	**ZOO 604 – 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).		
Suggested **Readings**	1) Gray P., Hand book of basic Microtechnique. 2) Indurkar A.K., Practical course in Cytology. 3) Me Mann J.F.A and R.W Mowry, Staining Methods (Histology and Histochemical) 4) Pathak, Microtechnique (Theory and Practical) 5) Patki, Bhalchanda and Jeevaji, Introduction to Microtechnique, S. Chand Publication. 6) Pearse A.G.E., Histochemistry – Vol. I and II 7) Tembhare D.B., Techniques in Life Sciences 8) Weesner F.M., General Zoological Microtechnique.		

KBC North Maharashtra University, Jalgaon

TYBSc Zoology

Equivalence for old courses

Semester V

Course code (Old syllabus 2017)	Course code (New syllabus 2020)
Zoo 351	Zoo 501
Zoo 352	Zoo 502
Zoo 353	Zoo 503
Zoo 354	Zoo 504
Zoo 355	Zoo 505
Zoo 356	Zoo 506
Zoo 357	Zoo 507
Zoo 358	Zoo 508
Zoo 359	Zoo 509

Semester VI

Course code (Old syllabus 2017)	Course code (New syllabus 2020)
Zoo 361	Zoo 601
Zoo 362	Zoo 602
Zoo 363	Zoo 603
Zoo 364	Zoo 604
Zoo 365	Zoo 605
Zoo 366	Zoo 606
Zoo 367	Zoo 607
Zoo 368	Zoo 608
Zoo 369	Zoo 609