MODIFIED CBCS CURRICULUM OF

M.Sc. ZOOLOGY PROGRAMME

SUBJECT CODE = ZOO

FOR POST GRADUATE COURSES UNDER RANCHI UNIVERSITY

Implemented w.e.f.
Academic Session 2018-2020

Members of Board of Studies of CBCS P.G. Syllabus in Zoology as per Guidelines of the Ranchi University, Ranchi.

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Contents

COURSE STUCTURE FOR M.Sc. ZOOLOGY

Table AI-1: Distribution of 80 Credits for Subjects having Practical Papers

[*wherever there is a practical examination there will be no tutorial and vice –versa.]

Course	Papers	Credits Theory + Practical	Credits Theory + Tutorial
I. Foundation Course (FC)			
1. Foundation Course Compulsory Foundation/ Elective Foundation	**(FC)** 1 Paper	1X5=5	1X5=5
II. Core Course (CC)	**(CC 1 to 10/11)**		
Theory	7 Papers/11 Papers	7X5=35	11X5=55
Practical/ Tutorial*	3 Papers/----------	3X5=15	
Project	1 Paper	1X5=5	1X5=5
III. Elective Course (EC)			
A. Ability Enhancement Course of the Core Course opted	**(AE/EC 1)** 1 Paper	1X5=5	1X5=5
B. Discipline Centric Elective	**(DC/EC 2&3)**		
Theory +	2 Papers	2X5=10	
Practical	1 Paper	1x5=5	
OR Theory/Practical/Tutorial*	1Paper + 1 Practical/Dissertation		2X5=10
OR Generic Elective/ Interdisciplinary	**(GE/EC 2&3)**		
Theory OR	2 Papers		
Theory/Practical/Tutorial*	1 Paper + 1 Practical/Dissertation		
	Total Credit = 80		**= 80**

Table AI-1.1: Course structure for M.Sc Programme with Practical Papers

Semester	Subject (Core Courses) 11 Papers	Allied (Elective Courses) 4 Papers	Foundation Course (Compulsory Course) 1 Paper	Total Credits
Sem-I	C-1, C-2, C-3 (5+5+5=15 Credits)		Foundation Course FC (05 Credits)	**20 Credits**
Sem-II	C-4, C-5, C-6, C-7 (5+5+5+5=20 Credits)			**20 Credits**
Sem-III	C-8, C-9, C-10 (5+5+5=15 Credits)	EC1 (05 Credits)		**20 Credits**
Sem-IV	C-11 (Project) (05 Credits)	EC2, EC3, EP (5+5+5=15Credits)		**20 Credits**
				Total = 80 Credits

COURSES OF STUDY FOR M.Sc. ZOOLOGY **2018 onwards**

Table AI-2 Subject Combinations allowed for M. Sc. Programme (80 Credits)

Foundation Course **FC** **1 Paper**	Core Subject **CC** **11 Papers**	Ability Enhancement Course **AE** **1 Paper**	Discipline Centric Elective/ Generic Elective Course **DC/ GE/ EC** **3 Papers**

Table AI-2.1 Semester wise Examination Structure for Mid Sem & End Sem Examinations:

Sem	Core, AE/ GE/ DC/ EC & Compulsory FC Courses				Examination Structure		
	Paper	Paper Code	Credit	Name of Paper	Mid Semester Evaluation (F.M.)	End Semester Evaluation (F.M.)	End Semester Practical/ Viva (F.M.)
I	Foundation Course	FCZOO101	5	Systematics, Evolution & Bioinformatics	30	70	----
	Core Course	CCZOO102	5	Invertebrate Diversity & Quantitative Biology	30	70	----
	Core Course	CCZOO103	5	Biotechniques, Histology & Histochemistry	30	70	----
	Practical's on Core	CPZOO104	5	Practical-I	----	----	70 + 30
II	Core Course	CCZOO201	5	Cellular and Molecular Biology	----	70	30
	Core Course	CCZOO202	5	Vertebrate Diversity, Ethology & Classical Genetics	30	70	----
	Core Course	CCZOO203	5	Environmental and General Vertebrate Physiology	30	70	----
	Practical's on Core	CPZOO204	5	Practical-II	----	----	70 + 30
III	Ability Enhancement Course	ECZOO301	5	Endocrinology & Developmental Biology	30	70	----
	Core Course	CCZOO302	5	Biochemistry & Immunology	30	70	----
	Core Course	CCZOO303	5	Mammalian Reproductive Physiology & Biotechnology	30	70	----
	Practical's on Core	CPZOO304	5	Practical-III	----	----	70 + 30
IV	Elective	ECZOO401	5	A. Fish and Fisheries-I B. Entomology-I C. Ecology-I	30	70	----
	Elective	ECZOO402	5	A. Fish and Fisheries-II B. Entomology-II C. Ecology-II	30	70	----
	Practical's on Elective	EPZOO403	5	A. Practical - Fish and Fisheries/ B. Practical - Entomology/ C. Practical - Ecology	----	----	70 + 30
	PROJECT	PRZOO404	5	Project Work	----	----	70 + 30

SEMESTER I 4 Papers

Total 100 x 4 = 400 Marks

I. COMPULSORY FOUNDATION COURSE [FCZOO101]:

(Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*
*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

SYSTEMATICS, EVOLUTION & BIOINFORMATICS

Theory: 60 Hours; Tutorial: 15 Hours

I Animal Systematics

Basic concept and nature of taxonomy and Systematics, contribution of systematic to biology
Different types of Classification
Numerical /Phenetic, Cladistic, Evolutionary Systematics (Phylogenetic)
Concept of Cytotaxonomy, Chemical and Molecular taxonomy
Systemic hierarchy, names, codes
Operative principles of nomenclature, application of important rules

II Evolution

Concept of Evolution**,** Theories of organic evolution: Neo Darwinism
Synthetic theory of Evolution
Population, Gene frequency, Hardy Weinberg's law in genetic stability
Genome evolution – Evolution of Multigene family,
Genetic Drift, Isolation,

III Bioinformatics

Principles of bioinformatics and its application
Biological databases:

- Nucleic acid sequence databases
- Protein sequence databases
- Protein structure databases
- Literature database

Data retrieval systems: Search engines, Entrez
Molecular sequence analysis software packages and tools: BLAST, RasMol, Biologist's Workbench - PERL

II. CORE COURSE [CCZOO102]: (Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100 Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):

*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):

*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

***Note:** There may be subdivisions in each question asked in Theory Examinations*

*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

INVERTEBRATE DIVERSITY & QUANTITATIVE BIOLOGY

Theory: 60 Hours; Tutorial: 15 Hours

I Invertebrate Diversity

Concept of Protostomes and Deuterostomes
Origin of coelom – Acoela, Pseudocoela, Schizocoela and Enterocoela.
Locomotion in Protozoa
Locomotion in Cnidaria, Annelida and Echinoderm with reference to Hydrostatic movement.
Origin of Segmentation
Excretion and Osmoregulation in Protozoa
Nephridia and Coelomic System in Annelids
Excretion in Arthropods
Respiration: Arthropods, Mollusca
Concept of Host specificity and Host parasite relationship

II Quantitative biology

Biostatistics: Samples and population, sampling designs
Probability distributions and their properties: Normal, Binomial, Poisson distribution
Hypothesis testing: Non parametric tests and parametric tests
Chi square, G- , t-, f-test, Analysis of variance, Correlation, Regression
Evaluation of Biodiversity indices: Shannon –Weiner index, index of dominance,
Similarity and Dissimilarity index, Association index: 2 x 2 contingency table

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III. CORE COURSE [CCZOO103]: (Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*
*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

BIOTECHNIQUES, HISTOLOGY & HISTOCHEMISTRY

Theory: 60 Hours; Tutorial:15 Hours

I Biotechniques

Analytical instruments: Spectrophotometry and spectrophotometric principles.
Spectroscopy - Atomic Absorption, ESR and NMR Spectroscopy, Microscopy and Scanning and Transmission electron microscopes, Fluorescence microscopy
Cryotechniques-Cryopreservation of cells, tissues and organisms, cryotechnique for microscopy.
Separation techniques: different types of chromatography (paper, TLC, GLC, Ion- exchange and HPLC)
Electrophoresis (Agarose and SDS PAGE)
Centrifugation: Basic principles, differential and density gradient centrifugation
Immuno–cytochemistry
ELISA

II Histology & Histochemistry

Fixation and tissue processing: Types of fixatives, Chemistry of fixation and selection of Fixatives, Dehydration, Clearing and embedding, Microtomy.
Staining of paraffin sections: Principle and methods of staining, Histological stains
Histochemical identification and localization of the following: Glycogen and glycoprotein-
Protein end groups -
Mercury Bromophenol Blue, Ninhydrin-Schiff, Performic acid-Schiff and Per formic acid-Alcian Blue
Lipid moieties - by Sudan Black B method, Sudan III and Sudan IV, Nile Blue Sulphate method
Nucleic acids - DNA and RNA by Methyl green pyronin-Y, DNA by Feulgen reaction.

IV. CORE COURSE PRACTICAL [CPZOO104]: (Credits: Practical-05)

Marks: 30 (ESE: 20 Viva + 5Attd. + 5 Record) + 70 (ESE Pr: 6Hrs)=100	Pass Marks =45

Instruction to Question Setter:

End Semester Practical Examination (ESE Pr):

The questions in practical examination will be of equal to 70 marks and will be so framed that the students are able to answer them within the stipulated time. 20 marks will be awarded on the performance in viva voce whereas 10 marks will be awarded on cumulative assessment which is further subdivided as 5 marks for Practical record and 5 marks for Attendance.

Note:
(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

PRACTICAL-I **Practical: 60Hours**

End Term (External) Assessment

Scheme of examinations

Items		Marks Distribution
Anatomical observation	(1x10)	10
Preparation of permanent slide	(whole mount – 1)	10
Quantitative assessment of Glucose in a test solution by spectrophotometer		20
Histochemical staining of the material provided		10
Spotting [slides 05, museum specimens 05]	(10 x 2)	20
Records and Sessional work		10
Viva voce		20

List of Practicals

I Invertebrate Diversity

General anatomy of:
Leech/ Prawn/ Squilla/ Scorpion/ Aquatic Beetle/ *Mytilus*/ *Aplysia*/ Sea urchin

Museum specimens:
Important representatives of different invertebrate phyla showing peculiarities/ adaptive features/ associations/ stages
Specimens showing convergent and divergent evolutions
Specimens of connecting links and living fossils- *Limulus*, *Peripatus*
Specimens showing mimicry and melanism

Slides:
Slides of larval stages showing recapitulation of ontogeny (Helminthes, Crustacean)

Preparation of taxonomic key upto order of the following:
Coelenterata – *Hydra*, *Obelia* (medusa and polyp), *Physalia*, *Gorgonia*, *Aurelia*, *Metridium*
Rotifera - *Brachionus*
Annelida – Earthworm, *Tubifex*, *Neries* and *Heteronereis*, *Arenicola*, *Chaetopterus*, *Hirudo*
Arthropods – *Sacculina* on crab, Crab, Prawn, *Lepus, Balanus*, Butterfly, Water beetle, *Cyclops*

Mollusca – *Chiton*, *Pila*, *Unio*, *Loligo*, *Sepia*, *Octopus*, *Aplysia*, *Dentalium*
Echinodermata – *Asteria*, *Echinus*, *Antedon*, Cucumaria, *Holothuria*

Study of the following using permanent slides - Trematode, Cestode, Nematode
Larval stages in the life cycle of diagenetic trematodes

II Biotechniques

Use of Ph meter, water bath, autoclave, balance, centrifuge, colorimeter, spectrophotometer
Measurement, figure drawing, and photography through microscope
Chromatographic separation of proteins (Paper, TLC)
Separation of amino acids, DNA by Gel electrophoresis
Quantitative assessment of Glucose in a test solution by spectrophotometer/ auto-analyzer
Demonstration of P.C.R. technique

III Histology and Histochemistry

Preparation of fixatives for histological and different histochemical staining
Paraffin sectioning
- Fixation of tissue
- Dehydration, clearing and embedding
- Trimming and sectioning of paraffin blocks
- Stretching and spreading of sections on slides

Preparation of stains for histological and different histochemical staining
Histological staining of paraffin sections
Histochemical staining of paraffin sections for:
- Carbohydrate moieties using PAS, Alcian blue at different pH
- Lipids using Sudan black B, Sudan III, Sudan IV methods

IV Bioinformatics

Use of search engines
Use of data bases – Gene Bank, PubMeD.
Demonstration of software packages – BLAST and CLUSTUL

SEMESTER II 4 Papers

Total 100 x 4 = 400 Marks

I. CORE COURSE [CCZOO201]: (Credits: Theory-05)

Marks: 30 (MSE: 20Pr. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):
Paper CCZOO201 will have no theory Mid-Sem Eexamination, but there will be a Practical session assessment of 30 marks. In this paper break-up of 20 (mid-semester examination) + 5(Assignment) + 5(overall performance) will not be applicable. Scheme of examination for this paper is given on next following page along with list of practical.

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*

CELLULAR AND MOLECULAR BIOLOGY

Theory: 60 Hours; Tutorial:15 Hours

Cellular and Molecular biology

Biomembranes and cell matrix adhesion

Cell Cycle: Mitosis and Meiosis

Protein Synthesis and trafficking

Cell Signalling and Cell-Cell Interaction

Replication: DNA replication, enzymes involved, Telomeric Replication,
Transcription: Mechanism of Transcription, Basic concepts of Transcription Regulation
Translation: Ribosome, Formation of Initiation Complex. Initiation factors and their

a. Control of Gene Expression in Prokaryotes: Operon Concept, Lac Operon, Tryptophan Operon and Arabinose Operon.
b. Control of Gene Expression in Eukaryotes: Conserved Mechanisms in Transcriptional Regulation.

PRACTICAL- CC1

Practical: 30Hours

Mid Sem (Internal) Assessment

Scheme of examinations **Time: 3Hrs**

Items		Marks Distribution
Microbiology		05
Molecular biology		05
Cell Biology		05
Spotting (2 slides- Bacteria & 2 slides mitosis & meiosis)	(1x4)	04
Records and Sessional work		05
Viva voce		06

List of Practical

I Microbiology

Microbiological quality of fresh and stale milk
Culture media (liquid/ solid) preparation of bacteria
Staining of bacteria

II Molecular Biology

Isolation of DNA from blood
Biochemical estimation of DNA: Diphenylamine reaction
Separation of amino acid by paper chromatography

III Cell Biology

Study of different stages of mitosis and meiosis: study of permanent slides.
Temporary slide preparation with acetocarmine stain:
To study stages of mitosis in onion root tip.
Stages of meiosis in grasshopper testis.
Trypan blue dye exclusion assay.

II. CORE COURSE [CCZOO202]: (Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*
*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

VERTEBRATE DIVERSITY, ETHOLOGY & CLASSICAL GENETICS

Theory: 60 Hours; Tutorial:15 Hours

I Vertebrate Diversity

Neomorphic air breathing organs in fish
Electric organ & Electro-Receptors in fishes
Organs of Distance Touch Orientation in fishes
Reproductive adaptations - Internal fertilization, Viviparity, Paedomorphosis and neoteny
Endocrine control of metamorphosis of the tadpole
Aerodynamics and energetic of flying and gliding in birds
Nest building and Parental care in Birds
Sensory system in birds - Vision, Olfaction, Hearing, Special senses used in navigation
Dentition in mammals, Aquatic mammals**.**

II Ethology

General concepts of Ethology: Motivation; Fixed Action Pattern; Sign or key stimulus or release; Innate Releasing Mechanism;Action specific energy; Learning or Experience Imprinting; Physiological Basis; Behavioral genetics; Evolution of Behaviour;
Behaviour and its types: Individual and social interaction , Social organization , Innate and learned behavior,
Orientation in animals - its nature and types
Biological rhythms – occurrence and significance:

III Classical Genetics

Extension of Mendelian principles – codominance, incomplete dominance, gene interactions, pleiotropy, sex limited and sex influenced characters
Gene mapping – linkage maps.
Extra chromosomal inheritance – inheritance of mitochondrial and chloroplast gene

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III. CORE COURSE [CCZOO203]: (Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	**Pass Marks (MSE:17 + ESE:28)=45**

Instruction to Question Setter:

Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*
*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

ENVIRONMENTAL AND GENERAL VERTEBRATE PHYSIOLOGY

Theory: 60 Hours; Tutorial: 15 Hours

I Environmental Physiology

- Elementary idea of stress and strain
  Adaptation, Fundamental mechanisms of adaptation. Physiological responses to exposure to cold, heat, low pressure (hypobaria), high pressure, electromagnetic radiation
- Thermoregulation
  Mechanism of thermoregulation in vertebrates, Ectotherms and Endotherms
  Endothermy as a high–energy approach to life. Anatomical, Physiological and Behavioral adaptations in endotherms to extreme hot & extreme cold.
- Excretion/Osmoregulation
  Patterns of excretion, organs of excretion.
  Physiology of Urine formation.
  Problems of salt balance in aquatic vertebrates.

II General Vertebrate Physiology

- Respiration : Respiratory pigments in animals, Transport of gases, O_2 dissociation curve, Bohr's effect, Root effect, CO_2 transport, CO_2 equilibrium curve, Regulation of acid base balance. Hb and associated diseases: sickle cell Anemia & Thalassemia. Cardio-Vascular System
- Contractibility / Motility
  Molecular structure of striated muscles and mechanism of muscle contraction.
- Nervous system
  Electrical potentials and its molecular basis. Propagation of impulses along myelinated nerves, Neurotransmitters. Autonomic nervous system

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IV. CORE COURSE PRACTICAL [CPZOO204]: (Credits: Practical-05)

Marks: 30 (ESE: 20 Viva + 5Attd. + 5 Record) + 70 (ESE Pr: 6Hrs)=100	Pass Marks =45

Instruction to Question Setter:
End Semester Practical Examination (ESE Pr):

The questions in practical examination will be of equal to 70 marks and will be so framed that the students are able to answer them within the stipulated time. 20 marks will be awarded on the performance in viva voce whereas 10 marks will be awarded on cumulative assessment which is further subdivided as 5 marks for Practical record and 5 marks for Attendance.

Note:
(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

PRACTICAL-II **Practical: 60Hours**

End Term (External) Assessment

Scheme of examinations **Time: 6Hrs**

Items		Marks Distribution
Anatomical observation	(2x10)	20
Physiology experiments - 2	(2x10)	20
Spectrophotometric determination [Protein/ Glucose/ Cholesterol/ Triglyceride/ DNA/ RNA]		30
Records and Sessional work		10
Viva voce		20

List of Practicals

I Vertebrate diversity

Anatomical observation of:

Accessory respiratory organs in fish- *Channa*, *Heteropneustes*, *Clarias*, *Anabus*

Cranial nerves and blood vessels in *Labeo* / *Wallago*

Flight muscles and air sacs in chick

Museum studies:

Models – Latimeria, *Sphenodon*, Ostrich, different types of beaks and feet in birds, nest of birds,

Specimens – Petromyzon, Myxine, Electric ray, Acipenser, Caecilian, Hyla/ Rhacophorus, Axolotl larva/ Salamander, Draco,Turtle, Snakes: Cobra, Krait, Rattle snake, Sea snake, Water snake, Bat

Bones – Skeleton of a bony fish, Chelonia, Snake, Dentition in mammals

II Physiology

Measurement of metabolic rate in small animals - effect of stress on gill ventilation in fish – plotting zone of resistance and zone of tolerance

Determination of blood pressure in man with help of Sphygmomanometer by auscultation method to show effects of exercise plotting time of acclimation

Detection of presence of blood in urine / fecal matter by Benzidine test

Preparation and study of hemin and haemochromogen crystals

Determination of Haemoglobin content

Permeability of erythrocyte membrane as a function of osmolarity of salt solution

Effect of temperature, drugs, hormones, and neurotransmitters on the rate of heart beat

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SEMESTER III 4Papers

Total 100 x 4 = 400 Marks

I. ABILITY ENHANCEMENT COURSE [ECZOO301]:

(Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	**Pass Marks (MSE:17 + ESE:28)=45**

Instruction to Question Setter:

Mid Semester Examination (MSE):

*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):

*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*

*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

ENDOCRINOLOGY & DEVELOPMENTAL BIOLOGY

Theory: 60 Hours; Tutorial:15 Hours

I Comparative and molecular endocrinology

- Chemical messengers, hormones and mechanism of their action

  Hormone – synthesis, secretion, mode of delivery, half life, entry into the target cells, actions.

  Receptor types and structure**,** second messenger system, cytosolic receptors and their action via gene expression
- Pineal in vertebrates, its hormones and their function
- Mammalian endocrine glands, their hormones and functions:

  Adenohypophysis, Neurohypophysis; Thyroid; Adrenal; Parathyroid
- Physiological Endocrinology:

  Endocrinology of calcium regulation, Endocrinology of osmoregulation

II Developmental Biology

- Fertilization : Specialization of egg, structural specialization of sperm, species-specific binding of gamates, sperm-egg fusion, capacitation, Acrosomal reaction , prevention of polyspermy.
- Cell differentiation : Myogenesis (skeletal muscle - formation, regeneration and hypertrophy), Differentiation of erythrocytes (Stem cells and their diversification, control of haemoglobin synthesis, erythrocyte membrane); Neurogenesis
- Post-embryonic Development : Metamorphosis – Anuran and Insect

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II. CORE COURSE [CCZOO302]: (Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*
*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

BIOCHEMISTRY & IMMUNOLOGY **Theory: 60 Hours; Tutorial:15 Hours**

I Biological Chemistry : Biomolecules and metabolic regulations

- Water – As a biological solvent; Unique physical and chemical properties
  Ionization of water; Equilibrium constant and ionic product of water and pH;
  Weak acids and Weak base; Buffering properties of water
- Biomolecules: Chemical bonds and bond energy
- Structure and significance of Biomolecules:
  Monosaccharide, Oligosaccharides and Polysaccharides
  Proteins – Amino acids, Primary, secondary, tertiary and quarternary structures
  Lipids – simple and complex. Significance of Biopolymers and their formation
- Metabolism:
  Biosynthesis and degradation of protein
  Metabolism of fructose, glucose, and glycogen
- Enzymes:
  Mechanism of action, regulation of enzyme activity; Enzyme Kinetics
  Coenzymes and isoenzyme; Immobilised enzyme and their application.
- Free Radicals and antioxidants

II Immunology

- Vertebrate immune system: Innate immune system; Organization and structure of lymphoid organs;
  Cells of immune system and their differentiation; Lymphocyte structure – lymphocyte traffic
  MHC complex and antigen; Cytokines; Hypersensitivity reaction
- Acquired immune systems: B-cells, type and receptors; T-cells, type and receptors;
  Antigens, antigenecity and immunogenesity; Epitopes, and Haptens types, structures,
  functions and diversity of antibody
- Immunoglobins: Ig genes, Differential expression of Ig genes.

III. CORE COURSE [CCZOO303]: (Credits: Theory-03, Practical-02)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:
Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*
*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

MAMMALIAN REPRODUCTIVE PHYSIOLOGY & BIOTECHNOLOGY

Theory: 60 Hours; Tutorial:15Hours

I Mammalian Reproductive Physiology & Biotechnology

Different mechanisms of sex determination in vertebrates (genetic, hormonal, thermal)
Testicular and ovarian hormones: sites of secretion, control and effects; Sperm maturation in male reproductive tract and the role of testicular hormones in eutherian mammals
Ovarian and uterine cycles and their control by ovarian and hypophyseal hormones in eutherian mammals

Implantation - mechanism and control.
Delayed implantation; Sterility due to hormonal defects
Manipulation of mammalian reproduction: Hormonal contraceptives, Super ovulation, IVF, Embryo-transfer

Environment and reproduction in mammals: Bruce effect, Lee Boot effect, Whitten effect

II Biotechnology

Enzymes and their application.
Vectors: Cloning and expression vectors, Properties of vectors.
Some important vectors: pBR322, pUC, Cosmids, BAC, YAC.
Selection of recombinants**;** Sources of cloned DNA**;** Genomic DNA library; cDNA library, PCR.

Application of Biotechnology: Preparation of transgenic animals
Mechanism of production of growth hormone, insulin, interferons.
Hybridoma technology: Monoclonal antibody production
Gene Therapy

IV. CORE COURSE PRACTICAL [CPZOO304]: (Credits: Practical-05)

Marks: 30 (ESE: 20 Viva + 5Attd. + 5 Record) + 70 (ESE Pr: 6Hrs)=100	Pass Marks =45

Instruction to Question Setter:
End Semester Practical Examination (ESE Pr):

The questions in practical examination will be of equal to 70 marks and will be so framed that the students are able to answer them within the stipulated time. 20 marks will be awarded on the performance in viva voce whereas 10 marks will be awarded on cumulative assessment which is further subdivided as 5 marks for Practical record and 5 marks for Attendance.
Note:
(Attendance Upto60%, 1mark; 60<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

PRACTICAL-III **Practical: 60Hours**

End Term (External) Assessment

Scheme of examinations **Time: 6Hrs**

Items		Marks Distribution
Endocrinology		10
Developmental Biology		10
Biochemistry	(2x10)	20
Immunology		10
Spotting	(2x10)	20
Records and Sessional work		10
Viva voce		20

List of Practicals

I Endocrinology
Study of histochemical slides –
- Endocrine glands of mammals
- Ultimobranchial glands and fish

Quantitative estimation of cortisol in blood
Qualitative analysis of chorionic gonadotrophin hormone in mammals.

II Development Biology
Study of permanent slides of: –
- Different stages of development in frog (cleavage, blastula, gastrula, organogenesis)
- Different stages of development in chick

Sperm motility, Sperm count, Sperm vitality study using suitable stain
Study of vaginal smear in rat by temporary mounting (methylene blue)

III Biochemistry
Biochemical estimation of protein: Lowry's method
Estimation of glucose
Estimation of serum total cholesterol
Determination of glycogen content of rat liver colorimetrically
Quantitative analysis of lipid: Saponification value of fat

IV Immunology
Study of permanent slides: Thymus, Spleen, lymph node
Antigen antibody interaction (Blood group analysis)
Collection of serum & plasma
Blood film preparation and identification of cell types
Demonstration of ouchterlony double diffusion (ODD)

SEMESTER IV 4 Papers

Total 100 x 4 = 400 Marks

I. GENERIC/DISCIPLINE CENTRIC ELECTIVE [ECZOO401A]:

(Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	**Pass Marks (MSE:17 + ESE:28)=45**

Instruction to Question Setter:

Mid Semester Examination (MSE):

*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):

*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*

*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

FISH AND FISHERIES-I **Theory: 60 Hours; Tutorial: 15 Hours**

Fish and Fisheries

Nutritional value and economic importance of fishes : brief account of byproducts

Aquaculture – Definition and classification

Outlines of fish culture in ponds

Ornamental fishes, larvivorous fishes

Classification of living fishes up to orders

Freshwater and important marine fishes of India

Adaptations in teleosts- hill stream, cave dwelling, antifreeze, colouration, bioluminescence

Migratory behaviour in fishes

Locomotion in teleosts

Aquatic respiration in teleosts

Structure of gills, gill areas and its significance, gas exchange and ventilation of gills

Digestive system of teleosts

Alimentary canal and its modification in relation to food and feeding habits in teleosts

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OR

GENERIC/DISCIPLINE CENTRIC ELECTIVE [ECZOO401B]:

(Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*
*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*
(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

ENTOMOLOGY-I

Theory: 60 Hours; Tutorial: 15 Hours

Entomology

- **Classification and phylogeny of Insects**
  Classification of the Apterygote Orders : Thysanura, Diplura, Protura and Collembola
  Classification of Exopterygote Orders : Orthoptera, Dictyoptera, Hemiptera
  Classification of Endopterygote Orders : Lepidoptera, Diptera, Hymenoptera and Coleoptera
- **Structures and life processes :**
  Integument: Structure and chemistry, cuticular modifications, Apolysis, Ecdysis and sclerotization
  Head and Thorax : Its appendages and their modifications
  Digestive system : Alimentary canal, salivary glands, mechanism of digestion, micro-organisms of the intestine.
- **Sense organs and perception:**
  Mechanoreceptors, Auditory organs, Chemoreceptors,
  Thermoreceptors. Humidity receptors and visual organs
  Effector organs : The sound and light producing organs
- **Insect Physiology:**
  Respiration - Respiration in aquatic, terrestrial and endoparasitic insects
  Excretion - Malphighian tubules and other organs of excretion, Metabolic pathways of nitrogenous excretion i.e. urea, uric acid, ammonia and aminoacids.
- **Reproductive Physiology:**
  Oogenesis, yolk formation, ovulation and oviposition spermatogenesis, transfer of sperms and spermatophores, Mating and fertilization , Endocrine system and hormones & pheromones

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OR

GENERIC/ DISCIPLINE CENTRIC ELECTIVE [ECZOO401C]:

(Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):

*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):

*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*

*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

ECOLOGY-I

Theory: 60 Hours; Tutorial: 15 Hours

Ecology

- **Basic Ecosystem Concept**
  Concept of Productivity: Primary, Secondary and Tertiary; Factors and Methods of measurement.
  Energy Flow in Ecosystem: Food chain, Food web, Food pyramid, Lindeman's Trophic Dynamic concept, Energy flow models.
  Concept of Limiting Factor: Shelford's Law of Tolerance, Leibig's Law of Minimum
  Fundamentals of Limnology
- **Community Ecology**
  The community concept. Development of the community through succession. Community organization and stratification. Classification of the community on the basis of life forms; Ecological Dominants, Species Diversity, Ecotypes, Ecotone and Edge Effect,, Concept of Ecological Niche: Niche Overlap, Niche Breadth, Ecological Release and Ecological Compression. Periodicity (Seasonal, Lunar and Diel) as a niche dimension.
- **Major Biomes of the world**: Forests, Tropical, Tundra, Grassland and Deserts and adaptations.
- **Population Ecology**
  Population Growth and attributes: Exponential, Sigmoid, Time lag Model, Stochastic Model; Natural Regulation of Population: Theories and Model for Population Regulation
  Competition: Intra and Interspecific competition, Competitive ability, Lotka &Volterra models for competing species.
- **Habitat Ecology**
  Physico-chemistry and Biological Characteristics of Freshwater and Marine System; Origin and Classification of Lakes, Types and significance of Freshwater Biota.
- **Biodiversity**:
  Definition, Status, monitoring and documentation, Major factors affecting biodiversity destruction, Biodiversity conservation and management strategies
- **Pollution Ecology:**
  Air, Water and, Soil pollution. Concept of: Bioaccumulation, Biomagnification, Bioremediation, Biosensors.

II. GENERIC/DISCIPLINE CENTRIC ELECTIVE [ECZOO402A]:

(Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100 Pass Marks (MSE:17 + ESE:28)=45

Instruction to Question Setter:

Mid Semester Examination (MSE):

*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):

*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*

*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

FISH AND FISHERIES-II

Theory: 60 Hours; Tutorial: 15 Hours

Fish and Fisheries

- **Cultivable water** – quality and quantity
  Physical and chemical properties of water influencing fish culture
  Natural food for fish in pond
  Role of plankton, blooms and benthos in fish culture
  Fertilizers and their role
  Supplementary feeding and artificial feeds
  Sewage fed fisheries, Integrated fish culture, paddy field fish culture and cage culture.
  Important reservoirs and rivers of Jharkhand – their problems and commercial
  Common aquatic weed and their control
- **Cultivable species**
  Introduction of exotic species – Composite culture, extensive and intensive culture
- **Fish seed production**
  Induced breeding – importance, technique, physiology and new generation of commercial agents
  Collection of seeds from natural resources - transport of carp seeds and breeders
  Management of nursery, rearing and stocking ponds
- **Fishing technology** – nets, crafts, gears, acoustic and other recent techniques.

OR

GENERIC/DISCIPLINE CENTRIC ELECTIVE [ECZOO402B]:

(Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	**Pass Marks (MSE:17 + ESE:28)=45**

Instruction to Question Setter:

Mid Semester Examination (MSE):
*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):
*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*
*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*
(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

ENTOMOLOGY-II

Theory: 60 Hours; Tutorial: 15 Hours

- **Entomology**
  Ecological management of the crop environment:
  Sanitation, destruction or modification of alternate hosts and habitats
  Tillage, irrigation and water management
  Trap cropping and strip harvesting
- **Chemical control :**
  Insecticides - nomenclature, formulae and different types of formulations.
  Common insecticides used in pest control
  Mode of action of insecticides and toxicity to humans.
  Definition of Biological control, agents of Biological Control Parasites, Parasitoids, Predators and Pathogenic microorganisms. Mass production and distribution. Advantages and disadvantages of Biological control.
  Integrated Pest Management (IPM)
  Other methods of Insect Pest Management
  Management of Insect Pests by Sterile-Insect Technique (Chemosterilants)
  Attractants, Repellants, Antifeedants and Pheromones.

OR

GENERIC/ DISCIPLINE CENTRIC ELECTIVE [ECZOO402C]:

(Credits: Theory-04, Tutorial-01)

Marks: 30 (MSE: 20Th. 1Hr + 5Attd. + 5Assign.) + 70 (ESE: 3Hrs)=100	**Pass Marks (MSE:17 + ESE:28)=45**

Instruction to Question Setter:

Mid Semester Examination (MSE):

*There will be **two** groups of questions in written examinations of 20 marks. **Group A is compulsory** and will contain five questions of **very short answer type** consisting of 1 mark each. **Group B will contain descriptive type five** questions of five marks each, out of which any three are to be answered.*

End Semester Examination (ESE):

*There will be **two** groups of questions. **Group A is compulsory** and will contain two questions. **Question No.1 will be very short answer type** consisting of five questions of 1 mark each. **Question No.2 will be short answer type** of 5 marks. **Group B will contain descriptive type six** questions of fifteen marks each, out of which any four are to be answered.*

Note: *There may be subdivisions in each question asked in Theory Examinations*

*The Mid Semester Examination shall have three components. (a) Two Semester Internal Assessment Test (SIA) of 20 Marks each, (b) Class Attendance Score (CAS) of 5 marks and (c) Class Performance Score (CPS) of 5 marks. "**Best of Two**" shall be applicable for computation of marks for SIA.*

(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

ECOLOGY-II

Theory: 60 Hours; Tutorial: 15 Hours

Ecology

- **Pollution Ecology**

- **Water Pollution:**
  Types and sources of pollution; Biodegradable and Non-degradable pollutants; Eutrophication.

- **Air Pollution**:
  Sources and Effects of Air Pollutants; control measures.

- **Ecotoxicology:**
  Toxicology: Routes and rate of administration; Environmental and behavioral factors affecting Toxicity; Synergism and Antagonism; Mechanism of action; Basic Principle of Dose Response relationship; Biotransformation of Toxicants; Translocation of Toxicants Antidotes; Toxicity Tests; Xenobiotics.

III. GE/DC PRACTICAL [EPZOO403A]: (Credits: Practical-05)

Marks: 30 (ESE: 20 Viva + 5Attd. + 5 Record) + 70 (ESE Pr: 6Hrs)=100	Pass Marks =45

Instruction to Question Setter:
End Semester Practical Examination (ESE Pr):

The questions in practical examination will be of equal to 70 marks and will be so framed that the students are able to answer them within the stipulated time. 20 marks will be awarded on the performance in viva voce whereas 10 marks will be awarded on cumulative assessment which is further subdivided as 5 marks for Practical record and 5 marks for Attendance.
Note:
(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

FISH AND FISHERIES PRACTICAL –IV **Practical: 60Hours**

End Term (External) Assessment

Scheme of examinations **Time: 6Hrs**

Items		Marks Distribution
Anatomical observation		10
Gut analysis and determination of feeding habit		10
Temporary slides		10
Spotting – 5 [Representative of major classes–1, histological slides–1, Endocrine section–1, fish showing adaptation–1, exotic/ornamental/ larvivorous fish-1]		15
Plankton identification		5
Taxonomic identification of fresh water fishes	(2x5)	10
Fish showing adaptive feature	(2x5)	10
Records and Sessional work		10
Viva voce		20

List of Practicals

Anatomical observation of a bony fish:

General anatomy, Digestive system of herbivore and carnivore fishes, Reproductive system, Pituitary gland, Weberian Ossicle.

Representatives of major groups (except teleosts)

Taxonomic identification of important fresh water and marine fishes up to genus

Study of histological slides of various organs

Study of slides, related to annual breeding cycles - ovary, testis, pituitary etc.

Study of skeletal system of bony fish

Study of exotic, ornamental, larvicidal fishes

Study of adaptive features: hill stream fishes, fishes showing parental care, bioluminescence, adaptations - feeding, respiratory, flying, poisonous, electric organs etc

Haematology – blood corpuscles, T.C., D.C., and Hb content/ Haematocrit

Study of fishing gears and ecological equipments

Collection, identification of plankton, weeds and aquatic plant

Determination of feeding habit on the basis of gut / gut content

Visit to fish market, landing site, fish pond, fish farm, breeding centers, fish reservoir and National Institutes of Fisheries Research

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OR

GE/DC PRACTICAL [EPZOO403B]: (Credits: Practical-05)

Marks: 30 (ESE: 20 Viva + 5Attd. + 5 Record) + 70 (ESE Pr: 6Hrs)=100	**Pass Marks =45**

Instruction to Question Setter:
End Semester Practical Examination (ESE Pr):

The questions in practical examination will be of equal to 70 marks and will be so framed that the students are able to answer them within the stipulated time. 20 marks will be awarded on the performance in viva voce whereas 10 marks will be awarded on cumulative assessment which is further subdivided as 5 marks for Practical record and 5 marks for Attendance.

Note:
(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

ENTOMOLOGY PRACTICAL –IV **Practical: 60Hours**

End Term (External) Assessment

Scheme of examinations **Time: 6Hrs**

Items		Marks Distribution
Adapting feature of aquatic/Semiaquatic/terrestrial insects		10
Temporary mounting of any body parts of insects		10
Calculation of species diversity of insects by shnnon-weiner index from generated data		10
Taxonomic description of a member of any order studied		10
Pest studies/life cycle of beneficial insects		10
Spotting	(2x10)	20
Records and Sessional work		10
Viva voce		20

List of Practicals

Taxonomy description & identification of following order:
Orthoptera, Dictyoptera, Hemiptera, Hymenoptera, Diptera, Coleoptera & Lepidoptera.
Study of permanent slides of body parts.
Study of Histological slides.
Pest study on affected objects.
Life history of beneficial insects like- lac & tasar.
Study of parasites, predators, parasitoids & pattrogens.
Embryological study through Drosphila culture.
Study of adaptive features in some order of insects.
Minor dissection: Temporary mounting of special type of mouth parts, wings, legs, ovpositer, Sting apparatus antennae- adaptation – arista.
Calculation of species diversity by Shannon-weiner index from generated data
Study of the external morphology of an insect, wings, haltere, elytra
Study of the adaptive feature of terrestrial and aquatic insects
Study of parasitic insects (Fleas and Lice)
Study of the mouthparts of the representative of the order: Orthoptera, Dictyoptera, Hemiptera, Lepidoptera and Hymenoptera.
Study of respiratory structure of terrestrial, semi-aquatic and aquatic insects.
Study of the life cycles of Termites, Honeybee, Mosquitoes.

OR

GE/DC PRACTICAL [EPZOO403C]: (Credits: Practical-05)

Marks: 30 (ESE: 20 Viva + 5Attd. + 5 Record) + 70 (ESE Pr: 6Hrs)=100	**Pass Marks =45**

Instruction to Question Setter:
End Semester Practical Examination (ESE Pr):

The questions in practical examination will be of equal to 70 marks and will be so framed that the students are able to answer them within the stipulated time. 20 marks will be awarded on the performance in viva voce whereas 10 marks will be awarded on cumulative assessment which is further subdivided as 5 marks for Practical record and 5 marks for Attendance.
Note:
(Attendance Upto75%, 1mark; 75<Attd.<80, 2 marks; 80<Attd.<85, 3 marks; 85<Attd.<90, 4 marks; 90<Attd, 5 marks).

ECOLOGY PRACTICAL –IV **Practical: 60Hours**

End Term (External) Assessment

Scheme of examinations **Time: 6Hrs**

Items	Marks Distribution
Water analysis	10
Soil analysis	10
Biotic analysis	10
Bio-statistical analysis	15
Adaptation Study Spotting (5 X 3)	15
Records and Sessional work	10
Viva voce	20

List of Practicals

Water Analysis

Estimation of BOD of sample
Estimation of Carbonate, Bicarbonate and Hydroxide & chloride in sample water
Estimation of hardness & Oxygen and Carbon of sample water
Estimation of Magnesium and Calcium in sample water

Soil Analysis

Estimation of OMC / Total Carbon of a soil sample
Estimation of $CaCO_3$ in a soil sample
Estimation of soil respiration rate in a sample

Biotic Analysis

Sampling and identification of freshwater planktons.
Qualitative, quantitative assessment and working of Indices of diversity and dominance of Plankton, Benthos, Soil fauna, Soil microbes

Biostatistical Analysis

Analysis of correlation coefficient and simple linear regression in a set of data
Estimation of density and relation frequency by quadrate analysis
Analysis of similarity index in the species composition by 2X2 contingency table

Adaptation study

Aquatic insects, Terrestrial Insects, Freshwater fish (Hill Stream fish)
Marine fish & Higher Vertebrates
Ecological Equipments
Ecological significance of plants and earthworm
Identification of Aquatic plants and Bioindicator Species

IV. CORE COURSE (PROJECT) [PRZOO404]: (Credits: 05)

Marks : 100 (ESE: 3Hrs)=100	Pass Marks =45

Guidelines to Examiners for

End Semester Examination (ESE):

Overall project dissertation may be evaluated under the following heads:

- *Motivation for the choice of topic*
- *Project dissertation design*
- *Methodology and Content depth*
- *Results and Discussion*
- *Future Scope & References*
- *Participation in Internship programme with reputed organization*
- *Application of Research technique in Data collection*
- *Report Presentation*
- *Presentation style*
- *Viva-voce*

PROJECT WORK

Each student has to submit two copies of the dissertation work duly forwarded by the HOD of Department concerned. The forwarded copies will be submitted in the Department of Zoology, Ranchi University, for evaluation (Seven days before the seminar).

The paper will consist of

(a) Field work/Lab work related to the project.
(b) Preparation of dissertation based on the work undertaken.
(c) Presentation of project work in the seminar on the assigned topic in the P.G. Department of Zoology, Ranchi University, Ranchi & open viva there on.

Topics

Project work related to the following Industrial/socially relevant topics may be given.

NB:- Students will select topics for the project work in consultation with a teacher of the department. The Seminar will be held in the Department of Zoolgy, Ranchi University, Ranchi.

RECOMMENDED READINGS

INVERTEBRATE BIOLOGY

- Barrington E.J.W. - Invertebrate structure and function. 2nd edn. ELBS/Nelson 1973
- Meglitsch P.A. & Schram F.R. - Invertebrate Zoology. 3rd edn. Oxford Univ Press 1991
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- Carleton H.M. & Short R.M.D. – Schafer's Essential of Histology: Descriptive and Practical. 16th edn. Longmans Green 1954
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INSTRUMENTATION

- Ambrose E.J. & Easty D.M. – Cell Biology. ELBS/ Nelson 1973
- Skoog D.A., Holler F.J. & Crouch S.R. – Principle of Instrumental Analysis. 6th edn. Thomson 2007
- Narayanan P. – Essentials of Biophysics. New Age 2000
- Roy R.N. – Biophysics
- Tembhare D.B. – Techniques in Life Sciences. Himalaya 2008
- Willard H.H., Merritt Jr. L.L., Dean J.A. & Settle Jr. F.A. – Instrumental Methods of Analysis. 6th edn. CBS 1986

QUANTITATIVE BIOLOGY

- Zar J.H. – Biostatistical Analysis. 4th edn. Pearson 2005
- Khan I.A. & Khanum A. – Fundamentals of Biostatistics 2nd edn. Ukaaz Publ. 2007
- Pagano M. & Gauvreau K. – Principles of Biostatistics. 2nd edn. Thomson 2007
- Sundar Rao P.S.S. & Richard J. – An Introduction to Biostatistics. 4th edn. PHI 2006
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DISTRIBUTION OF CREDITS FOR P.G. PROGRAMME (SEMESTER-WISE) FOR POSTGRADUATE **'P.G. Voc./M.Sc./M.A./M.Com'** PROGRAMME

Table B-1: Semester wise distribution of 80 Credits for Subjects with Practical Papers.

Semester	CC	FC	GE/DC	AE	Total credits
Semester I	15	05			20
Semester II	20				20
Semester III	15			05	20
Semester IV	5		15		20
	55	**05**	**15**	**05**	**80**

Table B-1: Semester wise distribution of 80 Credits for Subjects without Practical Papers.

Semester	CC	FC	GE/DC	AE	Total credits
Semester I	15	05			20
Semester II	20				20
Semester III	15			05	20
Semester IV	10		10		20
	60	**05**	**10**	**05**	**80**

CC=Core Course; FC=Foundation Compulsory/Elective Course; GE=Generic Elective; SE=Skill Enhancement Course; DC=Discipline Centric Elective

SAMPLE CALCULATION FOR SGPA & CGPA FOR POSTGRADUATE **'P.G. Voc./M.Sc./M.A./M.Com'** PROGRAMME

Table B-2: Sample calculation for SGPA for M.Sc./M.A./M.Com Programme

Course	Credit	Grade Letter	Grade Point	Credit Point (Credit X Grade)	SGPA (Credit Point/Credit)
Semester I					
FC	05	A	8	40	
C-1	05	B+	7	35	
C-2	05	B	6	30	
C-3/CP	05	B	6	30	
Total	**20**			**135**	**6.60 (135/20)**
Semester II					
C-4	05	B	6	30	
C-5	05	C	5	25	
C-6	05	B+	7	35	
C-7/CP	05	A+	9	45	
Total	**20**			**135**	**6.60 (135/20)**
Semester III					
EC-1	05	A+	9	45	
C-8	05	0	10	50	
C-9	05	A	8	40	
C-10/CP	05	A	8	40	
Total	**20**			**175**	**8.75 (175/20)**
Semester IV					
EC-2/EC-2	05	B	6	30	
EC-3/EC-3	05	A+	9	45	
C11/EP	05	B	6	30	
Project	05	A+	9	45	
Total	**20**			**150**	**7.50 (150/20)**
CGPA					
Grand Total	**80**			**595**	**7.44 (595/80)**

Table B-3: Sample calculation for CGPA for P.G. Vocational M.Sc./M.A./M.Com Programme

Semester I	Semester II	Semester III	Semester IV
Credit:20; SGPA:6.60	Credit:20; SGPA: 6.60	Credit:20; SGPA: 8.75	Credit:20; SGPA: 7.50

Thus CGPA= (20x6.60+20x6.60+20x8.75+20x7.50) /80**=7.36**

DISTRIBUTION OF MARKS FOR EXAMINATIONS AND FORMAT OF QUESTION PAPERS

Distribution of Marks for Mid Semester Evaluation:

Table No. 15: Distribution of marks of Theory Examinations of Mid Semester

Topic	Code	Full Marks	Pass Marks	Time	Group-A (Very short answer type Compulsory Questions) No. of Questions x Marks = F.M.	Group-B (Descriptive Questions) No. of Questions x Marks = F.M.	Total No. of Questions to Set	
							Group A	Group B
Mid Sem*	T30*	30 (20 +5 +5)	17	1 Hr	5 x1 =5	3 (out of 5) x5 =15	05	5

***There shall be 20 marks theory examination for mid sem, 05 marks for attendance/ regular interactions & 05 marks for seminar/ assignment/ term paper given by faculty concerned in classrooms.**

Distribution of Marks for End Semester Theory Examinations:

Table No. 16: Marks distribution of Theory Examinations of End Semester

Topic	Code	Full Marks	Pass Marks	Time	Group-A# (Very short answer type Compulsory Questions) No. of Questions x Marks = F.M.	Group-B (Descriptive Questions) No. of Questions x Marks = F.M.	Total No. of Questions to Set	
							Group A#	Group B
End Sem	T50	50	--	3 Hrs	2 x5 =10	2 (out of 3) x20 =40	2	3
	T70	70	28	3 Hrs	Q.No.1 (5x1) + 1x5 =10	4 (out of 6) x15 =60	2	6

 # Question No.1 in Group-A carries very short answer type questions of 1 Mark

Note : There may be subdivisions in each question asked in Theory Examinations.

FORMAT OF QUESTION PAPER FOR MID SEM EXAMINATION

20 MARKS

Ranchi University, Ranchi

Mid Sem No. Exam Year

Subject/ Code

F.M. =20 **Time**=1Hr.

General Instructions:
समान्य निर्देश :

i. **Group A** carries very short answer type compulsory questions.
(खंड 'A' में अत्यंत लघु उत्तरीय अनिवार्य प्रश्न हैं।)
ii. **Answer 3 out of 5** subjective/ descriptive questions given in **Group B**.
(खंड 'B' के पाँच में से किन्हीं तीन विषयनिष्ठ/ वर्णनात्मक प्रश्नों के उत्तर दें।)
iii. Answer in your own words as far as practicable.
(यथासंभव अपने शब्दों में उत्तर दें।)
iv. Answer all sub parts of a question at one place.
(एक प्रश्न के सभी भागों के उत्तर एक साथ लिखें।)
v. Numbers in right indicate full marks of the question.
(पूर्णांक दायीं ओर लिखे गये हैं।)

Group A

1. ..... [5x1=5]
2. .....
3. .....
4. .....
5. .....

Group B

6. ..... [5]
7. ..... [5]
8. ..... [5]
9. ..... [5]
10. ..... [5]

Note: There may be subdivisions in each question asked in Theory Examination.

FORMAT OF QUESTION PAPER FOR END SEM EXAMINATION

50 MARKS

Ranchi University, Ranchi

End Sem No. Exam Year

Subject/ Code

F.M. =50

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 2 out of 3** subjective/ descriptive questions given in **Group B**.
(खंड 'B' के तीन में से किन्हीं दो विषयनिष्ठ / वर्णनात्मक प्रश्नों के उत्तर दें।)
iii. Answer in your own words as far as practicable.
(यथासंभव अपने शब्दों में उत्तर दें।)
iv. Answer all sub parts of a question at one place.
(एक प्रश्न के सभी भागों के उत्तर एक साथ लिखें।)
v. Numbers in right indicate full marks of the question.
(पूर्णांक दायीं ओर लिखे गये हैं।)

Group A

1. ..... [5]
2. ..... [5]

Group B

3. ..... [20]
4. ..... [20]
5. ..... [20]

Note: There may be subdivisions in each question asked in Theory Examination.

FORMAT OF QUESTION PAPER FOR END SEM EXAMINATION

70 MARKS

Ranchi University, Ranchi

End Sem No. Exam Year

Subject/ Code

F.M. =70 **P.M.**=28 **Time**=3Hrs.

General Instructions:

i. **Group A** carries very short answer type **compulsory** questions.
ii. **Answer 4 out of 6** subjective/ descriptive questions given in **Group B**.
(खंड 'B' के छः में से किन्हीं चार विषयनिष्ठ / वर्णनात्मक प्रश्नों के उत्तर दें।)
iii. Answer in your own words as far as practicable.
(यथासंभव अपने शब्दों में उत्तर दें।)
iv. Answer all sub parts of a question at one place.
(एक प्रश्न के सभी भागों के उत्तर एक साथ लिखें।)
v. Numbers in right indicate full marks of the question.
(पूर्णांक दायीं ओर लिखे गये हैं।)

Group A

1. [5x1=5]

i. .....
ii. .....
iii. .....
iv. .....
v. .....

2. ..... [5]

Group B

3. ..... [15]
4. ..... [15]
5. ..... [15]
6. ..... [15]
7. ..... [15]
8. ..... [15]

Note: There may be subdivisions in each question asked in Theory Examination.