



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

Affiliated to
UNIVERSITY OF MUMBAI

Syllabus for M.Sc.-Part I
Program: M.Sc Zoology
Program Code: RJSPZOO
(CBCS 2020-21)

M.Sc. ZOOLOGY SEMESTER I
DISTRIBUTION OF TOPICS AND CREDITS

Course code	Nomenclature	Credits	Topic
RJSPZOO101	Non-chordates, chordates and their phylogeny-I	04	1. Phylogeny, Systematics of non-chordates and assorted topics-I
			2. Phylogeny, Systematics of non-chordates, hemichordate & assorted topics
			3. Phylogeny, Systematics of Chordates and Assorted topics-I
			4. Comparative Vertebrate Osteology-I
RJSPZOO102	Biochemistry and metabolism-I	04	1. Biomolecules- a structural and functional approach-I
			2. Metabolism and regulation
			3. Carbohydrate Metabolism and regulation
			4. Lipid and mineral metabolism and Regulation
RJSPZOO103	Genetics, Evolution and Developmental Biology-I	04	1. Cell cycle and cytoplasmic inheritance
			2. Genetics-Extension of Mendelian genetics and non-Mendelian inheritance-I
			3. Evolution-I
			4. Developmental Biology-I
RJSPZOO104	Tools and Techniques in Biology-I	04	1. Microtomy, microscopy, centrifugation
			2. Radioisotopes and extraction techniques
			3. Principles and application of Spectroscopy
			4. Research Methodology
RJSPZOOP101	Non-chordates, chordates and their phylogeny-I PRACTICAL	02	Practicals based on RJSPZOO101
RJSPZOOP102	Biochemistry and metabolism-I PRACTICAL	02	Practicals based on RJSPZOO102
RJSPZOOP103	Genetics, Evolution and Developmental Biology-I PRACTICAL	02	Practicals based on RJSPZOO103
RJSPZOOP104	Tools and Techniques in Biology-I PRACTICAL	02	Practicals based on RJSPZOO104

DISTRIBUTION OF TOPICS AND CREDITS
M.Sc. ZOOLOGY SEMESTER II

Course code	Nomenclature	Credits	Topic
RJSPZOO201	PAPER-I Non-chordates, chordates and their phylogeny-II	04	1. Phylogeny, Systematics of non-chordates and assorted topics-II
			2. Phylogeny, Systematics of protochordates, agnatha & assorted topics
			3. Phylogeny, Systematics of Chordates and Assorted topics-II
			4. Comparative Vertebrate Osteology-II
RJSPZOO202	PAPER -II Biochemistry and metabolism-II	04	1. Biomolecules- a structural and functional approach-II
			2. Enzymes and enzyme kinetics
			3. Metabolic pathways and integration of metabolism
			4. Regulation of metabolism and inborn errors of metabolism
RJSPZOO203	PAPER-III Genetics, Evolution and Developmental Biology-II	04	1. Genetics- Chromosome theory of inheritance and Mendelism-II
			2. Genetics-Extension of Mendelian genetics and non-Mendelian inheritance-II
			3. Evolution-II
			4. Developmental Biology-II
RJSPZOO204	PAPER-IV Tools and Techniques in Biology-II	04	1. Principles and application of chromatography I
			2. Principles and application of chromatography II
			3. Principles and application of chromatography and Electrophoresis
			4. Good Laboratory Practices and Biosafety
RJSPZOOP201	PRACTICAL-I	02	Practicals based on RJSPZOO201
RJSPZOOP202	PRACTICAL-II	02	Practicals based on RJSPZOO202
RJSPZOOP203	PRACTICAL-III	02	Practicals based on RJSPZOO203
RJSPZOOP204	PRACTICAL-IV	02	Practicals based on RJSPZOO204

SEMESTER-I (THEORY)		L	Cr
Paper-I :Non-chordates, chordates and their pylogeny-I		60	4
Paper Code: RJSPZOO101			
UNIT I		15	
Phylogeny, Systematics of non-chordates and assorted topics-I			
1	1.1. Principles of systematic, importance of taxonomic studies in Biology, use of morphometric studies, Osteological studies, use of homologous organs. 1.2. Taxonomic keys: Different kinds of taxonomic keys, their merits and demerits. 1.3. Phylogeny, salient features, classification up to classes (wherever applicable) of the following phyla- *1.3.1 Porifera 1.3.2 Coelenterata 1.3.3 Ctenophora		
UNIT II		15	
Phylogeny, Systematics of non-chordates, Hemichordate & assorted topics			
2	2.1. Phylogeny, salient features, classification (wherever applicable) up to classes of the following phyla- 2.1.1 Mollusca 2.1.2 Bryozoa 2.1.3 Brachiopoda 2.1.4 Echinodermata 2.1.5 Chaetognatha 2.2 Systematic position and affinities of Hemichordata. 2.3 Assorted Topics: *2.3.1 Economic importance of Protozoa. *2.3.2. Mesenteries in Coelenterata. *2.3.3 Economic importance of Arthropoda. 2.3.4 Sense organs in Arthropoda. 2.3.5 Spines and Pedicellariae in Echinodermata. *2.3.6 Invertebrate larvae- larval forms of free living invertebrates, larval forms of parasites, Strategies and evolutionary significance of larval forms.		
UNIT III		15	
Phylogeny, Systematics of Chordates and Assorted topics- I			
3	3.1. Discovery of Coelacanth. 3.2. Overview of fish phylogeny. 3.3. Primitive tetrapods- Labrynthodonts. 3.4. Crossopterigians- A blue print. 3.5. Dipnoi- a group that has failed to evolve as Amphibia. 3.6. Lissamphibia. *3.7. Sphenodon- a living fossil.		

	*3.8. Extinct reptiles. *3.9. Adaptive radiation in Reptilia.		
	Unit IV	15	
	Comparative Vertebrate Osteology- I		
4	<p>4.1. Embryonic development of- a) neurocranium, b) splanchnocranium and c) dermatocranium.</p> <p>*4.2. Comparative account of jaw suspension.</p> <p>*4.3. Embryonic development of Vertebra.</p> <p>4.4. Vertebral column of tetrapods- Atlas, Axis, Typical Vertebra, Thoracic vertebra, Trunk vertebra, Caudal vertebra of Dog fish and Bony fish, Frog, Varanus, Pigeon, and Rabbit.</p> <p>*Marked topics are to be taken for seminar</p>		

M.Sc-I	Semester I Theory
<p>RJSPZOO101</p> <p>Paper-I</p> <p>Non-chordates, chordates and their phylogeny-I</p>	<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To acquaint learners with the detail of principles of taxonomy and modern classification. 2. To introduce learners with systematic position of few non chordate and chordate phyla and hierarchy of classification along with their phylogeny . 3. To give insight to the learners about comparative osteology. <p>Learning Outcomes:</p> <ol style="list-style-type: none"> 1.Learners will get an idea of principles of taxonomy and modern classification. 2.Learners will be able to understand systematic position of few non chordate and chordate phyla and hierarchy of classification physiology in evolutionary hierarchy. 3.Learners will be able to understand increased complexity of comparative osteology.

SEMESTER-I (THEORY)		L	Cr
Paper- II Biochemistry and metabolism-I COURSE CODE: RJSPZOO102		60	4
UNIT I		15	
Biomolecules- a structural and functional approach-I			
1	<p>1.1. Concepts:</p> <ul style="list-style-type: none"> *1.1.1 Biological Macromolecules. *1.1.2 Polymerization and macromolecules. *1.1.3 Central role of carbon. *1.1.4 Common functional groups. *1.1.5 Common ring structure and isomerization in biological molecules. <p>1.2. Carbohydrates:</p> <p>1.2.1. Classification: mono-, oligo- and poly-saccharides.</p> <ol style="list-style-type: none"> 1. Monosaccharides- structure, classification, D- and L- isomers, Anomers and mutarotation, open chain and ring forms, pyranose and furanose forms, reactions of monosaccharides, glycosidic bonds and nomenclature. 2. Oligosaccharides. 3. Polysaccharides- homo- and hetero-polysaccharides. <p>*1.2.2. Biological functions of carbohydrates.</p> <p>1.3. Lipids:</p> <p>1.3.1 Classification: simple and complex lipids.</p> <p>*1.3.2. Fatty acids- Even and odd carbon fatty acids, numbering the carbon atoms, saturated and unsaturated fatty acids, cis- and trans-configuration, nomenclature and short hand representation of fatty acids.</p> <p>1.3.3. Acylglycerols- Mono-, di- and tri-glycerides, stereospecific numbering of glycerols in glycerides, properties of triacylglycerol.</p> <p>1.3.4. Complex lipids- Phospholipids, Sphingolipids, Sterols and waxes, Amphipathic lipids: Membrane lipid bilayers.</p> <p>1.3.5. Biological functions of lipids.</p>		
UNIT II		15	
Metabolism and Regulation			
	<p>2.1. Metabolism: Concept; Catabolism; Anabolism, intermediary metabolism.</p> <p>2.2 Application of Biochemical Thermodynamics to metabolism:</p> <p>2.2.1 Laws of thermodynamics, free energy, entropy, enthalpy, exergonic and endergonic reactions.</p> <p>2.2.2 *High energy compounds: ATP, ADP, ATP-ADP cycle, ATP-AMP ratio.</p> <p>2.3 General concepts of metabolic regulation.</p> <p>2.3.1 Control of metabolic flux, coupled reactions, Allosteric regulation,</p> <p>2.4 Biological oxidation: Electron transport chain and mitochondria; Oxidative</p>		

	Phosphorylation-mechanism, uncoupling of oxidative phosphorylation and its significance. 2.5 Free radicals, antioxidants and antioxidant system.		
	UNIT III	15	
	Carbohydrate metabolism and regulation		
3	<p>*3.1.Glycolysis: Reaction sequence, flow of carbon, conversion of pyruvate to lactate and Acetylcoenzyme-A, significance of pyruvate-lactate interconversion, aerobic and anaerobic glycolysis and energetic of glycolysis. Regulation of glycolysis.</p> <p>3.2. Gluconeogenesis: Reaction sequence from pyruvate, gluconeogenesis from aminoacids, glycerol, propionate and lactate. Regulation of gluconeogenesis.</p> <p>*3.3. Glycogen metabolism: Pathway and regulation of Glycogenesis and Glycogenolysis.</p> <p>3.4. Significance of following pathways: Hexose monophosphate shunt as a multifunctional pathway; *Uronic Acid Pathway; Glyoxylate cycle.</p> <p>3.5 Metabolism in starvation.</p>		
	Unit IV	15	
	Lipid and mineral metabolism and regulation		
4	<p>4.1. Dynamics of body lipids, mobilization of fats, regulation of hormone sensitive TG-lipase, fate of glycerol and free fatty acids.</p> <p>4.2. Fatty acid metabolism: Oxidation of even-carbon and odd-carbon atom fatty acid, oxidation of unsaturated fatty acids, biosynthesis of fatty acids including desaturation, metabolism of phospholipids, cholesterol and*alcohol. Formation and significance of Ketone bodies.</p> <p>4.3 Mineral metabolism and regulation: Calcium metabolism</p> <p>*Topics for Assignments and Essays</p>		

M.Sc-I	Semester I Theory
RJSPZOO102 Paper- II Biochemistry and metabolism-I	<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To acquaint learners with the detail of biomolecules. 2. To introduce various metabolic pathways which operate at cellular and subcellular level. 3. To introduce the learners to the basic concepts of biochemistry. <p>Learning Outcomes:</p> <ol style="list-style-type: none"> 1. Learners will get an idea of general characteristic and details of Biomolecules. 2. Learners will be able to understand interrelations between different metabolic pathways. 3. Learners will be able to understand the intricate processes involved in metabolism of body.

SEMESTER-I (THEORY)		L	Cr
Paper-III Genetics, Evolution and Developmental Biology-I		60	4
Paper Code: RJSPZOO103			
UNIT I		15	
Cell cycle and cytoplasmic inheritance			
1	<p>1.1. Cell cycle and its regulation</p> <p>*1.1.1. Concept of Cell cycle</p> <p>1.1.2. Checkpoints of cell cycle</p> <p>1.1.3. Regulation of cell cycle in yeast and mammalian cells</p> <p>1.1.4. Disruption of cell-cycle in cancer</p> <p>1.2. Cytoplasmic Inheritance / Extra-nuclear Inheritance</p> <p>1.2.1 Salient feature of Cytoplasmic Inheritance</p> <p>*1.2.2 Cytoplasmic Inheritance in animals.</p> <p>1.2.3 Introduction – Human Mitochondrial Genetics</p> <p>1.2.4 Paternal and Maternal mtDNA Inheritance in Humans</p> <p>1.2.5 mtDNA mutations and Human diseases.</p>		
UNIT II		15	
Genetics-Extension of Mendelian genetics and non-Mendelian inheritance-I			
2	<p>2.1. Alleles and phenotypes:</p> <p>2.1.1. *Incomplete or partial dominance and co-dominance</p> <p>2.1.2. *Epistasis</p> <p>2.1.3. Complementation analysis</p> <p>2.1.4. *Multiple alleles</p> <p>2.1.5. *Lethal alleles (recessive and dominant lethal alleles)</p> <p>2.1.6. Penetrance and expressivity</p> <p>2.2. Quantitative inheritance:</p> <p>2.2.1. Traits controlled by many loci</p> <p>2.2.2. Location of polygenes</p> <p>2.2.3. Heritability: measurement of heritability</p> <p>2.3. Linkage, crossing over and gene mapping:</p> <p>2.3.1. Chromosomal theory of linkage, lod score for linkage testing.</p> <p>2.3.2. *Mechanism and types of crossing over</p> <p>2.3.3. Mapping in prokaryotes and bacterial viruses</p> <p>2.3.4. Gene mapping in eukaryotes (three-point cross)</p> <p>2.3.5. Genetic mapping in humans-</p> <p>A) Physical chromosome mapping: deletion mapping, somatic cell hybridization mapping, mapping by in situ hybridization; correspondence of genetic and physical maps.</p>		

	B) Practical application of chromosome mapping- tracking the inheritance of an allele with coupled DNA markers.		
	UNIT III	15	
	Evolution –I		
3	3.1 Evolution: 3.1.1.*Concept of evolution & theories of organic evolution (Lamarckism, Darwinism, DeVries mutation theory, Neo-Darwinism). 3.1.2 *Evolution of horse 3.1.3. Human evolution 3.2. Population and Evolutionary genetics: 3.2.1*Gene pool 3.2.2 Calculating allelic frequencies 3.2.3. The Hardy-Weinberg equilibrium and mating systems (non-random mating, assortative mating, inbreeding, dis-assortative matings). 3.2.4. Adaptive radiation, isolating mechanisms, convergent divergent evolution and co- evolution.		
	Unit IV	15	
	Developmental Biology-I		
4	4.1 Basic concepts of development, gametogenesis, 4.2 Fertilization: sperm aggregation, activation, chemotaxis, maturation and capacitation in mammals. 4.3 Acrosome reaction, sperm-egg interaction, egg activation and calcium release. 4.4 Electrical events and prevention of polyspermy, cortical reaction. 4.5 Cleavage: types, determinate and regulatory embryos, fate maps. 4.6 Nuclear transplantation experiment 4.7 Gastrulation. *Marked topics are to be taken for seminar		

M.Sc-I	Semester I Theory
RJSPZOO103 Paper-III Genetics, Evolution and Developmental Biology-I	Course Objectives: <ol style="list-style-type: none"> 1. To introduce the concept of cell cycle and its regulation. 2. To acquaint the learners with classical mendelian concepts along with deviations from mendelian principles. 3. To make the learner understand the complexity of evolution. 4. To introduce the learners to the details of developmental biology Learning Outcomes: <ol style="list-style-type: none"> 1. Learners will be able to identify the significance of cell cycle check-points and co-relate it with diseases like cancer etc. 2. Learners will be able to work out on genetic problems and relate them to Mendelian inheritance. 3. Learners will be able to understand the processes of evolution and work out on mathematical problems of evolutionary biology. 4. Learner will be able to comprehend the complexity of the process of embryonic development.

SEMESTER-I (THEORY)		L	Cr
PAPER-IV Tools and Techniques in Biology-I		60	4
COURSE CODE: RJSPZOO104			
UNIT I		15	
Microtomy, microscopy, centrifugation			
1	<p>1.1. Microtomy: Tissue fixation, dehydration, clearing, infiltration, embedding for paraffin method, sectioning, mounting, staining-differential and specific.</p> <p>1.2. Principles and applications of microscopy: *Light microscopy, phase contrast microscopy, Fluorescence microscopy, polarization microscopy, confocal scanning microscopy, transmission electron microscopy, specimen preparation for electron microscopy, scanning electron microscopy.</p> <p>*1.3.Principles and applications of centrifugation: Basic principles of centrifugation, Low speed and high speed centrifuges, ultracentrifuge, application of centrifugation-preparative techniques, analytical measurements, care of centrifuges and rotors.</p>		
UNIT II		15	
Radioisotopes and extraction techniques			
2	<p>2.1. Principles and applications of radioisotopes: *Use of isotopes in biological sciences; units of radioactivity, detection and measurement of radioactivity by scintillation counting, autoradiography, preparation for the experiment, performing the experiment.</p> <p>2.2 Principles and application of filtration, distillation and extraction: Ordinary filtration under suction pressure, fractional distillation, steam distillation, technique of extraction with solvents.</p>		
UNIT III		15	
Principles and application of Spectroscopy			
3	<p>*3.1. Ultraviolet and visible absorption spectroscopy</p> <p>3. 2. Fluorescence spectroscopy</p> <p>3.3. Nuclear magnetic resonance spectroscopy</p> <p>3..4. Mass spectroscopy</p> <p>3..5. Atomic absorption spectrophotometer.</p>		
Unit IV		15	
Research Methodology			
4	<p>4.1. Research methodology: Meaning of research; objective of research; types of research; Research Process, Criteria for good research.</p> <p>4.2. Research problem: Selecting research problem; necessity of defining a problem; techniques involved in defining the problem.</p> <p>4.3. Research design: Important concepts related to research design.</p>		

	<p>4.4. Interpretation and report writing: Meaning of interpretation, technique of interpretation; layout of research report; types of reports; types of bibliography</p> <p>4.5. Writing research proposal: Characteristics of a proposal; content and organization of a proposal.</p> <p>*Topics for Assignments and Essays</p>		
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M.Sc-I	Semester I Theory
<p>RJSPZOO104 Paper-IV</p> <p>Tools And Techniques In Biology-I</p>	<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To acquaint learners with the detail of microtomy, microscopy & centrifugation techniques. 2. To introduce the learners with basic knowledge of the different radioactivity and imaging techniques useful in life science study 3. To acquaint learners with spectroscopic, techniques. 4. To educate learners about research methodology. <p>Learning Outcomes:</p> <ol style="list-style-type: none"> 1. Learners will get trained in basic principles and applications of microtomy, microscopy & centrifugation techniques. 2. Learners will be able to understand the major separation and imaging techniques 3. Learners will be able to understand the principles and application of Spectroscopy. 4. Learners will be able to understand and apply various research methodology tools.

SEMESTER-II (THEORY)		L	Cr
Paper- I Non-chordates, chordates and their phylogeny - II		60	4
Paper Code: RJSPZOO201			
UNIT I		15	
Phylogeny, Systematics of non-chordates and assorted topic-II			
1	1.1. Platyhelminthes and Nemathelminthes 1.2. Acanthocephala *1.3. Annelida *1.4. Sipunculoidea 1.5. Arthropoda 1.6 Onychophora – Peripatus, A connecting link between Annelida and Arthropoda.		
UNIT II		15	
Phylogeny of Protochordates, Agnatha and assorted topics II			
2	*2.1. Urochordata and its affinities. *2.2. Cephalochordata and its affinities 2.3. Vertebrate ancestry and origin of Vertebrates. 2.4. Changes leading to first vertebrates. 2.5. Salient features and phylogeny of Ostracoderms. *2.6. Affinities of Cyclostomes- a) resemblance with Cephalochordates. b) differences from fishes. c) vertebrate characters. d) specialized characters.		
UNIT III		15	
Phylogeny, Systematics of Chordates and Assorted topics- II			
3	3.1. Warm blooded reptiles. Archaeopteryx- a connecting link between Reptiles and Aves. 3.2. Affinities of Aves and classification up to subclass. 3.3. Origin of flight (theory of cursorial & arboreal origin). *3.4. Birds as glorified reptiles. *3.5. Egg laying mammals- connecting link between reptiles and mammals. *3.6. Classification of mammals up to orders. *3.7. Dentition in mammals. 3.8. Walking gait (Plantigrade, Digitigrade, and Unguligrade)		
Unit IV		15	
Comparative Vertebrate Osteology- II			
4	4.1. Pectoral & Pelvic girdles of Dog fish, Bony fish, Frog, Varanus, Pigeon and Rabbit 4.2. Comparative anatomy of limbs of tetrapods. *4.3. Mechanism of support and movements running, Jumping and Digging. *Marked topics are to be taken for seminar		

M.Sc-I	Semester II Theory
RJSPZOO201 Paper-I Non-chordates, chordates and their phylogeny-II	Course Objectives: <ol style="list-style-type: none"> 1. To acquaint learners with the salient features of few more non chordates. 2. To introduce learners with systematic position of few chordate phyla and hierarchy of classification along with their phylogeny . 3. To give insight to the learners about comparative osteology. Learning Outcomes: <ol style="list-style-type: none"> 1. Learners will get an idea of salient features of few more non chordates 2. Learners will be able to understand systematic position of few more chordate and chordate phyla and hierarchy of classification physiology in evolutionary hierarchy. 3. Learners would get trained to identify and classify invertebrate animals based on different characters. 4. Learners would get in depth knowledge of comparative osteology.

SEMESTER-II (THEORY)		L	Cr
Paper- II Biochemistry and metabolism-II		60	4
COURSE CODE: RJSPZOO202			
UNIT I		15	
Biomolecules- a structural and functional approach-II			
1	<p>1.1. Proteins as polymers of amino acids</p> <p>*1.1.1. Amino acids: structure, classification based on structure, polarity, nutritional requirement and metabolic fate; properties of amino acids; derivatives of amino acids, non-transcribed amino acids as protein constituents, D-amino acids.</p> <p>1.1.2. Organization of protein structure: Primary structure and peptide bond, secondary, tertiary and quaternary structure; conjugate proteins- haemoglobin, cytochromes, myoglobin; bonds involved in protein organization, Ramchandran plot.</p> <p>1.1.3. Properties of proteins: classification, denaturation and protein folding.</p> <p>1.1.4. Biological functions of proteins. Biologically important peptides: glutathione, octa-, nona-, and deca-peptides.</p> <p>1.2. Nucleic acids: Types- RNA and DNA.</p> <p>1.2.1. Components: Pentose, Nitrogenous bases, Nucleosides, tautomeric forms of purines and pyrimidines.</p> <p>1.2.2. Structure of DNA: *Watson and Crick model; different forms of DNA double helix.</p> <p>*1.2.3. Structure, types and functions of RNA.</p> <p>1.3. Complex biomolecules</p> <p>1.3.1 *Glycoproteins: Blood group substances</p> <p>1.3.2 Glycolipids: Gangliosides.</p> <p>1.3.3 Lipoproteins: Classification and functions- chylomicrons, VLDL, LDL, HDL, and free fatty acid-albumin complex.</p>		
UNIT II		15	
Enzymes and Enzyme kinetics			
2	<p>2.1. Enzymes and Enzyme kinetics.</p> <p>*2.1.1. Enzymes: Nomenclature and classification with numerical code; chemical nature of enzymes.</p> <p>*2.1.2. Mechanism of enzyme action: Fischer's Lock and Key Theory, Koshland's Induced fit model; Mechanism of enzyme catalysis.</p> <p>2.1.3. Enzyme kinetics: Michaelis Menton equation; Lineweaver-Burk plot; significance of V_{max} and K_m; factors affecting enzyme activity; enzyme activation and inhibition.</p> <p>2.1.4. Regulatory enzymes: a) covalently modulated, b) allosteric regulation, c) Isoenzymes (LDH, CK, ALP, ADH)</p> <p>2.1.5. Non-protein enzymes- Ribozymes.</p> <p>2.1.6. Advanced enzymes in human healthcare (e.g. fungal lactase, Hemicellulase, Trypsin chymotrypsin mix)</p>		
UNIT III		15	
Metabolic pathways and Integration of metabolism			
3	3.1. Protein Metabolism:		

M.Sc - I Zoology Syllabus Semester I & II

	<p>3.1.1. Metabolism of amino acids: Amino acid pool, transamination; oxidative and non- oxidative deamination; metabolism of branched chain amino acids; fate of carbon skeleton of amino acids.</p> <p>*3.1.2. Metabolism of ammonia: Urea cycle.</p> <p>3.2. Metabolism of nucleic acids:</p> <p>3.2.1 Synthesis of ribonucleotides- a brief idea of <i>de novo</i> pathway and salvation pathway.</p> <p>*3.2.2. Conversion of ribonucleotides to deoxyribonucleotides.</p> <p>3.2.3. Degradation of nucleotides.</p> <p>3.3. Integration of Metabolism, Energy demand and supply; Integration of major metabolic pathways of energy metabolism; intermediary metabolism; organ specialization and metabolic integration.</p>		
	Unit IV	15	
	Cell signalling and pathways		
4	<p>4.1. Cell signalling Cell signalling Hormones and their receptors, cell surface receptor, signalling through G-protein coupled receptors, second messengers.</p> <p>4.2 Cell signalling pathways</p> <p>4.2.1 Signal transduction pathways,</p> <p>4.2.2 Regulation of signalling pathways,</p> <p>4.2.3 Bacterial and plant two-component systems,</p> <p>4.2.4 Bacterial chemotaxis and quorum sensing.</p> <p>*Topics for Assignments and Essays</p>		

M.Sc-I	Semester II Theory
<p>RJSPZOO202</p> <p>Paper- II</p> <p>Biochemistry and metabolism-II</p>	<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To acquaint learners with the detail of proteins, lipids & nucleic acids. 2. To introduce various cell signalling pathways in detail. 3. To introduce the learners to the basics of enzymology and enzyme kinetics. <p>Learning Outcomes:</p> <ol style="list-style-type: none"> 1. Learners will get an idea of general characteristic and details of Biomolecules. 2. Learners will be able to understand different cell signalling pathways at molecular level. 3. Learners will be able to understand the general mechanisms of enzyme action and enzyme kinetics.

SEMESTER-II (THEORY)		L	Cr
Paper-III Genetics, Evolution and Developmental Biology -II		60	4
Paper Code: RJSPZOO203			
UNIT I		15	
Genetics- Chromosome theory of inheritance and Mendelism-II			
1	1.1. Mendelian genetics, probability and statistics 1.1.1 Combining probabilities (sum rule and product rule) 1.1.2. Chi square test 1.2. Modern concept of gene 1.2.1. * Difference between prokaryotic and eukaryotic gene structure 1.2.2. Properties of genes, gene-enzyme relationship 1.2.3. One gene-one enzyme hypothesis, one gene-one polypeptide concept. 1.2.4. Fine structure of gene, cistron, recon and muton 1.2.5. Split gene- exon and intron 1.2.6. Mobile genes and transposons 1.2.7. Pseudoalleles		
	UNIT II	15	
	Genetics- Extension of Mendelian genetics and non-Mendelian inheritance -II		
2	2.1. Determination of sex *2.1.1. Environmental control of sex (Bonellia, Crepedula); temperature dependent sex determination (TSD) in reptiles. 2.1.2. Genic control of sex determination in Maize, Caenorhabditis elegans *2.1.3. XX-XO, XX-XY and ZZ-ZW method of sex determination 2.1.4. Genic balance theory of sex determination in Drosophila 2.1.5. Gynandromorphs in Drosophila 2.1.6. Haplodiploidy in honeybees 2.1.7. Sex chromatin, Lyon hypothesis, X inactivation 2.1.8. SRY and Dax genes *2.1.9. XX males and XY females in human. 2.2. Non-Mendelian Inheritance: *2.2.1. Maternal effects; Shell coiling in snails, pigmentation in moths 2.2.2. Cytoplasmic inheritance: Mitochondria, chloroplasts, plasmids, infective particles. 2.2.3. Microbial genetics: Transformation, conjugation, Transduction.		
	UNIT III	15	
	Evolution-II		
3	*3.1. Additive gene action and continuous variation 3.2. Heterosis and inbreeding depression: measuring inbreeding, the effects of inbreeding 3.3. Processes that change allelic frequencies: mutation, migration, natural		

	<p>selection, directional selection, stabilizing and disruptive selection, heterozygote advantage, balance between selection and mutation; genetic drift- random genetic drift.</p> <p>3.4. Environmental variation: causes of environmental variation; genotype by environmental interaction</p> <p>3.5. Broad sense heritability: a) Effect of dominance, epistasis and environmental variations on selection;</p> <p>b) Quantitative trait loci and DNA markers;</p> <p>c) Realized heritability.</p> <p>3.6. Limits on selection</p>		
	Unit IV	15	
	Developmental Biology- II		
	<p>4.1. Morphogenesis and organogenesis</p> <p>4.2. Pattern formation in drosophila, amphibian and chick.</p> <p>4.3. Organogenesis:</p> <p>a. Vulva formation in C.elegans</p> <p>b. Eye lens (any suitable example)</p> <p>c. Limb development in chick.</p> <p>4.4 Morphogenesis in insect and amphibians.</p> <p>4.5 Regeneration in Planaria, hydra and Urodels.</p> <p>*Marked topics are to be taken for seminar</p>		

M.Sc	Semester II Theory
RJSUZOO203 Paper-II Genetics, Evolution and Developmental Biology -II	<p>Course Objectives:</p> <ol style="list-style-type: none"> To introduce the concept of statistical genetics and evolutionary biology. To introduce learners the basis of sex determination and non-mendelian inheritance. To understand comparative embryonic development of certain model organisms. <p>Learning Outcomes:</p> <ol style="list-style-type: none"> Learners will be able to calculate statistical problems on genetics and evolutionary biology. Learners will be able to comprehend the nature of chromosomal inheritance. Learners will be able to work with model systems in the field of research.

SEMESTER-II (THEORY)		L	Cr
Paper- IV Tools and Techniques in Biology- II		60	4
Paper Code: RJSPZOO204			
UNIT I		15	
Principles and application of chromatography I			
1	Unit I Principles and application of chromatography I *1.1 Planar chromatography (Paper and Thin layer): Preparation of stationary support, solvent, detection and measurement of components, applications. 1.2 Column chromatography: Packing and operation of column, loading the column, eluting the column, collection of eluent, detection of effluent, application. 1.3 Ion exchange chromatography: Ion exchange resins, selection of ion-exchanger, choice of buffers, preparation and use of ion-exchangers, storage of resins.		
UNIT II		15	
Principles and application of chromatography II			
2	2.1. Gel chromatography: *Theory of gel filtration; physical characteristics of gel chromatography, chemical properties of gel, selection of gel, gel preparation and storage, operation of gel column, application 2.2 Affinity chromatography: Chromatography media, immobilized ligands, attachment of ligands to the matrix, experimental procedures and application.		
UNIT III		15	
Principles and application of GC, HPLC and Electrophoresis			
3	3.1. Gas and Liquid chromatography 3.1.1 Gas chromatography (GC): Instrumentation, selection of operating conditions, analysis of data and application. 3.1.2 HPLC. 3.2. Electrophoresis *3.2.1. Theory of electrophoresis *3.2.2. Horizontal agarose gel electrophoresis *3.2.3. Vertical polyacrylamide gel electrophoresis 3.2.4. Pulse field electrophoresis 3.2.5. Capillary electrophoresis 3.2.6. Isoelectric focusing of proteins 3.2.7. Two-dimensional electrophoresis.		
Unit IV		15	
Good Laboratory Practices and Biosafety			
4	4.1 Safety in laboratories, Use, care and maintenance of common laboratory equipments: Microscope , pH meter, Colorimeter/Spectrophotometer, analytical balance, centrifuge, electrophoresis apparatus, glassware. 4.2 Biosafety: General safety measures, Personal protection, chemical hazards, spillage and waste disposal, first aid.		

	4.3 Risk assessment. 4.4 Biosafety levels 1-4 * Topics for Assignments & Essays		
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M.Sc-I	Semester II Theory
RJSPZOO104 Paper-IV Tools and Techniques in Biology-I	Course Objectives: <ol style="list-style-type: none"> 1. To acquaint learners with the detail of various types of chromatography techniques. 2. To introduce the learners with basic knowledge and types of electrophoresis. 3. To educate learners about use & care of laboratory apparatuses and biosafety in laboratories. Learning Outcomes: <ol style="list-style-type: none"> 1. Learners will get trained in basic principles and applications of various types of chromatography techniques. 2. Learners will be able to understand the basic principles and applications of major electrophoretic techniques. 3. Learners will be able to understand the significance of various good laboratory practices and how to ensure biosafety measures while working in laboratory.

SEMESTER-I PRACTICALS		L	Cr
Paper-I Non-chordates, chordates and their phylogeny - I			
Course Code- RJSPZOO101			2
<p>1. Study of systematic and major features of:</p> <ol style="list-style-type: none"> 1. <u>Porifera</u> (<i>Leucosolenia, Grantia, Euplectella, Euspongia</i>); 2. <u>Coelenterata</u> (<i>Obelia colony, Physalia, Porpita, Sea-anemone, Madrepora, Aurelia</i>); 3. <u>Mollusca</u> (<i>Chiton, Dentalium, Patella, Aplysia, Limnea/Achatina, Mytilus, Loligo/Octopus, Nautilus</i>); 4. <u>Echinodermata</u> (<i>Starfish, Brittlestar, Seaurchin, Seacucumber, Featherstar</i>); 5. <u>Minor Phyla</u> (<i>Comb jelly, Lingula, Sagitta</i>,); Hemichordata (<i>Balanoglossus</i>). <p>2. Study of accessory respiratory organs in: <i>Anabas, Clarius, Sacchobranthus</i> and <i>Boleophthalmus</i>.</p> <p>3. Study of Larval forms: Echinoderm larvae and Tornaria larva.</p> <p>4. Cephalochordata (<i>Amphioxus</i>). Study of systematic and major features of:</p> <ol style="list-style-type: none"> a. Agnatha (<i>Petromyzon, Myxine</i>); b. Pisces (<i>Shark, Stingray, Electricray, Hippocampus, Eel</i> and any lung fish); c. Amphibia (<i>Caecilian, Salamander, Frog, Toad</i>); d. Reptilia (<i>Turtle/Terrapin, Tortoise, Calotes/Chameleon, Draco, Phrynosoma, Viper, Rattlesnake, Hydrophis, Crocodile/Alligator/Gharial</i>) <p>5. Comparative Osteology: Types of vertebrae (Procoelous, Opisthocoelous, Amphicoelous, Heterocoelous)</p>			

M.Sc I	Semester-I Practical-I
RJSPZOO101 Practical- I	<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To familiarize the learner to understand various characteristic features of some non chordates and chordates. 2. To make the learner understand different types of nonchordate larval forms. 3. To introduce learner about respiratory organs in some fishes. 4. To understand various types of vertebrae <p>Learning Outcomes:</p> <ol style="list-style-type: none"> 1. The learner will be able to apply the knowledge of taxonomy to identify various animals 2. The learner can understand larval forms and metamorphosis process during development 3. Learner will understand various modification for respiration in some fishes 4. Learner will observe and understand various types of vertebrae.
Non-chordates, chordates and their phylogeny-I	

SEMESTER-I PRACTICALS		L	Cr
Paper- II Biochemistry and metabolism-I			
Course Code- RJSPZOO102			2
1. Qualitative tests for carbohydrates and identification of the nature of carbohydrates in the given sample:			
i. Molisch's test;			
ii. Anthrone test;			
iii. Iodine test;			
iv. Barfoed's test,;			
v. Seliwanoff's test;			
vi. Fehling's test;			
vii. Benedict's test,			
viii. Picric acid test;			
ix. Mucic acid test; and			
x. Bial's test.			
2. Determination of glucose by Benedict's method (volumetric).			
3. Determination of reducing sugars by 3,5-dinitrosalicylic acid (colorimetric) method.			
4. Determination of glycogen in the given tissue (liver/skeletal muscle/kidney/brain).			
5. Acid and enzyme hydrolysis of glycogen and colorimetric estimation of the products by 3,5-DNSA method.			
6. Isolation of starch from potato.			
7. Determination of acid value of fats/oils.			
8. Determination of saponification value of fats/oils.			

M.Sc.-I	Semester I Practical II
RJSPZOO102 Practical- II Biochemistry and metabolism-I	<p>Course Objectives:</p> <ol style="list-style-type: none"> To familiarize the learner to understand various biochemical tests for carbohydrates. To make the learner understand some basics of enzyme hydrolysis and general tests for lipids. <p>Learning Outcomes:</p> <ol style="list-style-type: none"> The learner will be able to apply the knowledge of different biochemical tests to check presence of different types of carbohydrates in the sample. The learner would learn basics of enzyme hydrolysis and general tests for lipids.

SEMESTER-I PRACTICALS		L	Cr
Paper-III Genetics, Evolution and Developmental Biology-I			
Course Code- RJSPZOO103			2
	<ol style="list-style-type: none"> 1. Temporary squash preparation of onion/garlic root tip cells to study stages of mitosis. 2. Temporary squash preparation of testis of cockroach/ grasshopper/ Tradescantia pollen to study stages of meiosis. 3. Demonstration of inter-chromosomal connections in the cells of Tradescantia buds. 4. Temporary preparation of polytene chromosomes from salivary gland cells of Drosophila/ Chironomus. 5. Study of chromosome structures in human karyotype. 6. Study of different types of chromosome banding techniques. 7. Temporary preparation of buccal smear to study sex chromatin in human 		

M.Sc-I	Semester I Practical III
RJSPZOO103 Practical- III Genetics, Evolution and Developmental Biology-I	Course Objectives: <ol style="list-style-type: none"> 1. To familiarize the learner with the technique of slide preparation for observation of certain genetic phenomenon. 2. To make the learner understand different types of chromosomal anomalies and chromosome banding techniques. Learning Outcomes: <ol style="list-style-type: none"> 1. The learner will gain the technical skill of microscopy. 2. The learner will be able to understand the chromosomal disorders and perform the banding techniques

	SEMESTER-I PRACTICALS	L	Cr
	Paper-IV Tools and Techniques in Biology-I		
	Course Code- RJSPZOO104		2
	1. Identification of pictograms, symbols and signs of safety in laboratory practice. 2. Microtomy: Tissue preservation and fixation, dehydration, infiltration, paraffin embedding and block preparation, sectioning, staining. 3. Solutions and Buffers: Mode of expressing concentration of solutions- Molarity (M), Molality (M), normality (N), Mass concentration, mass fraction, mass percentage or % (w/w), % by volume (v/v), parts per million (ppm) with practical exercises. Types of solutions- Stock solutions practical exercises 4. Preparation of buffers of different pH using Henderson-Hasselbalch equation and its verification using pH meter. 5. Determination of pKa of weak acid. 6. Colorimeter: Selection of filter and determination of unknown concentration of solute		

M.Sc-I	Semester I Practical IV
RJSPZOO104 Practical-IV Tools and Techniques in Biology-I	Course Objectives: 1.To train the learners to use basic laboratory equipment's e.g. microtome, microscopes & centrifugation. 2.To educate the learners with method of preparation of solutions and buffers utilized in biochemistry studies. 3.To acquaint learners with use of colorimeter. Learning Outcomes: 1.Learners will get trained to use microtome, microscopes & centrifuges skilfully. 2.Learners will be able to prepare various chemicals used in biological studies. 3.Learners will be able to understand the working principles and application of colorimeter.

SEMESTER-II PRACTICAL-I		L	Cr
Paper -I Non-chordates, chordates and their phylogeny - II			
Course Code- RJSPZOOP201			2
	<p>1.Study of systematics and major features of: Helminthes (Planaria, Liverfluke, Tapeworm, Ascaris, Trichinella); Annelida (Nereis, Earthworm, Leech); Sipunculoidea:(Sipunculus), Arthropoda (Lobster, Balanus, Crab, Lepas, Scorpion, Spider, Limulus, Centipede, Millipede, Beetle). Urochordata (Simple Ascidian, Salpa/ Doliolum); Cephalochordata (Amphioxus).</p> <p>2.Study of Larval forms: Larvae of Helminthes- Miracidium, Redia, Cercaria, Metacercaria; Trochophore, Crustacean larvae, Ascidian tadpole.</p> <p>3.Study of systematics and major features of: Aves (Ostrich, Kiwi, Kite, Owl, and Duck); Mammals (Duck billed platypus, Echidna, Kangaroo, Shrew, Bat, Loris, Seal/ Walrus, Dolphin, Sea Cow, Tiger, Giant panda, Tapir, Camel, Striped squirrel, Guinea pig, Porcupine, Rabbit)</p> <p>4.Comparative Osteology: Study of pectoral and pelvic girdles (Shark, Bony fish, Frog, Varanus, Pigeon, Rabbit); Study of comparative anatomy of tetrapod limbs (Frog, Varanus, Pigeon and Rabbit).</p>		

M.Sc I	Semester-II Practical-I
RJSPZOOP201 Practical- I Non-chordates, chordates and their phylogeny-II	<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To familiarize the learner to understand various characteristic features of some non chordates and chordates. 2. To make the learner understand different types of nonchordate larval forms. 3. To introduce learner about classification of class mammalia with suitable examples. 4. To understand pectoral and pelvic girdles of some animals. <p>Learning Outcomes:</p> <ol style="list-style-type: none"> 1. The learner will be able to apply the knowledge of taxonomy to identify various animals 2. The learner can understand larval forms and metamorphosis process during development 3. Learner will understand various features for classification of class mammalia with suitable examples. 4. Learner will observe and understand pectoral and pelvic girdles of some animals

SEMESTER-II PRACTICAL II		L	Cr
Paper- II Biochemistry and metabolism-II			
Course Code -RJSPZOOP202			2
	<ol style="list-style-type: none"> 1. Determination of total cholesterol and HDL cholesterol from serum. 2. Qualitative tests for amino acids and Proteins: Ninhydrin test; Xanthoproteic test; Millon's test; Biuret test. 3. Colorimetric estimation of protein by Peterson-Lowry method. 4. Quantitative estimation of amino acids using ninhydrin reagent. 5. Isolation of casein from milk. 6. Detection of conformation of BSA by viscosity measurement and effect of varying concentration of urea on viscosity of BSA. 7. Determination of creatinine in serum and urea. 8. SDH specific activity. 		

M.Sc.-I	Semester II Practical-II
RJSPZOOP202 Practical- II Biochemistry and metabolism-II	Course Objectives: <ol style="list-style-type: none"> 1. To familiarize the learner to understand various biochemical tests for amino acids & proteins. 2. To make the learner understand some basics of enzyme catalysis. Learning Outcomes: <ol style="list-style-type: none"> 1. The learner will be able to apply the knowledge of different biochemical tests for qualitative and quantitative estimation of amino acids & proteins. 2. The learner would learn basics of enzyme catalysis.

SEMESTER-II PRACTICAL III		L	Cr
Paper-III Genetics, Evolution and Developmental Biology-II			
Course Code- RJSPZOOP203			2
	1. Problems in genetics. 2. Pedigree analysis. 3. Quantitative estimation of DNA in a suitable tissue by diphenyl amine method. 4. Quantitative estimation of RNA in a suitable tissue by orcinol method. 5. Observation of morphogenetic movements in chick embryo. 6. Isolation of limb bud and its chorioallantoic grafting.		

M.Sc-I	Semester II Practical-III
RJSPZOOP203 Practical- III Genetics, Evolution and Developmental Biology-II	Course Objectives: <ol style="list-style-type: none"> 1. To familiarize the learner to understand technique of solving problems of genetics and inheritance. 2. To make the learner understand the technique of embryonic experimentation using chick as model. Learning Outcomes: <ol style="list-style-type: none"> 1. The learner will be able to solve the problems in genetics and analyse pedigree charts in capacity of genetic counsellor. 2. The learner will be able to design experiments on embryonic development of other model systems.

SEMESTER II PRACTICALS		L	Cr
Paper -IV Tools and Techniques in Biology-II			2
Course Code -RJSPZOOP204			
	1. Identification of lipids in a given sample by TLC. 2. Separation of pigments from leaves or flowers by adsorption column chromatography. 3. Separation of amino acids by ion exchange chromatography using cation exchanger. 4. Separation and identification of amino acids by 2D paper chromatography 5. SDS-polyacrylamide slab gel electrophoresis of proteins.		

M.Sc-I	Semester II Practical IV
RJSPZOOP204 Practical-IV Tools and Techniques in Biology-II	Course Objectives: 1. To acquaint learners of various chromatographic techniques. 2.To educate the learners with method of SDS-polyacrylamide slab gel electrophoresis of proteins. Learning Outcomes: 1.Learners will get trained in various chromatographic techniques. 2.Learners will be able to perform SDS-polyacrylamide slab gel electrophoresis of proteins.

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Modality of Assessment:**A) Internal Assessment- 40%****a) Theory**

Sr. No.	Evaluation type	Marks
1.	One Assignments/ Project	20
2.	Seminar & Presentation	20

B) External examination- 60%**a) Semester End Theory Assessment- 60%****60 Marks**

- i) Duration – These examinations shall be of two hours duration for each paper.
- ii) Theory Question Paper Pattern:-
 - There shall be five questions each of 12 marks. On each unit there will be one question and the first one will be based on entire syllabus.
 - All questions shall be compulsory with internal choice within the questions. Each question will be of 18 to 20 marks with options.
 - Question may be subdivided into sub-questions a, b, c... and the allocation of marks depend on the weightage of the topic.

M.Sc. ZOOLOGY

Semester I/Semester II EXAMINATION

Maximum Marks: 60

Duration: 2 Hours

Marks Option: 90

Question 1: Unit I

Question 2: Unit II

Question 3: Unit III

Question 4: Unit IV

Question 5: Unit I to Unit IV (Mixed Questions) Instructions:

- i. All questions are compulsory.
- ii. All questions carry equal marks.
- iii. Draw neat and labeled diagrams wherever necessary.

1. Answer any **two questions** from the following (Based on Unit I)

- | | |
|----|----|
| a. | 06 |
| b. | 06 |
| c. | 06 |

2. Answer any **two questions** from the following (Based on Unit II)

- | | |
|----|----|
| a. | 06 |
| b. | 06 |
| c. | 06 |

3. Answer any **two questions** from the following (Based on Unit III)

- | | |
|----|----|
| a. | 06 |
| b. | 06 |
| c. | 06 |

4. Answer any **two questions** from the following (Based on Unit IV)

- | | |
|----|----|
| a. | 06 |
| b. | 06 |
| c. | 06 |

5. Answer any **four questions** from the following (Based on entire syllabus)

- | | |
|----|----|
| a. | 03 |
| b. | 03 |
| c. | 03 |
| d. | 03 |
| e. | 03 |
| f. | 03 |

ZOOLOGY Semester I
PRACTICAL EXAMINATION RJSPZOO101

Total Marks: 50

1. *Dissect Sepia so as to expose its digestive system/reproductive system/nervous system. 13
2. *Make temporary preparation/mounting (stain if necessary) of - 06
Jaws/Radula/Spermatophores/Statocyst of Sepia
Or *
Spicules of Holothurian.
3. Identify specimen/slide a, b, c, d as per instructions. 12
4. Identify specimen/slide e, f as per instructions. 06
5. Identify specimen/slide g as per instructions. 03
6. Viva 05
7. Journal 05

- Candidates are required to present certified journal on the day of practical examination. (* Demonstration/Dissection/Virtual dissection/Model (2D or 3D)/Chart of animal system as per UGC guidelines)

**M.Sc. ZOOLOGY Semester I
PRACTICAL EXAMINATION RJSPZOOP102**

Total Marks: 50

1. Estimate the yield of glycogen from skeletal muscles / liver. Show the results to the examiners and submit a report. 20

Or

Demonstrate the enzymatic / acid hydrolysis of glycogen from the given sample. Show the results to the examiners and submit a report. 20

Or

Identify the nature of carbohydrates in the given sample using qualitative tests (6 tests). 20

2. From the given material isolate Starch and estimate the yield. Show the results to the examiners and submit a report. 20

Or

Estimate the amount of Glucose by Benedict's volumetric method. Show the results to the Examiners and submit a report. 20

Or

Determine the amount of reducing sugars from the given sample by DNSA method. Show the results to the examiners and submit a report. 20

Or

Determine the Saponification Value / Acid Value / Reichert-Meissl (RM) number of the given sample of lipid. Show the results to the examiners and submit a report. 20

3. Viva 05
4. Journal 05

- Candidates are required to present certified journal on the day of practical examination.

ZOOLOGY Semester I
EXAMINATION RJSPZOO103

Total Marks: 50

1. Make a temporary squash preparation of testis of cockroach/ grasshopper/

Tradescantia young anther to study stages of meiosis.

15

Or

Make a temporary preparation of polytene chromosomes from salivary gland cells
Of Drosophila/ Chironomus larva.

15

2. Make a temporary squash preparation of onion/garlic root tip cells to study stages
of mitosis.

09

Or

Make a temporary preparation of buccal smear to study sex chromatin in human.

09

3. a. Make a karyotype analysis from the given printed material and comment on the numerical or/and
structural variations in the chromosomes. 08
b. Identify and describe different types of chromosome banding techniques. 08

4. Viva 05

5. Journal 05

- Candidates are required to present certified journal on the day of practical examination.

**M.Sc-I Semester I
EXAMINATION RJSPZOOPI04**

Total Marks: 50

Major Experiment: 15

Demonstrate the relationship between absorbance of light and the conc. of the dye in the solution using different wavelengths for five dilutions. Tabulate the readings. Plot the absorbance curves on the same graph paper and explain the choice of ideal filter from your results.

Or

Determine the pKa of the given weak acid.

Minor Experiment: 13

Using Henderson Hasselbalch equation calculate the p^H of buffer prepared by mixing known volume of either acid and or salt solutions. Check p^H using p^H meter.

Or

2. (a) Identify the pictograms/ signs/symbols 'a' and 'b' and comment on their significance in a scientific laboratory.

06

And

- (b) Prepare a solution of a given molarity/Normality

07

Minor Experiment: 12

From the infiltrated tissue prepare blocks, trim and mount it on the holder for section cutting.

Or

Trim the given block, mount it on the block holder, cut the sections and from ribbons prepare slides

Or

Dewax the mounted ribbons and stain the sections with Hematoxylin/Eosin.

4. Viva

05

5. Journal

05

- Candidates are required to present certified journal on the day of practical examination.

**ZOOLOGY Semester II
EXAMINATION RJSPZOOP201**

Total Marks: 50

1.	*Dissect Cockroach so as to expose its digestive system/ reproductive system/ nervous system.	13
2.	*Make temporary preparation/mounting (stain if necessary) of - Cockroach – cornea/salivary glands/gonapophyses/spermatheca	05
3.	Identify specimen/slide a, b, c, d as per instructions.	12
4.	Identify specimen/slide 'e' and 'f' as per instruction	06
5.	Identify specimen g as per instructions.	03
6.	Viva	05
7.	Journal	05

- ▲ Candidates are required to present certified journal on the day of practical examination.
(*Demonstration/Dissection/Virtual dissection/Model (2D or 3D)/Chart of animal system as per UGC guidelines)

M.Sc. ZOOLOGY**Semester II****PRACTICAL EXAMINATION RJSPZOOP202****Total****Marks: 50**

- | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| 1. Estimate the protein content of the given tissue homogenate by Peterson-Lowry method
Show the results to the examiners and submit the report. | 20 |
| Or | |
| Estimate the amino acid content of the given sample by Ninhydrin reagent. Prepare a
Standard graph. | |
| Or | |
| Demonstrate the effect of inhibitor on Succinic Dehydrogenase activity. Show the results
and submit a report. | to the examiners |
| Or | |
| Demonstrate the effect of variation in Urea concentration on the conformation of Protein
measurements. Show the results to the examiners and submit a report. | by viscosity |
| Or | |
| Estimate the concentration of Creatinine in the given serum / urine sample. Show the
examiners and submit a report. | results to the |
| 2. Isolate Casein from the given sample of milk and determine its yield. Show the results to the
submit a report. | examiners and
20 |
| Or | |
| Determine Total / HDL Cholesterol from the given serum sample. Show the results to the
examiners and submit a report. | 20 |
| Or | |
| Detect the protein / amino acids in the given sample using qualitative tests (4 tests) | 20 |
| 3. Viva | 05 |
| 4. Journal | 05 |
- Candidates are required to present certified journal on the day of practical examination.

M.Sc. ZOOLOGY

Semester II

PRACTICAL EXAMINATION RJSPZOO203

Total Marks: 50

1. Extract and quantitatively estimate the amount of DNA/RNA from the given tissue homogenate. 15
2. Demonstrate the morphogenetic movements in chick embryo and isolate Limb bud from the given chick embryo. 09

Or

Isolate limb bud from the given chick embryo and demonstrate chorioallantoic grafting from the given chick embryo.

3. (i) Solve the given problem in Genetics. 08
(ii) Solve the given problem related to Pedigree analysis. 08
4. Viva 05
5. Journal 05

* Candidates are required to present certified journal on the day of practical examination.

**. M.Sc. ZOOLOGY Semester II
PRACTICAL EXAMINATION RJSPZOO204**

Total Marks: 50

1. Demonstrate the technique of two-dimensional paper chromatography to separate the amino acids.
Calculate Rf value. 20

Or

Demonstrate the use of adsorption column chromatography to separate the pigments from leaves or flowers.

Or

Demonstrate the technique of ion exchange column chromatography in the separation of amino acids using two buffers.

- 2 Identification of lipids in a given sample by TLC. 10
and

Demonstrate SDS-PAGE under reducing conditions for separation of Plasma/Proteins. 10

3. Viva 05
4. Journal 05

- Candidates are required to present certified journal on the day of practical examination.