

SCIENCE FACULTY

NORTH MAHARASHTRA UNIVERSITY, JALGAON



SYLLABUS

FOR

M.Sc. Part-I

Zoology

(With effect from June - 2017)

NORTH MAHARASHTRA UNIVERSITY, JALGAON

PROPOSED SYLLABUS STRUCTURE FOR M.Sc. ZOOLOGY

Year 2017-18 (Semester-I and II)

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 101	Structure and Function of Invertebrates	04	--	--	04	40	60	--	--	100	4.00
ZOO 102	Cell and Developmental Biology	04	--	--	04	40	60	--	--	100	4.00
ZOO 103	Quantitative Biology	04	--	--	04	40	60	--	--	100	4.00
ZOO 104	Practical	--	--	06	06	--	--	40	60	100	4.00
ZOO 105	Practical	--	--	06	06	--	--	40	60	100	4.00
ZOO 201	Structure and Function of Vertebrates	04	--	--	04	40	60	--	--	100	4.00
ZOO 202	Biochemistry and Enzymology	04	--	--	04	40	60	--	--	100	4.00
ZOO 203	Tools and Techniques for Biology	04	--	--	04	40	60	--	--	100	4.00
ZOO 204	Practical	--	--	06	06	--	--	40	60	100	4.00
ZOO 205	Practical	--	--	06	06	--	--	40	60	100	4.00

CA: College Assessment, UA: University Assessment

NORTH MAHARASHTRA UNIVERSITY, JALGAON

M. Sc. (Part-I) ZOOLOGY New Syllabus 2017

Pattern 60:40

Semester I

	UA + CA	Hours
ZOO 101 Structure and Function of Invertebrates	60 + 40	60
ZOO 102 Cell and Developmental Biology	60 + 40	60
ZOO 103 Quantitative Biology	60 + 40	60
ZOO 104 Practical	60 + 40	60
ZOO 105 Practical	60 + 40	60

Semester II

	UA + CA	Hours
ZOO 201: Structure and function of Vertebrates	60 + 40	60
ZOO 202 Biochemistry and Enzymology	60 + 40	60
ZOO 203 Tools and Techniques for Biology	60 + 40	60
ZOO 204 Practical	60 + 40	60
ZOO 205 Practical	60 + 40	60

M. Sc. Zoology Part I: Semester I

ZOO 101 Structure and Function of Invertebrates

Unit No.	Name of Topic	Lectures
1.	Organization and life: a) Homology and analogy in organization, b) Diversity of invertebrate, c) Phylogeny of invertebrates	06
2.	Organization of Coelom: a) Acoelomates, b) Pseudocoelomates c) Coelomates - Protostomia and Deuterostomia	05
3.	Locomotion: a) Locomotory organelles – Cilia, flagella b) Flagella, Ciliary and amoeboid movement in protozoa	06
4.	Nutrition and Digestion: a) Pattern of feeding and digestion in lower metazoan, b) Filter feeding in polychaeta, c) Filter feeding and digestion in mollusca, d) Filter feeding and digestion in deuterostoma	08
5.	Respiration: a) Organs of respiration- Gills and lophophores, b) Gills and lungs in Mollusca, c) Gills and trachea in Arthropoda, d) Respiratory pigments in invertebrates. e) Mechanism of respiration in gastropoda and insecta.	07
6.	Excretion: a) Organs and Mechanism of excretion - Coelom, Coelomoducts, Nephridia and Malpighian tubules, b) Osmoregulation in terrestrial and aquatic invertebrates.	06
7.	Nervous system: a) Primitive nervous system- Coelenterates and Echinodermata, b) Advanced nervous system- Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda). c) Trends in neural evolution.	08
8.	Invertebrate larvae: a) Larval forms of Platyhelminthes, Crustacea, Mollusca and Echinodermata, b) Significance of larval forms.	08
9.	Colonial and social life: a) Protozoan and colonies b) Sponge and Coelenterate colonies and c) Social life in honey bee.	06
	Total	60

Practical corresponding to ZOO 101 Structure and Function of Invertebrates

- 1) Dissection of Grasshopper/Cockroach so as to expose its – (E)
 - a) Digestive system
 - b) Nervous System
 - c) Reproductive system (Male and Female)
- 2) Mounting of following – (E)
 - a) Nephridia and Spermatheca of earthworm,
 - b) Mouthparts and Spiracles of Grasshopper/Cockroach,
 - c) Cornea and Wings of Grasshopper/Cockroach,
- 3) Classification of Invertebrates - Porifera to Annelida up to order (one example from each order)
- 4) Classification of Invertebrates -Arthropoda to Hemichordata up to order (one example from each order)

Reference books

- Barnes R. O.: The Invertebrates, W. B. Saunders and Co.
- Barrington E.J.W.: Invertebrates, Structure and function, homes Nelson and Sons Ltd., London
- Hyman L.H.: The Invertebrate Volume 1 to 8, McGraw Hill Co. New York
- Jordan, E. L.: The Invertebrates, S. C. Chand, New Delhi.
- Kotpal R. L.: Modern Text book of Zoology : Invertebrates, Rastogi publications, Meerut
- Kotpal R.L.: Protozoa to Echinodermata Series,
- Marshall and William : A text book of Zoology:Invertebrate Vol. I, CBS publishers, New Delhi.
- Prasad S. N.: Life of Invertebrates, Vikas publishing house, New Delhi.
- Russel Hunter : A Biology of higher invertebrates, McMillon Co. Ltd. London

M. Sc. Zoology Part I: Semester I

ZOO 102 Cell and Developmental Biology

Unit No.	Name of Topic	Lectures
1.	Structure and function of Plasma Membrane: a) Different models of Plasma Membrane b) Functions of Plasma Membrane –diffusion, osmosis, ion channels, active and passive transport, ion pumps	03
2.	Structural organization and function of intracellular organelles: a) Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic reticulum, b) Structure and function of cytoskeleton and its role in motility, c) Structure and function of filaments	08
3.	Cell cycle: a) Steps in cell cycle b) Regulation of cell cycle.	03
4.	Cell signaling: a) Signaling molecules – Hormones, neurotransmitters, second messengers. b) Types of signaling receptors - Extra cellular and intra cellular. c) Signal transduction pathways, signaling through G- protein coupled receptors, regulation of signaling pathways.	12
5.	Basic concepts of development: a) Potency, commitment, specification, induction, competence, determination and differentiation; b) Morphogenetic gradients; cell fate and cell lineages; c) Stem cells; genomic equivalence and the cytoplasmic determinants; imprinting	12
6.	Gametogenesis, fertilization and early development: a) Formation of gametes, b) Cell surface molecules in sperm-egg recognition in animals; c) Zygote formation, Cleavage, Blastulation, Gastrulation	08
7.	Morphogenesis and Organogenesis in animals: a) Cell aggregation and differentiation in <i>Dictyostelium</i> ; b) Axes and pattern formation in <i>Drosophila</i> , frog and chick; c) Organogenesis – vulva formation in <i>Caenorhabditis elegans</i> ; eye lens induction, limb development and regeneration in <i>Planaria</i> and <i>Hemidactylus flaviviridis</i> . d) Differentiation of neurons, post embryonic development-larval formation, metamorphosis; environmental regulation of normal development; sex determination.	12
8.	Aging, Apoptosis and Senescence.	02
	Total	60

Practicals corresponding to ZOO 102 Cell Biology

1. Study of electron microphotographs of various cell organelles.
2. Preparation of mitotic Chromosomes from any suitable cell material.
3. Detection of carbohydrates by PAS reaction.
4. Detection of protein by bromophenol blue reaction.
5. Detection of DNA by Feulgen reaction.
6. Detection of Mitochondria by Janus green method

Practicals corresponding to ZOO 102 Developmental Biology

1. Preparation of Permanent slide of Chick Embryo
2. Study of different types of eggs – on the basis of amount of yolk, distribution of yolk,
3. presence and absence of shell.
4. Study of Cleavages- Snail, Amphioxus, fish, frog, birds and mammals
5. Study of Blastulae- Amphioxus, frog and birds.
6. Study of Gastrulae- Amphioxus, frog and birds.
7. Study of types of placenta - Based on Distribution of villi on chorion, Histological types of placenta

Reference books

- De Roberts: Cell biology
- Du Praw E.J.: Cell and Molecular biology
- J. D. Watson: Molecular Biology of the gene
- Prakash S. Lohar : Cell and Molecular Biology, MJP Publishers, Chennai
- J. R. Baker: Cytological techniques
- Gerald Karp: Cell and Molecular Biology, John Wiley and Sons International, London
- Arumugam: Developmental Biology
- Mourice: Animal growth and development
- David R. Newth: Animal growth and development
- Gilbert: Developmental Biology
- B.M. Patten: Early embryology of Chick
- B.M. Patten: Foundation of embryology
- M. Sussaman: Animal growth and development

M. Sc. Zoology Part I: Semester I

ZOO 103 Quantitative Biology

Unit No.	Name of Topic	Lectures
1.	Introduction: a) Applications and uses of statistics. b) Meaning of Population, Sample and Sampling, Random sampling. c) Methods of collection of Data: Systematic random sampling, Stratified random Sampling -SRSWR, SRAWOR d) Meaning of variable, discrete variable, continuous variable.	10
2.	Data Classification: a) Some important terms: frequency, relative frequency, class limits, class- width, inclusive and exclusive method of classification. b) Frequency distribution, relative frequency distribution, cumulative Frequency distribution. c) Graphical representation of grouped data - Bar diagram, Histogram, Pi diagram, frequency polygon, Ogive curves. d) Problems and Exercise.	10
3.	Measures of central tendency and dispersion: a) Computation of Arithmetic Mean, Mode and Median (for raw data and grouped data) b) Computation of Standard Deviation, Standard Error, Variance, Coefficient of Variation (for raw data and grouped data) c) Problems and Exercise.	10
4.	Correlation and Regression:- a) Concept of Correlation, types of correlation, scatter diagram. b) Karl-Pearson's coefficient of correlation (ungrouped data) and its properties. c) Concept of Regression, linear regression, regression coefficients and its properties. d) Problems and Exercise.	10
5.	Testing of hypothesis: a) Statistical Hypothesis, Null hypothesis, Alternative hypothesis, critical region, acceptance region, Type I error, Type II error, Level of significance, one tailed and two tailed tests. b) Tests Based on large samples: test of significance of mean, test of significance of difference of means. c) Tests based on small samples: i) t- test: Testing single population mean, two population means, paired t-test. ii) χ^2 – test for testing independence of attributes, single population variance. iii) F- Test for testing two population variances. d) Problems and Exercise.	10
6.	Analysis of variance a) Meaning of ANOVA, one way and two way classification. b) Linear model of one way and two way classification. c) Problems and Exercise.	10
	Total	60

Practicals corresponding to ZOO 103 Quantitative Biology

1. Construction of frequency distribution and its graphical representation-Bar diagram, Histogram, Pi diagram, Frequency curve, Frequency polygon, Ogives.
2. Computation of Arithmetic Mean, Mode, and Median (ungrouped and grouped data).
3. Computation of Standard Deviation, Variance, and Coefficient of Variation (ungrouped and grouped data).
4. Correlation and Regression (ungrouped data).
5. Large sample tests on test of significance of mean, test of significance of difference of means.
6. Small sample tests on t- test: Testing single population mean, two population means, paired t-test.
7. χ^2 – test for testing independence of attributes, single population variance.
8. F- Test for testing two population variances.
9. ANOVA (Based on one way and two way classification)

Reference Books

- N. Gurumani :- An introduction to biostatistics, 2nd revised edition, MJP publishers, Chennai 600 005
- Irfan Ali Khan and AtiyaKhanum:- Fundamentals of biostatistics, 3rd edition, Ukaaz publication, Hyderabad
- Dr. Satguru Prasad:- Fundamentals of biostatistics [Biometry], Emkay publications, Delhi 110 051
- B.K.Mahajan:- Methods in Biostatistics, Jaypee Brothers, Medical publishers (p) ltd. New Delhi, 110 002
- Principles and practice of Biostatistics :- J.V.Dixit

M. Sc. Zoology Part I: Semester I

ZOO 104 Practical

Practical corresponding to ZOO 101 Structure and Function of Invertebrates

1. Dissection of Grasshopper/Cockroach so as to expose its – (E)
 - i. Digestive system
 - ii. Nervous System
 - iii. Reproductive system (Male and Female)
2. Mounting of following – (E)
 - i. Nephridia and Spermatheca of earthworm,
 - ii. Mouthparts and Spiracles of Grasshopper/Cockroach,
 - iii. Cornea and Wings of Grasshopper/Cockroach,
3. Classification of Invertebrates - Porifera to Annelida up to order (one example from each order)
4. Classification of Invertebrates -Arthropoda to Hemichordata up to order (one example from each order)

Practicals corresponding to ZOO 102 Cell Biology

1. Study of electron microphotographs of various cell organelles.
2. Preparation of mitotic Chromosomes from any suitable cell material.
3. Detection of carbohydrates by PAS reaction.
4. Detection of protein by bromophenol blue reaction.
5. Detection of DNA by Feulgen reaction.
6. Detection of Mitochondria by Janus green method

M. Sc. Zoology Part I: Semester I

ZOO 105 Practical

Practicals corresponding to ZOO 102 Developmental Biology

1. Preparation of Permanent slide of Chick Embryo
2. Study of different types of eggs – on the basis of amount of yolk, distribution of yolk, presence and absence of shell.
3. Study of Cleavages- Snail, Amphioxus, fish, frog, birds and mammals
4. Study of Blastulae- Amphioxus, frog and birds.
5. Study of Gastrulae- Amphioxus, frog and birds.
6. Study of types of placenta - Based on Distribution of villi on chorion, Histological types of placenta

Practicals corresponding to ZOO 103 Quantitative Biology

1. Construction of frequency distribution and its graphical representation-Bar diagram, Histogram, Pi diagram, Frequency curve, Frequency polygon, Ogives.
2. Computation of Arithmetic Mean, Mode, and Median (ungrouped and grouped data).
3. Computation of Standard Deviation, Variance, and Coefficient of Variation (ungrouped and grouped data).
4. Correlation and Regression (ungrouped data).
5. Large sample tests on test of significance of mean, test of significance of difference of means.
6. Small sample tests on t- test: Testing single population mean, two population means, paired t-test.
7. χ^2 – test for testing independence of attributes, single population variance.
8. F- Test for testing two population variances.
9. ANOVA (Based on one way and two way classification)

M. Sc. Zoology Part I: Semester II

ZOO 201: Structure and function of Vertebrates

Unit No.	Name of Topic	Period
1.	Organization of Protochordates: a. Urochordata with respect to <i>Doliolum</i> (Morphology and Anatomy) b. Cephalochordata with respect to <i>Amphioxus</i> (Morphology and Anatomy).	07
2.	a. Origin and phylogeny of vertebrates.	05
3.	Cyclostomata: a. Affinities of cyclostomata b. Phylogenetic status of cyclostomata.	06
4.	a. Fishes (Chondrichthyes and Ostiochthyes) - adaptive radiation b. Amphibia: Origin and evolution of Amphibia c. Reptilia: Evolution and adaptive radiation in Reptiles. d. Aves: Affinities of birds, origin and ancestry of birds, Birds as glorified reptiles e. Mammals: Origin and ancestry of mammals, adaptive radiations in mammals (Prototheria, Metatheria and Eutheria.)	10
5.	Study of endoskeleton of human: a. Axial Skeleton:Skull, Vertebral Column, Rib Cage, b. Appendicular Skeleton:Shoulder Girdle,Skeleton of Upper limb,Pelvic Girdle,Skeleton of Lower limb, c. Functions of human skeleton.	08
6.	a. Comparative account of urogenital system of vertebrate (Dogfish, Frog, Lizard, Pigeon, Rabbit.)	08
7.	a. Endocrine systems in vertebrates b. Neuro-endocrine interrelationship.	06
8.	Receptor organs in vertebrates - Dogfish, Frog, Lizard, Pigeon, Rabbit : a. Olfactory b. Gustatory c. Photoreceptors (Eye) d. Statoacoustic (Ear)	10
	Total	60

Practicals corresponding to Zoo: 201 Structure and function of Vertebrates

1. Classification of Urochordata up to order Doliolida and Cephalochordata up to order Amphioxiformes
2. Classification of Pisces (Fishes) up to orders - Elasmobranchii, Osteichthyes, Teleostomi and Dipnoi.
3. Classification of Amphibia up to orders- Anura, Urodela and Apoda
4. Classification of Reptilia up to orders - Anapsida, Diapsida, Chelonia, squamata, And crocodilian
5. Classification of Aves up to orders - Palaeognathae, Neognathae, Archaeopteryx as connecting link.
6. Classification of Mammals up to subclasses - Prototheria, Metatheria, Eutheria
7. Study of Appendicular and Axial skeleton of human.
8. Comparative study of urogenital system of vertebrate (with the help of models / charts / pictures / simulation) - Dogfish, Frog, Lizard, Pigeon, Rabbit.
9. Study of eye ball muscles of Dog fish/ Pecten from eye ball of hen. (With the help of models/charts/ pictures/simulation).

Reference books

- Alexander, R. M.: The chordate. Cambridge University press London.
- Ballairs- Reptiles (Hutchinson)
- Bourne, G. M.: The structure and function of nervous tissue. Academic Press, Newyork.
- Carter, G. S.: Structure and Habit in vertebrate evolutions. Sedgwich and Jackson London.
- Eccles, J. C.: The understanding of the brain. McGraw hill Co., Newyork.
- Hyman : Comparative vertebrate Anatomy, University of Chicago Perss.
- Green : Anatomy of Rat (Hafner)
- Kingsley J.S. : outlines of comparative Anatomy of Vertebrates (Central book Depot, Allahabad)

M. Sc. Zoology Part I: Semester II

ZOO 202 Biochemistry and Enzymology

Unit No.	Name of Topic	Lectures
1.	Basics of Biochemistry a) Covalent and Non-covalent bonds. b) Acids and bases- proton donors and acceptors; strong/weak acids/bases; ionization of water and the ion product; c) pH scale and the physiological pH range; dissociation constant - K_a and pK_a ; d) Henderson-Hasselbalch equation; buffer solutions; Normality and Molarity	04
2.	Chemistry of biomolecules and their significance: a) Carbohydrates-Classification; derivatives of monosaccharides – phosphate esters, acids and lactones; amino sugars; oligosaccharides; polysaccharides – storage and structural polysaccharides; b) Lipids - Definition, classification, structure of fatty acids, triacylglycerols, phospholipids and sphingolipids, Steroid hormones; lipids as constituents of biological membranes c) Amino acids - Structure, classification; non-protein amino acids, essential and non-essential amino acids; modified amino acids and function. d) Nucleic acids: Structure of bases, nucleosides and nucleotides; importance of nucleic acids	12
3.	Protein structure: a) Primary, secondary, tertiary and quaternary structures. b) Fibrous proteins and globular proteins- examples and biological significance. c) Conformation of protein - Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds. d) Stability of protein structures.	08
4.	Chemistry of hormones: a) Types: Amine, peptide and steroids. b) Properties of hormones. c) Mode of action of peptide hormones and steroid hormones.	06
5.	Enzyme structure and properties : a) Enzyme Classification and nomenclature (International Union of Biochemistry (I.U.B.); Enzyme Commission number (EC number) b) Primary and secondary structure, tertiary structure, the active site, quaternary structure, examples of enzyme- ribonuclease and chymotrypsin and their mechanism of action.	06
6.	Enzyme activity- a) Methods of investigating the mechanisms of enzyme catalyzed reactions- Isotopes labeling, b) Kinetics methods (enzyme velocity, units) steady-state methods, continuous methods. c) Steady-state enzyme kinetics- Effect of substrate concentration on	12

	initial velocity, d) Michaelis-Menten Hypothesis, Briggs- Haldane Hypothesis, Determination of Km and Vmax, derivations from Hyperbolic Michaelis-Menten Behavior, e) Enzyme Immunoassay (ELISA and EMIT).	
7.	Enzyme immobilization- a) Enzyme purification techniques, b) Immobilization techniques, experimental procedures, enzyme stabilization, properties of immobilized enzyme	06
8.	a) Enzyme inhibition Competitive, non-competitive and uncompetitive inhibition, b) Allosteric activation and inhibition- sequential and concerned symmetry models.	06
	Total	60

Practicals corresponding to Biochemistry (Any 5)

1. Preparation of buffer of known molarity and pH.
2. Determination of pKa value of glycine.
3. Estimation of total sugars and reducing sugars
4. Estimation of cholesterol.
5. Estimation of Nucleic acid, DNA and RNA.
6. Determination of protein by using Lowry method.
7. Estimation of Vit. 'C' from suitable source.

Practicals corresponding to Enzymology (Any 5)

1. Preparation of tissue homogenate and fractionation of liver cell components
2. Effect of activators and inhibitors on enzyme activity
3. Determination of α -amylase by starch digestion
4. Determination of tryptic activity by casein digestion method
5. Determination of pancreatic lipase activity
6. Determination of Km Value of enzyme

Reference Books

- Cox, M., Michael. Nelson, L.D. (2008). Principles of Biochemistry. 5thedition. W.H. Freeman and company, New York.
- Lehninger, Nelson and Cox, Principles of Biochemistry, 4th Edition, W.H. Freeman & Company, 2004.
- Nelson, D.L. and Cox, M.M. (2004), Principles of Biochemistry, CBS publishers and Distributors. New Delhi.
- Stryer, L. (1995), Biochemistry (4th Edition) W.H. Freeman and company, New York
- Thomas M. Devlin, (2006) Text Book of Biochemistry with clinical correlations, 6th edition, Wiley – Liss Publication.

M. Sc. Zoology Part I: Semester II

ZOO 203 Tools and Techniques for Biology

Unit No.	Name of Topic	Lectures
1.	Principle, parts and its applications of Microscopic techniques: a) Microscope: Light, phase contrast, interference, fluorescence, polarization. b) Inverted and electron microscopy.	05
2.	Principles and Uses of analytical instruments- a) Balances, pH meter, colorimeter, spectrophotometer. b) Densitometric scanner, spectrofluorometer, chemiluminometer. c) Radioactivity counter, Differential scanning calorimeter. d) ESR and NMR spectrometers.	10
3.	Principle, instrumentation and application of - a) UV-Vis spectrophotometer, b) Colorimeter c) Fluorimeter	05
4.	a) Electrophoresis: Principle, types and applications of agarose gel electrophoresis, starch, SDS and PAGE electrophoresis. b) Radioactivity: Radioisotopes, half life units, Geiger Muller counter, gamma counter and scintillation, safety guidelines.	06
5.	a) Centrifuge: Basic principle, type analytical and preparative centrifuges, different density gradient centrifuge and analytical with its application b) Incubator, hot air oven and autoclave: Principle, instrument and its application. c) pH meter: Principle types, types of electrodes and application. d) Freezers, coolers, platelet agitators, cryo thawing baths.	10
6.	Cell culture techniques a) Design and functioning of tissue culture laboratory b) Cell proliferation measurement c) Cell viability testing d) Culture media preparation and cell harvesting methods	10
7.	Separation techniques in biology a) Molecular separation by chromatography, Precipitation. b) Organelles separation by centrifugation etc. c) Cell separation by flowcytometry, density gradient centrifugation, unit gravity centrifugation, affinity adsorption, anchorage base techniques.	10
8.	a) Immunological techniques based on antigen-antibody interaction – Principle and applications. b) Biosensors.	04
	Total	60

Practicals corresponding to ZOO 203 Tools and Techniques for Biology

1. Calibration of pH meter.
2. Study of Compound and Phase Contrast microscopy.
3. To verify Beer-Lamberts Law.
4. Cell fractionation by using density gradient centrifuge (any suitable gradient)
5. Test Cell viability and Counting.
6. Determination of Molecular Weight of DNA by electrophoresis
7. Study of agglutination reaction and its significance performing WIDAL test.

Reference Books

- Plummer, L: Practical Biochemistry Tata McGraw-Hill.
- Bullock, J. D., Kristiansen, B.- Basic Biotechnology, 1987, academic press, New York.
- Prave, P. Faust, V., Siting, W & Sukatsch, D.A.- Fundamental of Biotechnology, VCL Publishers, New York. 1987.
- Spier, R. E. and Griffins, J.B.- Animal Cell Biotechnology, Vol. I&II, Academic Press, Orlando, 1985.
- Keshav Trehan- Biotechnology. Wiley Eastern Limited, Bangalore, 1990.
- D. B. Tembhare- Techniques in Life Sciences, Himalaya Publishing House.
- T. Poddar, S. Mukhopadhyay, S. K. Das- An Advanced Laboratory Manual Of Zoology, MACMILLAN.
- Keith Wilson, John Walker Principles and Techniques of Practical Biochemistry (Wilson, Principles and Techniques of Practical Biochemistry)

M. Sc. Zoology Part I: Semester II

ZOO 204 Practical

Practicals corresponding to Zoo: 201 Structure and function of Vertebrates

1. Classification of Urochordata up to order Doliolida and Cephalochordata up to order Amphioxiformes
2. Classification of Pisces (Fishes) up to orders - Elasmobranchii, Osteichthyes, Teleostomi and Dipnoi.
3. Classification of Amphibia up to orders- Anura, Urodela and Apoda
4. Classification of Reptilia up to orders - Anapsida, Diapsida, Chelonia, squamata, and crocodilian
5. Classification of Aves up to orders - Palaeognathae, Neognathae, Archaeopteryx as connecting link.
6. Classification of Mammals up to subclasses - Prototheria, Metatheria, Eutheria
7. Study of Appendicular and Axial skeleton of human.
8. Comparative study of urogenital system of vertebrate (with the help of models/charts/ pictures/simulation) - Dogfish, Frog, Lizard, Pigeon, Rabbit.
9. Study of eye ball muscles of Dog fish/ Pecten from eye ball of hen (With the help of models/charts/ pictures/simulation).

Practicals corresponding to Biochemistry (Any 5)

1. Preparation of buffer of known molarity and pH.
2. Determination of pKa value of glycine.
3. Estimation of total sugars and reducing sugars
4. Estimation of cholesterol.
5. Estimation of Nucleic acid, DNA and RNA.
6. Determination of protein by using Lowry method.
7. Estimation of Vit. 'C' from suitable source.

M. Sc. Zoology Part I: Semester II

ZOO 205 Practical

Practicals corresponding to Enzymology (Any 5)

1. Preparation of tissue homogenate and fractionation of liver cell components
2. Effect of activators and inhibitors on enzyme activity
3. Determination of α -amylase by starch digestion
4. Determination of tryptic activity by casein digestion method
5. Determination of pancreatic lipase activity
6. Determination of K_m Value of enzyme

Practicals corresponding to ZOO 203 Tools and Techniques for Biology

1. Calibration of pH meter.
2. Study of Compound and Phase Contrast microscopy.
3. To verify Beer-Lamberts Law.
4. Cell fractionation by using density gradient centrifuge (any suitable gradient)
5. Test Cell viability and Counting.
6. Determination of Molecular Weight of DNA by electrophoresis
7. Study of agglutination reaction and its significance performing WIDAL test.

North Maharashtra University, Jalgaon

M. Sc. (Part I) Zoology

Equivalence for Old Syllabus 2014

Paper Code	Old Course – 2014	Paper Code	New Course – 2017
Semester I			
ZOO 101	A) Structural and Functional Anatomy of Invertebrates B) Biostatistics	ZOO 101	Structure and Function of Invertebrates
ZOO 102	A) Cellular Organisation B) Molecular Biology	ZOO 102	Cell and Developmental Biology
ZOO 103	A) Ecology B) Animal Behavior	ZOO 103	Quantitative Biology
ZOO 104	Practical – 101 (A) + (B) + 102 (A)	ZOO 104	Practical
ZOO 105	Practical – 102 (B) + 103 (A) + (B)	ZOO 105	Practical
Semester II			
Paper Code	Old Course – 2014	Paper Code	New Course – 2017
ZOO 201	A) Structural and Functional Anatomy of Vertebrates B) Immunology	ZOO 201	Structure and Function of Vertebrates
ZOO 202	A) Biochemistry B) Enzymology	ZOO 202	Biochemistry and Enzymology
ZOO 203	A) Developmental Biology B) Genetics	ZOO 203	Tools and Techniques for Biology
ZOO 204	Practical – 201 (A) + (B) + 202 (A)	ZOO 204	Practical
ZOO 205	Practical – 202 (B) + 203 (A) + (B)	ZOO 205	Practical