

DEPARTMENT OF ZOOLOGY GOVT. N.P.G. COLLEGE OF SCIENCE, RAIPUR M. Sc. ZOOLOGY							
<b>FIRST July Dec. 2019</b>	Paper		Title of Paper	Theory	Test	Credit	Total
	I		Biosystematics and Taxonomy	80	20	4	100
	II		Structure and function of Invertebrates	80	20	4	100
	III		Quantitative Biology (Computer and Biostatistics)	80	20	4	100
	IV		Methods and Techniques in Zoology	80	20	4	100
	LC-I		Lab Course I (Based on paper I & II)	-	-	2	100
	LC-II		Lab Course II (Based on paper III & IV)	-	-	2	100
Total					20	600	
<b>SECOND Jan-June 2020</b>	Paper No.		Title of Paper	Theory	Seminar		Marks
	I		Comparative anatomy of Vertebrates	80	20	4	100
	II		Physiology of Vertebrates	80	20	4	100
	III		Molecular Cell Biology	80	20	4	100
	IV		Population genetics and Evolution	80	20	4	100
	LC-I		Lab Course I (Based on paper I & II)			2	100
	LC-II		Lab Course II (Based on paper III & IV)			2	100
Total					20	600	
<b>THIRD July-Dec. 2020</b>	Paper No.		Title of Paper	Theory	Test		Marks
	I		Developmental Biology	80	20	4	100
	II		Animal Behaviour and Population Ecology	80	20	4	100
	III		Limnology	80	20	4	100
	IV		Biology of Parasitism	80	20	4	100
	LC-I		Lab Course I (Based on paper I & II)			2	100
	LC-II		Lab Course II (Based on paper III & IV)			2	100
Total					20	600	
<b>FOURTH Jan-June 2021</b>	Paper No.		Title of Paper	Theory	Seminar		Marks
	I		General & Comparative Vertebrate Endocrinology	80	20	4	100
	II		Ecology and Environmental Physiology	80	20	4	100
	EL. Group A	III A	Aquaculture and Fisheries	80	20	4	100
		IV A	Ichthyology	80	20	4	100
	EL. Group B	III B	Biology of Immune system	80	20	4	100
		IV B	Immunopathology and Immunotechniques	80	20	4	100
	LC-I		Lab Course I (Based on paper I & II)	-	-	2	100
	LC-II		Lab Course I (Based on paper III & IV)	-	-	2	100
Total					20	600	
Grand Total					80	2400	

Members of Board of Studies

**DEPARTMENT OF ZOOLOGY,  
GOVT. N.P.G. COLLEGE OF SCIENCE, RAIPUR**

**July-December 2019**

**M.Sc. (I Semester) Zoology**

Paper No.	Title of Paper	Theory	Internal test	Credit	Total Marks
I	Biosystematics and Taxonomy	80	20	4	100
II	Structure and function of Invertebrates	80	20	4	100
III	Quantitative Biology (Computer and Biostatistics)	80	20	4	100
IV	Methods and Techniques in Zoology	80	20	4	100
LC-I	Lab Course I (Based on paper I & II)	-	-	2	100
LC-II	Lab Course II (Based on paper III & IV)	-	-	2	100
Total				20	600

**Members of Board of Studies in Zoology**

**July-Dec 2019**  
**M. Sc. ZOOLOGY**  
**Ist Semester**  
**Paper-I: Biosystematics and Taxonomy**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit-I**

Definition & basic concepts of Biosystematics, Zoological nomenclature  
History and theories of biological classification, Different types of taxonomic characters  
Taxonomic procedure, collection, preservation and identification

**Unit-II**

Newer trends in biosystematics- Morphological, Embryological, Behavioral, Cytological and Biochemical approach. Numerical taxonomy. Differential systematics. Molecular taxonomy. Hierarchy of the categories, key & taxa.

**Unit-III**

Dimension of speciation. Species- problem, Concept and origin of species.  
Mechanism of speciation in Panmictic and apomictic species, Species concept- different species concepts; sub species, infra species categories (Biological, Evolutionary, Typological, Nomenclastic, Polytyping and other kind of species), eco, ceno and super species. Relationship between species and their graphical presentation.

**Unit- IV**

Key procedures in taxonomy. Types of taxonomic key their merits and demerits. Process of typification and different Zoological types. Classification- purpose, use and basis. Biological, artificial and natural classification

**Books recommended:**

Elements of Taxonomy- E. Mayer  
Principles of animal taxonomy- G.G. Simpson  
Taxonomy- R.C. Dalella & Verma  
Taxonomy-V.C. Kapoor  
Biodiversity-E.O. Wilson

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**July –Dec 2019**

**M. Sc. ZOOLOGY**

**Ist Semester**

**Paper-II: Structure and Function of Invertebrates**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit -I**

Classification, Locomotion, Nutrition, Reproduction in Protozoa  
Classification, Skeleton system, Canal system, Reproduction in Porifera,

**Unit-II**

Classification, Polymorphism, Mesenteries in Coelentrata  
Classification of Platyhelminthes & Nemathehelminthes  
General organization of Trematoda and Nematoda and their larval forms  
Life cycle of Schistosoma, Paragonimus, Clonorchis

**Unit-III**

Classification of Annelida, Coelomoducts, Nephridia, Filter feeding in Polychaeta  
Classification, of Arthropoda, Respiration in insect, Larval forms in crustacea, Mouth parts of insects

**Unit-IV**

Classification, Foot and Nervous system, Torsion and Detorsion in Mollusca  
Classification, water vascular system and Larval forms in Echinodermata,  
Minor Phyla- Ectoprocta & Endoprocta

**Books recommended:**

The Invertebrate Vol. 1 & 2- L.H. Hyman  
Invertebrate structure and function – E.J.W. Barrington  
Invertebrate Zoology-R.D. Barnes  
Biology of higher Invertebrate- W.D. Russell -Hunter  
Text Book of Zoology- T.J. Parker & W.A. Haswell  
A student text book of Zoology- A. Sedgwick

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**July-Dec 2019**  
**M. Sc. ZOOLOGY**  
**I<sup>st</sup> Semester**

**Paper-III: Quantitative Biology (Computer and Biostatistics)**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit-I: Computer**

History of Computers, Structure of Computers, Classification of Computers, Introduction to digital computer- basic knowledge of hard ware & soft ware, CPU, Input and Output devices, Binary number system.

**Unit-II: Computer**

Introduction to MS Office- MS Word, MS Excel, MS Power point,  
Introduction of Internet

**Unit-III: Biostatistics**

Measurement of central tendency- Arithmetic Mean, Median & Mode. Measurement of Dispersion- Standard deviation, Standard error. Presentation of data by Tables -types, rules for making tables, Use of tables, Graph- types, rules for making graph & its uses, pie diagram, pictogram & its uses.

**Unit-IV: Biostatistics**

Probability- normal and binomial distribution, Correlation and regression- kinds, significance and application of correlation and regression. Test of significance-t-test and Chi square test. Analysis of Variance (one & two way ANOVA).

**Books Recommended**

Programming in BASIC- E. Balagurusamy  
How computers work- J.H. Zar  
Computers: concept & uses- A.C. Wardlaw  
Statistics for Biologists- R.C. Campbell  
Statistical methods- R.R. Sokal & F.J. Rolf  
Introduction to Biostatistics- M. Summer

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**July-Dec 2019**  
**M. Sc. ZOOLOGY**  
**Ist Semester**

**Paper-IV: Methods and Techniques in Zoology**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit-I**

Lab safety and disposal of bio-waste, pH metry, Colorimetry, Spectrophotometry-UV, visible spectrophotometer. Infra red spectrophotometer, NMR, ESR,

**Unit-II**

Light and Electron microscopy, Florescencemicroscopy, Phase contrast microscopy, Confocal microscopy.

**Unit-III**

Radioisotopes techniques- Radioactive decay, sample preparation for radioactive counting, Radioactive counters, Autoradiography, Magnetic resonance Imaging (MRI), Biosensors.

**Unit-IV**

Centrifugation-Principle, techniques and types, Chromatography-Principle, techniques and types (paper, thin layer, column and gel Chromatography), Electrophoresis- Principle, techniques and types (especially Paper and Gel).

**Books recommended**

Introduction to Instrumental analysis- Robert Braun  
Principles of Instrumentation- B.K. Sharma  
Principles of Instrumentation- Upadhayay&Upadhayay  
Principles of Instrumentation- Chatwal & Chatwal

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**July-Dec 2019**  
**M. Sc. ZOOLOGY 1st Semester**  
**Lab Course- I (Practical based on paper I & II)**

Duration- 6 hrs.

Max. Marks-100

1. Study of museum specimens from Protozoa to Minor Phyla.
2. Study of histological slides of Protozoa to Minor Phyla.
3. Alternative methods of dissection– Prawn, Cockroach, Snail, Earth worm, Leech,
4. Mounting of preserved stored material
5. Exercise based on taxonomy

**Examination Scheme**

<b>Major dissection (Alternative procedure)</b>	<b>18 marks</b>
<b>Minor- dissection Alternative procedure)</b>	<b>12</b>
<b>Spotting</b>	<b>20</b>
<b>Exercise based on taxonomy/Mounting</b>	<b>10</b>
<b>Collection</b>	<b>10</b>
<b>Viva-voce</b>	<b>10</b>
<b>Sessional</b>	<b>20</b>

**Lab Course- II (Practical based on paper III & IV)**

Duration-6 hrs.

Max. Marks-100

**List of practical for paper III**

**35 marks**

1. Exercises for computation of Mean, Mode, Median, SD, SE, regression.
2. Exercises for data presentation.
3. Data analysis by ANOVA.
4. Hypothesis testing by *t*-test, Chi-square test.
5. Exercise based on Microsoft word.
6. Study of different components of a computer system.
7. Preparation of a document/non-document by using a suitable word processor.
8. Graphical presentation of data using excel

**List of practical for paper IV**

**35 marks**

1. Determination of pH of different soil & water samples
2. Determination of maximum absorption
3. Demonstration of Beers Law
4. Extraction of carbohydrate, protein and amino acids from tissue
5. Separation of Amino acids, sugars by paper and thin layer chromatography
6. Paper & Gel Electrophoresis

**Viva-voce**

**10marks**

**Sessional 20 marks**

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**DEPARTMENT OF ZOOLOGY**  
**GOVT.N.P.G.COLLEGE OF SCIENCE, RAIPUR**

**Jan- June 2020**

**M.Sc. (II Semester) Zoology**

Paper No.	Title of Paper	Marks		Credit
		Theory	Seminar	
I	Comparative anatomy of Vertebrates	80	20	4
II	Physiology of Vertebrates	80	20	4
III	Molecular Cell Biology	80	20	4
IV	Population genetics & Evolution	80	20	4
LC-I	Lab Course I (Based on paper I & II)	100		2
LC-II	Lab Course II (Based on paper III & IV)	100		2
Total		600		20

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**Jan- June 2020**

**M. Sc. ZOOLOGY**

**IInd Semester**

**Paper-1: Comparative anatomy of Vertebrates**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit-I**

Origin of chordates- Fishes, Amphibia, Reptiles, Aves & Mammals. Classification of Fishes, Amphibia, Reptiles, Aves & Mammals (as proposed by Williams & Marshall).

**Unit-II**

Vertebrate integument and its derivatives- Development, general structure and function of skin and its derivatives, glands, scales, horns, claws, feathers & hairs. General plan of circulation in various groups- Structure and function of blood, Evolution of heart, evolution of aortic arches and portal system. Comparative account of digestive system in vertebrates.

**Unit-III**

Respiratory system in Vertebrates- Comparative account of respiratory organs in vertebrates, Skeletal system- Comparative account of Skull, vertebrae, limbs and girdles. Evolution of Urinogenital system in vertebrates. Comparative account of urinogenital system in vertebrates.

**Unit-IV**

Sense organs- receptors, organs of olfaction and taste, lateral line system and electroreception. Nervous system- Comparative account of the brain in relation to its function, Comparative anatomy of spinal cord, Nerves- cranial, peripheral and Autonomic nervous system.

**Books recommended**

Life of the vertebrate- J.Z. Young

Vertebrate body- A.S. Romer

Evolution of vertebrate- E.H. Colbert

Comparative anatomy of Vertebrate- C.G. Kent

Life of the mammals- J.Z. Young

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**Jan- June 2020**

**M. Sc. ZOOLOGY**

**IInd Semester**

**Paper-II: Physiology of Vertebrates**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit-I**

Feeding mechanism and physiology of digestion, Respiratory organs and respiratory pigments through phylogenetic group, Mechanism and regulation of breathing, Exchange and transport of gases. Chromatophores, their regulation & function.

**Unit-II**

Blood Circulation of body fluid (blood) and their regulation- Composition of blood, Cell types, Blood coagulation. Cardiac cycle and its regulation. Physiology of excretion, formation of urea and urine osmoregulation

**Unit-III**

Muscles contraction, Reproductive physiology-reproductive cycle, gametogenesis, estrous cycle, menstrual cycle, lactation & pregnancy, Placenta, Thermoregulation-homeothermic, poikilothermic animals and hibernation,.

**Unit-IV**

Nerve impulse and their transmission- Mechanisms of conduction along axon and across synapses Neurotransmitters, Types and physiology of reflexes. Receptor physiology- Mechano, photo, phono, chemo & equilibrium reception, Bioluminescence, Pheromones

**Books recommended**

Comparative Animal Physiology- C.L. Prosser  
Animal Physiology- R. Eckert  
General and Comparative Animal Physiology- W.S. Hoar  
Review of Medical Physiology- W.F. Ganong  
Text Book of Medical Physiology - A.C. Guyton

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**Jan- June 2020**  
**M. Sc. ZOOLOGY**  
**IInd Semester**  
**Paper-III: Molecular Cell Biology**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit-I**

Biomembranes- Different models, molecular composition and arrangement. Transportation of biomolecules across biomembrane. Structure and function of Mitochondria, Golgi complex, Endoplasmic reticulum, Lysosomes, Ribosome.

**Unit-II**

Nucleus and Nucleolus- structure and function. Cytoskeleton- cilia and flagella, structure and dynamics of microtubules and Microfilaments. Chromosomes- structure, types and function, Human karyotype. Nucleosomes- structure and function. Apoptosis- Mechanism and regulation. Aging.

**Unit-III**

Cell- cycle-check points, cyclin dependent kinases and its regulation. Cell signaling-cell surface receptors, messenger system, signaling from plasma membrane to nucleus. Protein synthesis and its regulation.

**Unit- IV**

DNA- structure, types, replication in prokaryotic & eukaryotic cell, noncoding region, mobile DNA, R DNA technology, Genomic library, PCR techniques and colony hybridization, DNA chip, Blotting techniques, DNA foot printing, RFLP, RADP, Gene related disorders

**Books recommended**

Genes VIII- B. Lewin  
Molecular Biology of Genes- Watson & other  
Principle of Genetics- Gardner  
Molecular Biology of Cell- B. Albert's & other

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**Jan. June 2020**  
**M. Sc. ZOOLOGY**  
**IInd Semester**  
**Paper-IV: Population Genetics & Evolution**

**Note:** **There will be four questions** in all. One question from each unit with fifty percent internal choice is compulsory.

**Unit-I**

Molecular population genetics- molecular phylogenetics of amino acids & nucleic acids, molecular clock. Destabilizing forces for evolution- Genetic variation, natural selection, mutation, Genetic drift ,Hardy-Weinberg Law.

**Unit- II**

Gene Migration,Quantitative traits.Phylogenetic and biological concept of species, Models of Speciation-allopatric, sympatric, parapatric and metapatric, Phyletic speciation, quaternary speciation, gradual speciation, theories of evolution. Pattern & mechanism of isolation.

**Unit- III**

Origin of life,Evidences of Evolution, Theories of Evolution (Lamarckism, Darwinism & Synthetic theory). Basic patterns of Evolution: Micro, Macro& Mega Evolution.

**Unit- IV**

Phylogenetic tree, Fossils- their nature and interpretation, Evolution of Camel, Man, Elephant & Horse.

**Books recommended**

Genes & Evolution- A.P. Jha  
Evolution- M.W. Strikberger  
Evolutionary Genetics- Smith  
Evolution –Moody  
Evolution – Dobzhansky & Other

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**Jan- June 2020**

**M. Sc. ZOOLOGY II Ind Semester**

**Lab Course-I (Practical based on paper I & II)**

Duration-6 hrs.

Max. Marks-100

**Practical based on paper-I**

**35**

Study of museum specimens of chordate (from protochordate to mammal).

Study of histological slide (from protochordate to mammal).

Osteology of Fishes, Amphibia, Aves, Reptiles and Mammals, skull of dog, cattle, and man.

Alternative methods of dissection- cranial nerves of vertebrates,

**Practical based on paper-II**

**35**

RBC, WBC and DLC blood.

Hb% and Ht. of vertebrate blood.

Blood group & clotting time.

Preparation of haemin crystals

Demonstration of Kymograph

Demonstration of action of salivary amylase

**Viva-voce**

**10**

**Sessional**

**20**

**Lab Course- II (Practical based on paper III & IV)**

Duration-6 hrs.

Max. Marks-100

**Practical based on paper-III**

**35**

Biochemical estimation of DNA

Biochemical estimation of RNA by orcinol method

Isolation and electrophoresis of DNA

Problem based on molecular genetics.

Study of types of cells.

Study of permanent slide of cell organelles and cell division.

Preparation of slide of cell division by squash preparation.

Preparation of slide of polytene chromosomes.

Demonstration of Apoptosis

**Practical based on paper-IV**

**35**

Experimental analysis of Genetic drift

Experimental analysis of Hardy Weinberg Law

Numerical problem based on quantitative traits

Construction of phylogenetic tree

Comments upon important evolutionary traits

**Viva-voce**

**10**

**Sessional**

**20**

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**DEPARTMENT OF ZOOLOGY**  
**GOVT.N.P.G.COLLEGE OF SCIENCE, RAIPUR**  
**July-Dec. 2020**

**M.Sc. (III Semester) Zoology**

Paper No.	Title of Paper	Theory	Test	Marks	credit
I	Developmental Biology	80	20	100	4
II	Animal Behaviour and Population Ecology	80	20	100	4
III	Limnology	80	20	100	4
IV	Biology of Parasitism	80	20	100	4
LC-I	Lab Course I (Based on paper I & II)	-	-	100	2
LC-II	Lab Course II (Based on paper III & IV)	-	-	100	2
Total				600	20

**Members of Board of Studies in Zoology**

**July-Dec. 2020**  
**M. Sc. ZOOLOGY**  
**IIIrd Semester**  
**Paper-I: Developmental Biology**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit-I**

Biology of sex determination, Biology of sex differentiation, Spermatogenesis, Oogenesis and vitellogenesis, Ovulation and ovum transport in mammals

**Unit-II**

Fertilization-recognition of gametes, acrosome reaction, activation of egg metabolism Cleavage-pattern and mechanism of cleavage, Fate maps Formative movements, Metamorphosis- in insect and in frog,

**Unit-III**

Organizer concept. Multiple ovulation and embryo transfer technology (IVF and IVET), super ovulation, embryo sexing and cloning, Stem cell, Teratology.

**Unit-IV**

Parthenogenesis, Transgenic animals- knockout experiments, methods of transfection its application and production of transgenic animals-rat, sheep, pig, cattle, fish, Nucleo-cytoplasmic interaction.

**Books Recommended**

Developmental Biology- S.F. Gilbert  
Reproduction in animals- Auston & Short  
Embryology- N.J. Berril

**Members of Board of Studies in Zoology**

**July-Dec. 2020**  
**M. Sc. ZOOLOGY**  
**IIIrd Semester**

**Paper-II: Animal Behaviour and Population Ecology**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit-I**

Ethology- history & branches, Ethogram- analysis of behaviour, Concept and Patterns of behavior, Biological rhythm, communication-chemical, visual, light, tactile and audio, Learning & memory-conditioning: Classical, Instrumental and Insight learning, habituation, reasoning, neural mechanism of learning,

**Unit-II**

Ecological aspects of behaviour-feeding strategies & territorial behaviour. Social behaviour-social organization in insects & primate, evolution of language (Primates and honey bee). Aggregation- schooling in fishes & flocking in birds, Bird migration, navigation and orientation, reproductive behavior, Parental care in amphibian.

**Unit-III**

Population characteristics, Demography-life table. Population growth-exponential, logistic, stochastic & time lag. Population density, reproductive strategies (r and k selection).

**Unit-IV**

Competition & niche theory, Mutualism (plants pollinator & animal interaction), predation, population regulation (extrinsic & intrinsic), distribution of organism.

**Book recommended**

Behavioural Ecology- J.R. Krebs & N.B. Davies

Animal behaviour- Reena Mathur

Animal behaviour- R.A. Hinde

Evolutionary Ecology-E.R. Pianka

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**July-Dec. 2020**  
**M. Sc ZOOLOGY**  
**IIIrd Semester**  
**Paper-III: Limnology**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit-I**

Characteristic of water, Lentic system, Pond ecosystem and communities and lake-forms and origin, Eutrophication.

**Unit-II**

Lotic ecosystem, river, stream ecosystem and biota Phytoplankton & Zooplankton of fresh water, Estuaries.

**Unit-III**

Physical condition of water- light (transmission and absorption of light, thermal radiation, color of water), heat (thermal stratification, flow of heat, comparative analysis of river reservoirs and lake), water (properties of water, hydrological cycle, global water balance), water movement (flow of water, motion in epilimnion, thermocline, hypolimnion, circulation due to thermal bars, river influence).

**Unit-IV**

Chemical component of fresh water-Oxygen(Sources, effect of temperature, salinity and organism, seasonal changes, oxygen depth curve, distribution), carbon dioxide (Distribution, dial & seasonal variation, utilization), Nitrogen (Cycle, forms of N<sub>2</sub> in lakes, seasonal distribution, Nitrogen fixation, dinitrification), Phosphorus (Distribution, cycling, recycling), Iron, silica, Calcium and sulphur (cycle, Bacterial transformation).

**Books recommended**

Fundamental of Ecology- E. P. Odum  
Ecology- C.J. Krebs  
Ecology- R.E. Ricklets and G. Miller

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**July-Dec. 2020**  
**M. Sc. ZOOLOGY**  
**IIIrdSemester**  
**Paper-IV: Biology of Parasitism**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit-I**

Host-parasite relationship, Transmission of infectious agent, Protozoan diseases (Amoebiasis, Malaria, Giardiasis, Trypanosomiasis, Coccidiasis), Vectors of human diseases.

**Unit-II**

Helminth parasites and diseases (Taeniasis, Schistosomiasis), nematodes parasites and diseases (Ascariasis, Filariasis), bacterial disease (Tuberculosis). Parasites of domestic animals

**Unit-III**

Viral diseases (AIDS, Rababies, Plague, respiratory disease caused by virus & bacteria).

**Unit-IV**

Fungal diseases (Mycosis, Mycotoxicosis), disease transmitted by ticks and insects (Lyme disease, Rickettsiae).

**Books Recommended**

Parasitology- Chandler  
Parasitology-Chatterji&Chatterji  
Parasitology-Dey  
Microbiology- Prescott

**Members of Board of Studies in Zoology**

**July-Dec. 2020**  
**M. Sc. ZOOLOGY IIIrd Semester**  
**Lab Course I (Based on paper I & II)**

Duration - 6 hrs. Max. Marks-100

**Practical based on paper-I** **35**

Study of histological slides of gonads.  
Alternative to dissection and display the reproductive system of vertebrates.  
Study of embryological slides of frog and chick.  
Effect of thyroid hormones on metamorphosis of frog.  
Window preparation in chick  
Study of complete developmental cycle of invertebrate (Snail)  
Study of complete developmental cycle of vertebrate (Frog)

**Practical based on paper-II** **35**

Study of insect behavior in response to various environmental stimuli  
Study of various behaviour patterns in vertebrate  
Preparation of life table from given data  
Study of experiment showing animal –animal interaction  
Study of experiment showing animal –plant interaction  
Study of population characteristics- density, frequency and abundance

**Viva-voce** **10**  
**Sessional** **20**

**Lab Course II (Based on paper III & IV)**

Duration - 6 hrs. Max. Marks. - 100

**Practical based on paper III** **35**

Study of physical condition of fresh water.  
Study of chemical constituents of freshwater.  
Plankton analysis-identification of phyto and zooplankton.  
Study of aquatic weeds and aquatic insects.

**Practical based on paper-IV** **35**

Study of slides of protozoan parasites  
Study of slides of helminthes parasites  
Study of slides of bacterial, fungal and viral diseases  
Study of rectal content of vertebrate showing parasites  
Preparation of permanent slide of parasites& vector

**Viva-voce** **10**  
**Sessional** **20**

**Members of Board of Studies in Zoology**

**DEPARTMENT OF ZOOLOGY**  
**GOVT. N.P.G.COLLEGE OF SCIENCE, RAIPUR**

**Jan-June 2021**

**M.Sc. (IV Semester) Zoology**

Paper No.		Title of Paper			Marks	Credit
			Theory	Seminar		
I		General & Comparative Vertebrate Endocrinology	80	20	100	4
II		Ecology and Environmental Physiology	80	20	100	4
EL. Group A	IIIA	Aquaculture and Fisheries	80	20	100	4
	IV A	Ichthyology	80	20	100	4
EL. Group B	IIIB	Biology of Immune system	80	20	100	4
	IVB	Immuno-pathology and Immuno-techniques	80	20	100	4
LC-I		Lab Course I (Based on paper I & II)	-	-	100	2
LC-II A/ B		Lab Course II (Based on paper III & IV)	-	-	100	2
Total					600	20

**Members of Board of Studies in Zoology**

**Jan.-June 2021**  
**M. Sc. ZOOLOGY**  
**IVth Semester**

**Paper-I: General & Comparative Vertebrate Endocrinology**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit-I**

Aims & scope of Endocrinology, Neuro-endocrine system and neuro-secretion, Endocrine glands, their structure & function-hypothalamus, Pituitary, Thyroid, Adrenal, Pancreas and other endocrine structure(mucosa of alimentary canal, placenta, gonads, kidney, heart), Classification of hormones,

**Unit-II**

Chemical structure and biosynthesis of hormones- peptide hormones (pre & pro hormones), steroid hormones, amino acid derived hormones (thyroid and epinephrine hormones),

**Unit-III**

General principle of hormone releasing, transport & action-mechanism of hormone action, hormone receptors-membrane bound & intracellular receptor, termination of hormone action. Hormones & Metabolic regulation (regulation of carbohydrate, protein, lipid & Ca metabolism).

**Unit-IV**

Hormones & behaviour, Hormones & Osmoregulation, Hormones & Reproduction-the gonadal cycle (Parturition, menstruation, lactation & pregnancy), the control of metamorphosis, the role of hormone in maturation.

**Books recommended**

General and Comparative Endocrinology- E.J.W. Barrington  
Comparative vertebrate Endocrinology- P.J. Bentley  
Endocrine Physiology- C.R. Martin  
Endocrinology- Turner

**Members of Board of Studies in Zoology**

**Jan.-June 2021**  
**M. Sc. ZOOLOGY**  
**IVth Semester**

**Paper-II: Ecology and Environmental Physiology**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit-I**

Abiotic factors (climatic and edaphic), biotic factors and Limiting factors. Community ecology, Ecological succession, energy flow, aquatic and terrestrial habitat

**Unit-II**

Kinds of environmental pollution and their control methods, Bioremediation, Natural resources and its conservation—forest, soil, water and energy. Wild life and its conservation, Environmental impact assessment

**Unit-III**

Aquatic adaptation-Fresh water, marine water- deep sea, shores and estuarine water. Terrestrial adaptation- Cursorial, fussional, cave and desert. Aerial adaptation. Parasitic adaptation. Specific adaptation- fight and autotomy.

**Unit-IV**

Basic concept of environmental stress: Temperature, Chemical and Noise.  
Responding Stress Concepts: Emotional, Physiological, Behavioural, and Psychological concepts.  
Biology of Stress: Hormonal Control and Neurological control.  
Stress resistance, stress tolerance, stress avoidance.  
Physiological response to oxygen deficient stress.  
Assessment of Stress: General adaptive syndrome.  
Stress management: Yoga, Meditation.

**Books recommended**

Ecology –E.P. Odum  
Environmental and metabolic animal Physiology- C.L. Prosser  
Animal Physiology: Adaptation & Environment- S. Nielsen  
Environmental Physiology-P.G. Willmer& other  
Animal Physiology: mechanism and adaptation- R. Eckert

**Members of Board of Studies in Zoology**

**Jan.-June 2021  
M. Sc. ZOOLOGY  
IVth Semester**

**Group A Paper – IIIA: Aquaculture and Fisheries**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit- I**

General characters, classification, evolution and phylogeny of-Placodermi, Holocephali, Elasmobranchi, Dipnoi, Teleostomi, Actinopterygii, Crossopterygii.

**Unit-II**

Indian major carps, Construction and maintenance of fresh water fish farm, management of ponds, physiochemical condition of water and its effect on fishes. Fresh water fish breeding (Dry & wet bundh breeding and induced breeding), fishing methods.

**Unit-III**

Fish cum paddy culture, Sewage fisheries, Composite fish culture and integrated fish farming, intensive culture of air-breathing fishes, Aquarium fishes, preparation and maintainance of fish aquarium

**Unit-IV**

Capture fishery (marine), Prawn fishery, Pearl fisheries, Fish preservation & Fish byproduct, Fish disease.

**Books recommended**

Fish & Fisheries- V.G. Jhingran

Fish & Fisheries- C.B.L. Shrivastava

Ichthyology- S.K. Gupta & P.C. Gupta

Fish Biology & Fisheries- R.P. Parihar

Classification of Fishes- L.S. Berg

A manual of fresh water aquaculture- R. Santhanam & other

**Members of Board of Studies in Zoology**

**Jan.-June 2021**  
**M. Sc. ZOOLOGY**  
**IVth Semester**  
**Group A Paper-IVA: Ichthyology**

**Note:** There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.

**Unit-I**

Skin, scales, coloration, Skeleton system, Light production & Electric production in fishes.

**Unit-II**

Locomotion, fins, Deep sea fishes, Hill stream fishes, Migration in fishes, Parental care.

**Unit-III:**

Food, feeding habit and alimentary canal, Respiration & accessory respiratory organs, Swim bladder, Weberian ossicles, Blood vascular system-heart, blood vessels & blood, Endocrine gland.

**Unit-IV**

Excretion, Osmoregulation, Nervous system, (Brain, Spinal cord & Cranial nerves) Sense organs (eye, ear, tango receptors & olfactory receptors) Reproductive system-Male & female, lateral line system.

**Books recommended**

Fish Physiology (series) – W.S. Hoar and D.J. Randall

Fish Physiology (Vol. 1-2) – Brown

Ichthyology- Lagler

Ichthyology- S.S. Khanna

Fish & Fisheries- R.P. Parihar

**Members of Board of Studies in Zoology**

**Jan.-June 2021**  
**M. Sc. ZOOLOGY**  
**IVth Semester**

**Group B Paper-IIIB: Biology of Immune system**

**Note: There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

**Unit – I**

History; scope and applications of immunology  
Immunity, Introduction to innate and acquired immune system  
Haematopoiesis, Different cells & tissues of immune system  
Immune organs their structure functions and organization  
Inflammation

**Unit – II**

T-cell receptors and B-cell receptors  
T-cell maturation, activation and differentiation  
B-cell generation, activation and differentiation  
Antigen, its processing and presentation

**Unit – III**

Antibody- immunoglobulin structures, types and functions  
Major histocompatibility complex & human leucocytes antigen  
Cytokines,  
Complements

**Unit – IV**

Immune response- humoral and cell mediated immune response  
Hypersensitivity reactions – Types I, II, III, IV  
Vaccines and vaccination

**Books recommended**

Immunology – Roitt, Brostoff and Male  
Immunology – Tizard  
Understanding immune system – Elgert  
Immunology – Abbas et al  
Fundamentals of Immunology-, William Paul  
Immunology – Dulsy Fatima, A. Murumgan (saraspblication)  
Immunology - Benzamini et al  
Kubey's Immunology- Goldsby et al  
Internet: .ac.in, edu.com, nic.in

**Members of Board of Studies in Zoology**

Jan.-June 2021  
M. Sc. ZOOLOGY  
IVth Semester

## Group B Paper-IVB: Immunopathology and Immunotechniques

Note: **There will be four questions in all. One question from each unit with fifty percent internal choice is compulsory.**

### UNIT I:

Immunity to viruses  
Immunity bacteria (Streptococcus & Mycobacterium) and fungi  
Immunity to worm (Filaria, Ascaris, Taenia and Fasciola) and protozoans( Plasmodium, Leishmania, Trypanosoma)

### UNIT II:

Immunodeficiency diseases (Primary, secondary & combined) and disorders  
Secondary immunodeficiency Disease-AIDS, Bird flu  
B- cell & T-cell generated diseases, Aging and immune factors

### UNIT III:

Tumor immunology  
Immune tolerance  
Autoimmunity and autoimmune diseases  
Transplantation

### UNIT IV:

Hybridoma technology, Monoclonal Antibodies  
Ag-Ab- interaction: Its principles & application  
Ag-Ab- interaction techniques- precipitation, agglutination, Immunodiffusion (RID, DID), Immunoelectrophoresis, ELISA., Radioimmuno assay, Immunofluorescence assay  
Applications of immune techniques in Immunodiagnosics .

### Books recommended

Immunology – Roitt, Brostoff and Male  
Immunology – Tizard  
Understanding immune system – Elgert  
Immunology – Abbas et al  
Fundamentals of Immunology- William Paul  
Immunology – Dulsy Fatima, A. Murumgan (saraspblication)  
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### Members of Board of Studies in Zoology

**Jan.-June 2021**  
**M. Sc. ZOOLOGY**  
**IVth Semester**

**Lab Course-I (Practical based on paper I& II)**

Duration-6 hrs.

Max. Marks-100

**Practical based on paper-I**

**35**

Study of histological slide of various endocrine glands of vertebrates

Alternative methods of dissection of vertebrates to show the position of endocrine glands

Histological preparation of endocrine glands

Hormone assay

**Practical based on paper-II**

**35**

Water analysis- Determination of hardness, turbidity & alkalinity of water sample. Soil analysis-

Determination of chemical composition, physical condition and Cl content of soil. Oxygen

consumption of aquatic animal under stress. Experiments showing Stress physiology.

Measurement of stress using stress scaling.

**Viva-voce**

**10**

**Sessional**

**20**

**Jan.-June 2021**  
**M. Sc. ZOOLOGY**  
**IVth Semester**

**Lab Course-II A(Practical based on paper IIIA& IVA)**

**Practical based on paper IIIA & IVA** **70**

Study of representative fishes from museum specimens and from their own collection, Study of histological slides, Osteology of fishes, Alternative methods of dissection of fishes- Nervous system of fishes, Alternative methods of dissection accessory respiratory organs of Heteropneustesfossilis, Clariasbatrachus, Webarianossiclaesof fish, Identification of fish egg, fry and fingerling.RBC, WBC &DLC ,Age determination by scales, Identification of fishes, Induced breeding in fishes, Opercular activity in fishes,Thermoregulatory behaviour in fishes.,

<b>Viva-voce</b>	<b>10</b>
<b>Sessional</b>	<b>20</b>

**Jan.-June 2021**  
**M. Sc. ZOOLOGY**  
**IVth Semester**

**Lab Course-II B(Practical based on paper IIIB& IVB)**

Duration-6

Max. Marks-100

**Practical based on paper IIIB & IVB**

**70**

- Enumeration of total leucocytes from human blood samples
- Enumeration of differential leucocytes from human blood samples
- Demonstration of agglutination reaction using human RBC
- Demonstration of Ag-Ab precipitation by immunodiffusion technique
- Antigen detection by radial immunodiffusion technique (RID)
- Estimation of total serum protein
- Estimation of serum gamma globulins
- Estimation of A/G ratio
- procedure of anti serum
- Paper and gel immuno-electrophoresis.
- conventional vdr tests
- strip immunological test of pregnancy (urine)
- ELISA

**Viva-voce**

**10**

**Sessional**

**20**

**DEPARTMENT OF ZOOLOGY**  
**M.Sc. ZOOLOGY DEGREE PROGRAM**

**Course offered**

**I<sup>st</sup> Semester**

Paper I: Biosystematics and Taxonomy

Paper II: Structure and Function of Invertebrates

Paper III: Quantitative Biology (Computer and Biostatistics)

Paper IV: Methods and Techniques in Zoology

V: LC I Lab course based on paper I & II

VI: LC II Lab course based on paper III & IV

**II<sup>nd</sup> Semester**

Paper I: Comparative anatomy of Vertebrates

Paper II: Physiology of Vertebrates

Paper III: Molecular Cell Biology

Paper IV: Population Genetics & Evolution

V: LC I Lab course based on paper I & II

VI: LC II Lab course based on paper III & IV

**III<sup>rd</sup> Semester**

Paper I: Developmental Biology

Paper II: Animal Behaviour and Population Ecology

Paper III: Limnology

Paper IV: Biology of Parasitism

V: LC I Lab course based on paper I & II

VI: LC II Lab course based on paper III & IV

#### **IV<sup>th</sup> Semester**

Paper I: General & Comparative Vertebrate Endocrinology

Paper II : Ecology and Environmental Physiology

Paper III :

Paper III A: Aquaculture and Fisheries

Paper III B: Biology of Immune system

Paper IV :

Paper IV A: Ichthyology

Paper IV B: Immunopathology and Immunotechniques

V: LC I Lab course based on paper I & II

VI: LC II Lab course based on paper III & IV

#### **Programme Outcome**

**PO 1.** Enable the learners to take certificate in the Master's degree in Zoology.

**PO 2.** Students acquire an in-depth knowledge in the area of Zoology

**PO 3.** M.Sc. programme enable students to specialize in one of the branches of Zoology either Ichthyology or Immunology that would be offered as elective courses.

**PO 4.** Programme offers opportunities of continuing education and professional development.

**PO 5.** Widen the scope of the learners for career opportunities such as teaching, industry and research.

**PO 6.** Students can go for self employment as well as can provide employment to others by fish farming.

#### **Programme Specific Outcome**

**PSO 1.** Development of academically sound future researchers and intellectuals in the area of general biology, molecular biology, biotechnology, genetics, cell biology, environmental conservation, immunology and ichthyology.

**PSO 2.** Producing contributors in the area of biological research, teaching and biodiversity conservation.

**PSO 3.** Cultivating a generation with scientific ethics and temperament.

## **Course Outcome**

### **M.Sc. (I<sup>st</sup> Semester) Zoology**

#### **Paper I: Biosystematics and Taxonomy**

**CO 1.** Deep understanding in the principles and practice of systematic.

**CO 2.** Acquire an in-depth knowledge on the diversity and relationships in animal world.

**CO 3.** Develop a holistic appreciation on the phylogeny and adaptations in animals.

**CO 4.** Classification of animals with taxonomic keys.

**CO 5.** Student learn how to collect the specimen its preservation and identification.

#### **Paper-II: Structure and Function of Invertebrates**

**CO 1.** Describe general taxonomic rules on animal classification

**CO 2.** Classify Phylum of invertebrates with taxonomic keys.

**CO 3.** Describe examples of pathogenic nematodes, ecology, zoogeography,

**CO 4.** Distribution of fauna in different realms interaction.

#### **Paper-III: Quantitative Biology (Computer and Biostatistics)**

**CO 1.** Students learn basic of hardware & software of computer.

**CO 2.** Students gain skills in basics of computers, operating systems, overview of programming languages.

**CO 3.** Students gain knowledge about statistical methods like measures of central tendencies, probability, learns about hypothesis testing and inferential statistics

### **Paper-IV: Methods and Techniques in Zoology**

**CO 1.** Understand the importance of Physics to recognize life process.

**CO 2.** Students learn about lab safety and how to dispose off biowastes.

**CO 3.** Understanding of basic concepts of instrumentation such as pH meter, microscopy and its type and centrifugation.

**CO 4.** Students gain skills and knowledge in techniques of chromatography, electrophoresis, spectroscopy and radioisotopes.

**CO 5.** Equip the learner to use the tools and techniques for project work and research.

### **V: LC I Lab course based on paper I & II**

**CO .** Developing Observational, Analytical and Evaluation skills related to paper I and paper II.

### **VI: LC II Lab course based on paper III & IV**

**CO .** Developing Observational, Analytical and Evaluation skills related to paper III and IV.

## **M.Sc. (II<sup>nd</sup> Semester) Zoology**

### **Paper-1: Comparative anatomy of Vertebrates**

**CO 1.** Students learn how the complex form of life originated from the simple forms

**CO 2.** The students learn to classify the chordates phylum.

**CO 3.** Students get a deeper approach about comparative anatomy among the chordates.

**CO 4.** The course describes the evolution of different organ system such as heart and aortic arches, urinogenital system.

### **Paper-II: Physiology of Vertebrates**

**CO 1.** Physiological and biochemical understanding of mechanical, physical, and biochemical functions of animals, their organs, and the cells of which they are composed.

**CO 2.** Interactions and interdependence of physiological and biochemical processes.

**CO 3.** Students gain fundamental knowledge of animal physiology. Students are taught the detailed concepts of digestion respiration excretion the functioning of nerves and muscles.

**CO 4.** Students learn the concepts of endocrine systems and homeostasis a brief account of genetics and organic evolution.

**CO 5.** This course helps students to gain fundamental knowledge in these topics.

### **Paper-III: Molecular Cell Biology**

**CO 1.** Understanding on the details of the basic unit of life at the molecular level.

**CO 2.** Explain the fine structure and functions of cell organelles.

**CO 3.** Introduce the new developments in molecular biology and its implications in human welfare.

**CO 4.** Students get an idea with recent technique like PCR, colony hybridization, DNA chip, blotting, DNA foot printing, RFLP,RAPD etc.

**CO 5.** Expose the learners to the emerging field of research in Molecular Biology.

### **Paper-IV: Population Genetics & Evolution**

**CO 1.** Understanding of genetic basis of evolution, human karyotyping, speciation, population genetics and Hardy-Weinberg law.

**CO 2.** The course elaborates about evolution of camel, man, elephant and horse.

### **V: LC I Lab course based on paper I & II**

**CO .** Developing Observational, Analytical and Evaluation skills related to paper I and paper II.

### **VI: LC II Lab course based on paper III & IV**

**CO .** Developing Observational, Analytical and Evaluation skills related to paper III and IV.

## **M.Sc. (III<sup>rd</sup> Semester) Zoology**

### **Paper-I: Developmental Biology**

**CO 1.** Basic concepts of developmental biology, embryology of frog, chick and mammal, role of hormone during pregnancy.

**CO 2.** Students learn modern techniques such as; Stem cell, IVF, embryo cloning, knock out experiments, methods of transfection and its application etc.

**CO 3.** Expose to concepts and process in developmental biology.

**CO 4.** Understand and appreciate the genetic mechanisms and the unfolding of the same during development.

### **Paper-II: Animal Behaviour and Population Ecology**

**CO 1.** Expose to the basics and advances in ethology.

**CO 2.** Generate an interest in Ethology in order to understand the complexities of both animal and human behaviour.

### **Paper-III: Limnology**

**CO 1.** Students learn about the fresh water habit and habitat.

**CO 2.** Students learn to analyse water quality and determine whether water is good for drinking or fish culture.

**CO 3.** Students learn about water pollution and its control measure.

### **Paper-IV: Biology of Parasitism**

**CO 1.** Students get knowledge related to the techniques involved in detection of various diseases, Pathology associated with various diseases.

**CO 2.** Students learn about various diseases, their causative agent, vector and control measure. The information gained by the students can be further used to educate the common people to how to prevent the pathogenic disease caused by protozoans, helminths, fungus and virus.

### **V: LC I Lab course based on paper I & II**

**CO .** Developing Observational, Analytical and Evaluation skills related to paper I and paper II

## **VI: LC II Lab course based on paper III & IV**

**CO .** Developing Observational, Analytical and Evaluation skills related to paper III and IV

## **M.Sc. (IV<sup>th</sup> Semester) Zoology**

### **Paper - I: General & Comparative Vertebrate Endocrinology**

**CO 1.** Students learn classification, chemical nature and biosynthesis of hormones.

**CO 2.** Students get knowledge about the diseases caused by abnormal secretion of hormones.

**CO 3.** The course elaborates how behaviour is affected by hormones.

**CO 4.** Students learn about role of hormone in maturation and reproductive cycle.

### **Paper - II: Ecology and Environmental Physiology**

**CO 1.** Understanding on the basic theories and principles of ecology.

**CO 2.** Learn current environmental issues based on ecological principles.

**CO 3.** Gain critical understanding on human influence on environment.

**CO 4.** Positive attitude towards Biodiversity conservation.

**CO 5.** Broad and deep understanding on environment and influence of man on environment.

**CO 6.** Equip the students to use various tools and techniques for the study of environment.

**CO 7.** The students learn the importance of Yoga and how to manage stress through yoga and meditation.

### **Paper – III A: Aquaculture and Fisheries**

**CO 1.** Students learn about different type of fishes and it's classification.

**CO 2.** Understands concepts of fisheries, fishing tools and site selection, Aqua culture systems, induced breeding techniques, post harvesting techniques.

**CO 3.** Understanding of construction and maintenance of fresh water fish farm, fish breeding and fishing methods.

**CO 4.** Understanding of composite and integrated fish culture, fish cum paddy culture, sewage fisheries etc.

**CO 5.** The course enable the students make their own career in fisheries as well as can provide employment to others.

### **Paper - IVA: Ichthyology**

**CO 1.** Students get knowledge about fish physiology.

**CO 2.** The course elaborates about fish migration and parental care in fishes.

### **III B: Biology of Immune system**

**CO 1.** Appreciate the contribution of great immunologists.

**CO 2.** Types of immunity, antigens-antibodies and their properties.

**CO 3.** Imparts in depth knowledge of tissues, cells and molecules involved in host defence mechanisms.

**CO 4.** Understanding of types of immunity, Interactions of antigens, antibodies, and complements and other immune components, immune mechanisms in disease control, vaccination, process of immune interactions.

### **Group B Paper-IVB: Immunopathology and Immunotechniques**

**CO 1.** Understand about different diseases and the role of Immune system.

**CO 2.** Familiar with the tools and techniques used in immunology.

**CO 3.** Students get knowledge about the immunodeficiency disease and disorders.

**CO 4.** Students understand about secondary immunodeficiency disease such as AIDS.

The information gained can be further used to aware and eradicate the myths related to AIDS from the society.

**CO 5.** Students get knowledge about cancer.

**V: LC I Lab course based on paper I & II**

**CO .** Developing Observational, Analytical and Evaluation skills related to paper I and paper II

**VI: LC II Lab course based on paper III & IV**

**CO .** Developing Observational, Analytical and Evaluation skills related to paper III A, IV A and III B, IV B