RANCHI WOMEN'S COLLEGE, RANCHI SYLLABUS

M.Sc ZOOLOGY

Choice Based Credit System

(2016-2018)

Department of Zoology, Ranchi University, Ranchi Syllabus for M.Sc. Zoology (Semester with credit based pattern) we f 2016-18 Academic Session

Semester wise Distribution of Courses

M.Sc. Programme

| Course Structure for M.Sc. Programme | | | | | |
|--------------------------------------|-----------------------------|--------|--------------------|--|--|
| Semester | Courses | Credit | Hrs./week | | |
| I | FC (Compulsory) – (FC-1) | 5 | 5(L) + 1(T) | | |
| • | Core Course- 1 (CC-1) | 5 | 5(L) + 1(T) | | |
| | Core Course-2 (CC-2) | 5 | 5(L) + 1(T) | | |
| | Core Course(P)-3 [CC (P)-3] | 5 | 10 | | |
| II | Elective Course (SE) (EC-1) | 5 | 5(L) + 1(T) | | |
| ** | CC - 4 | 5 | 5(L) + 1(T) | | |
| | CC - 5 | 5 | 5(L) + 1(T) | | |
| | CC (P) -6 | 5 | 10 | | |
| III | CC - 7 | 5 | 5(L) + 1(T) | | |
| *** | CC - 8 | 5 | 5(L) + 1(T) | | |
| | Elective (GE/DC) (EC-2) | 5 | $\int 5(L) + 1(T)$ | | |
| | Core Course (P) – 9 | 5 | 10 | | |
| īV | CC - 10 | 5 | 5(L) + 1(T) | | |
| • | Elective (GE/DC) (EC-3) | 5 | 5 (L) + 1(T) | | |
| | EC - 4(P) | 5 | 5(L) + I(T) | | |
| | Project work | 5 | 10 | | |

Note: GE- Generic Elective

DC - Discipline Centric
EC - Elective Course
FC - Foundation Course
CC - Core Course

(P) – Practical ESUE- End Semester University Examination

SIA - Sessional Internal Assessment

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Ranchi University, Ranchi

Syllabus for M.Sc. Zoology (Semester with choice based credit pattern) w.e.f. 2016-2018 academic session. COURSE STRUCTURE

| M. Sc. Zoology Semester I (ZOOL) | | | | | | | | | |
|----------------------------------|---|----------|---------------|--------|-----------------------|---|-----------------------------|------------|------------|
| | | | | | Examination Scheme | | | | |
| Code | Theory/ Practical | | eme Practical | Credit | Hours / Week | Internal (SIA) 1 hour. | External (ESUE) 3hrs. | Full marks | Pass marks |
| FC -1 (Compulsory) | Systematics Evolution Bioinformatics | 1 | | 5 | 5(L) + 1(T) | 20 (exam) 05 (assign.) 05 (perform.) | 70 | 100 | |
| (Core course- 1) | Invertebrate Structure & Function Quantitative biology | ~ | | 5 | 5(L) + 1(1) | 20 (exam) 05 (attend.) 05 (perform.) | 70 | 100 | |
| CC-2 (Core course-2) | Biotechniques Histology & Histochemistry | ~ | v | 5 | 5(L) + !(T) | 20 (exam) 05 (attend.) 05 (perform.) | 70 | 100 | |
| CC(P)- 3 (Core course P- 3) | Practical based on theory papers- CC1 and CC2. | | V | 5 | 10 | | 80 (Pt.) 20 (viva) | 100 | |
| | TOTAL | Three | One | 20 | 28 | 90 | 310 | 400 | |

A total of eight questions will be asked in each course in ESUE. Question 1 will be of short answer type and compulsory. From the rest seven questions, any four are to be answered.

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A total of eight questions will be asked in each course in ESUE. Question 1 will be of short answer type and compulsory. From the rest seven questions, any four are to be answered.

| M. Sc. Zoology Semester II (ZOOL) | | | | | | | | | |
|-------------------------------------|---|-----------------|-------|--------|--------------------|---|-----------------------------|-----|------------|
| | cal | Teaching scheme | | | Examination Scheme | | | | |
| Code | Theory/ Practical | | | Credit | Hours / Week | Internal (SIA) I hour. | External (ESUE) 3hrs. | | Pass marks |
| EC - 1 (Elective course- EC1) | Cell biology, Molecular biology, Microbiology | ✓ | | 5 | 5(L) + 1(T) | 20 (exam) 05 (assign.) 05 (perform.) | 70 | 100 | |
| CC-4 (Core course-4) | Vertebrate diversity, Ethology Classical Genetics | · | | 5 | 5(L) + 1(T) | 20 (exam) 05 (assign.) 05 (perform.) | 70 | 100 | |
| CC- 5 (Core course- 5) | Environment al and general vertebrate physiology | * | | 5 | 5(L) + 1(T) | 20 (exam) 05 (assign.) 05 (perform.) | 70 | 100 | |
| CC(P)-6 (Core Course P-6) | Practical based on theory papers CC4, CC5 | | ✓ | 5 | 10 | | 80 (Pt.) 20 (viva) | 100 | |
| | TOTAL | Three | , One | 20 | 28 | 90 | 310 | 400 | |

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A total of eight questions will be asked in each course in ESUE. Question 1 will be of short answer type and compulsory. From the rest seven questions, any four are to be answered.

| | Zoology Semester II | I (ZGOL) | | | | Fyar | ni 1ation | | |
|----------------------------|--|----------|----------|--------|-----------------------|---|-----------------------------|------------|------------|
| Code | Theory/ Practical | | g scheme | Credit | Hours/ Week | Internal(SIA) I hour. | External (CESUE) 3hrs. | Full marks | Pass marks |
| CC - 7 (Core course- 7) | Endocrinology Developmental biology | ~ | | 5 | 5(L) + 1(T) | 20 (exam) 05 (assign.) 05 (perform.) | 70 | 100 | |
| CC-8 (Core course- 8) | Biochemistry Biomolecules and Metabolic regulations Immunology | ~ | | 5 | 5(L) + 1(T) | 20 (exam) 05 (assign.) 05 (perform.) | 70 | 100 | |
| EC-2 (Elective course- | Fish and Fisheries Entomology Ecology | * | | 5 | 5(L) + 1(T) | 20 (exam) 05 (assign.) 05 (perform.) | 70 | 100 | |
| CC-P-9 | Practical based on theory paper CC-7 & CC-8 | | * | 5 | 10 | | 80 (Pt.) 20 (viva) | 100 | |
| | | Three | One | 20 | 28 | 90 | 310 | 400 | |

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A total of eight questions will be asked in each course in ESUE. Question 1 will be of short answer type and compulsory. From the rest seven questions, any four arc to be answered.

| M. Sc. Z | cology Semeste | r IV (ZO | OL) | | | 12 | | | |
|----------------------------------|--|-----------------|------------------|--------|-------------------|--|--|------------|------------|
| Code | Theory/ Practical | Teaching scheme | | Credit | Hours/ Week | Internal(SIA) 1 hour. | External (ESUE) 3nrs. applications of a solid property) | Full marks | Pass marks |
| ! | The | Theory | Practical | | - | Inte 1 ho | External | Full | Pass |
| CC – 10 (Core course- 10) | Mammalian Reproductive Physiology Biotechnology | √ | | 5 | 5(L) + 1(T) | 20 (exam) 05 (assign.) 05 (perform) | 70 | 100 | |
| EC-3 (Elective course-GE/DC) | Fish and Fisheries Entomology Ecology | √ | | 5 | 5(L) + 1(T) | 20 (exam) 05 (assign.) 05 (perform) | 70 | 100 | |
| EC(P)- 4 (Elective course-GE/DC) | Practical based on theory paper EC2 &EC3 | | , | 5 | 5(L) + 1(T) | | 80 (Pt.) 20 (viva) | 100 | |
| PROJECT WORK | | | · | 5 | 10 | | 80 (ESUE) + 20 (viva) to be conducted by external and supervisor | 100 | |
| | | One | One + Project | 25 | 28 | 60 | 340 | 400 | |

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M. Sc. Zoology Semester I (ZOOL)

FC-1 Foundation course (Compulsory)

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 $\mathcal{Q}_{\mathcal{Q}}$ Systemic hierarchy, names, codes

- Operative principles of nomenclature, application of important rules

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,

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 - PERU

M. Sc. Zoology Semester I (ZOOL)

CC-1 (Core course)

Invertebrate Diversity

Trochophore larva and Protostomates

Origin of coeloin - Acoela, Pseudocoela, Schizocoela and Enterocoela.

O (Deuterostomate groups

Locomotion: Cilia, Flagella - Protozoa

Hydrostatic movement - Cnidarian, Annelida and Echinoderm with reference to

Locomotion

Origin of Segmentation

Excretion and Osmoregulation: Osmoregulation in Protozoa

Nephridia and Coelomic System in Annelids

Excretion in Arthropods

Respiration: Arthropods, Mollusca

Concept of Host specificity and Host parasite relationship

Quantitative biology

Biostatistics: Samples and population, sampling designs

Probability distributions and their properties: Normal, Binomial, Poissen 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

M. Sc. Zoology Scmester J (ZOOL)

CC-2 (Core course)

Biotechniques

Analytical instruments: Spectrophotometer

Spectroscopy - Atomic Absorption, ESR and NMR Spectroscopy, Microscopy and Cryotechnique-Scanning and Transmission electron microscopes, Fluorescence microscopy

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

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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.

M. Sc. Zoology Semester 1 (ZOOL)

CC(P)-3(Core course P-3)

Practical based on theory papers CC1 and CC2.

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Scheme of examinations

End term (external) assessment

Exam Duration: 3.00 hrs

Full Marks: 80+20

ITEMS

MARKS DISTIRBUTION

| Anatomical observation | (2x10) | 20 |
|--|-------------------|----|
| Preparation of permanent slide | (whole mount + 1) | 10 |
| Trimming and cutting of paraffin block/ Sprea | ading and | |
| stretching of paraffin sections/ micrometric m | | |
| of the given sample | | 05 |
| Histochemical staining of the material provid | ed | 05 |
| Spotting [slides 05, museum specimens 05] | (10×2) | 20 |
| Records and Sessional work | | 20 |
| Viva voce | | 20 |

List of Practicals

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 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, Chactopterus, Hirudo

Arthropods - Sacculina on crab, Crab, Prawn, Lepus, Balanus, Butterfly, Water beetle,

Cycleps

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

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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 Glucese in a test solution by spectrophotometer/ auto-analyzer

Demonstration of P.C.R. technique

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 moicties using PAS, Alcian blue at different pH

lipids using Sudan black B, Sudan III, Sudan IV methods

Bioinformatics

Use of search engines

Use of data bases - Gene Bank, PubMeD.

Demonstration of software packages – BLAST and CLUSTUL

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M. Sc. Zoology Semester II (ZOOL)

EC - 1(Elective course-SE)

Cellular and Molecular biology

Biomembranes and cell matrix adhesion

Cell Cycle: Mitosis and Meiosis Protein Synthesis and trafficking

Cell Signalling and Cell-Cell Interactional B

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 Regulation. Translational Proof reading. Translational Inhibitors. Post Translational modification of Protein.

Control of Gene Expression in Prokaryotes: Operon Concept, Lac Operon, Catebolite Repression, Tryptophan Operon and Arabinose Operon.

Control of Gene Expression in Eukaryotes: Conserved Mechanisms in Transcriptional

regulation, Alternative splicing Gene Silencing: By Modification of Histone and DNA, RNA Interference (RNAi): A Major Regulatory Mechanism in Eukaryotes.

Microbiclogy

Pathogenic microbes: HIV, Rabies, Prions, Viroids, H₁N₁

Antibiotics & their mode of action Vaccine preparation methodology

Environmental Microbiology: Bioremediation, Sewage treatment, Biofertilizers.

M. Sc. Zoology Semester II (ZOOL)

CC - 4(Core course)

Vertebrate Diversity

M.K (Neomorphic air breathing organs in fish Electric organ & Electro-Receptors in lishes

Organs of Distance Touch Orientation in fishes

Reproductive adaptations - Internal fertilization, Viviparity

- Paedomorphosis and neoteny. MEndocrine control of metamorphosis of the tadpole

M.K. 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

m.k. Dentition in mammals, Aquatic mammals.

Ethology.

General concepts of Ethology:

Motivation

Fixed Action Pattern

Sign or key stimulus or releasers

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,

/ Wildlife behaviour —

| Reproductive behaviour -

Orientation in animals - its nature and types

Biological rhythms - occurrence and significance:

Classical Genetics

Extension of Mendelian principles – codominance, incomplete dominance, gene interactions, pleiotropy, sex limited and sex influenced characters

Gene mapping – linkage maps, with molecular markers, using somatic cell hybrids

Extra chromosomal inheritance – inheritance of mitochondrial and chloroplast gene

M. Sc. Zoology Semester II (ZOOL)

CC-5 (Core course)

Environmental Physiology

Elementary idea of stress and strain

Adaptation

Fundamental mechanisms of adaptation

Physiological responses to exposure to celd, 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 endothern to extreme hot &

extreme cold.

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Excretion/Osmoregulation

Patterns of excretion, organs of excretion.

Physiology of Urine formation.

Problems of salt balance in aquatic vertebrates, marine air breathing vertebrates, and terrestrial vertebrates.

General Vertebrate Physiology

Respiration: Respiratory pigments in animals, Transport of gases

O2 dissociation curve, Bohr's effect, Root effect

CO2 transport, CO2 equilibrium curve, Regulation of acid base balance

Hb and associated diseases: sickle cell Anemia & Thalassemia, Neural and

chemical regulation of respiration

Cardio-Vascular System

Contractibility / Motility

Vertebrate Striated Muscle & Its Structure.

Contractile proteins & mechanism of their contraction

Nervous system

Origin and differentiation of neurons

Electrical potentials of Neurilemma and its molecular basis

Motor neurons in vertebrates

Propagation of impulses along myelinated nerves

Neurotransmitters

Autonomic nervous system

M.Sc. Zoology Semester I! (ZOOL)

CC(P)-6 (core course P-6)

Practical based on theory papers CC4 & CC5

Scheme of examinations

End term (external) assessment

Exam Duration: 3.00 hrs

Full Marks: 80+20

MARKS DISTIRBUTION **ITEMS**

Anatomical observation

 (2×10)

20

Physiology experiments - 2

 (2×10)

20

Colorimetric estimation [Protein/ Glucose/ Cholesterol/ Triglyceride/ Na/ K/

Mg/ DNA/ RNA] - 1

20

Records and Sessional work

Viva voce

List of Practicals

vertebrate diversity

Anatomical observation of:

Accessory respiratory organs in fish-Channa, Heteropneustes, Clárias, 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, Cheionia, Snake, Dentition in mammals

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

EC-1 (Mid term Practical based on Theory Paper FC-1)

| | Total Marks – 20 |
|--|--|
| ITEMS | 3 marks |
| 1. Microbiology | 3 marks |
| 2. Moiecular biology | 3 marks |
| 3. Ceil Biology | |
| 4. Spotting (2 slides- Bacteria & 2 slides n | BROSIS & ITIETOSIS) (17.7) |
| 5. Records | ,— O Finalks |
| 6. Viva- voice | 4 marks |
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List of Practical

Microbiology

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

Molecular Biology

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

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.

Cocoo Haller Short Mills

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M.Sc. Zoology Semester III (ZOOL)

CC -7(Core course-7)

Unit A: Comparative and molecular endocrinology

• Chemical messengers, hormones and mechanism of their action Life history a 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 and their hormones

Adenohypophysis

Neurohypophysis

Thyroid

Adrenal

Functions of the hormones secreted from -Hypothalamus (mammals only)

Urophysis

Parathyroid

Ultimobranchial glands

Corpuscles of Stannius

Interrenal and chromaffin cells

Gut endocrine cells, endocrinology of hunger and satiate

Kidney

Heart

Thymus

Physiological Endocrinology: Endocrinology of calcium regulation Endocrinology of osmoregulation

Unit B: 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)

Post-embryonic Development: Metamorphosis - Anuran and Insect

Regeneration: morphallaxis and epimorphosis

Sex determination in Bonellia; Arrhenotoky

M.Sc. Zoology Semester III (ZOOL)

CC-8(Core course - 8)

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 bases

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

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 pressentation

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 antibo

Immunoglobins: Ig genes, Differential expression of Ig genes

M.Sc Zoology semester III (ZOOL)

EC-2 (Elective course GE/DC)

❖ 1. Fish and Fisheries

- Nutritional value and economic importance of fishes: brief account of byproducts
 - ppAquaculture Definition and classification
 - Outlines of fish culture in ponds
 - Ornamental fishes, larvivorous fishes
 - OClassification of living fishes up to orders
 - 3 Freshwater and important marine fishes of India
 - Adaptations in teleosts hill stream, cave dwelling, nantifreeze, colouration, bioluminescence
 - Migratory behaviour in fishes
 - Locomotion in teleosts
 - Aquatic respiration in teleosts 40 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

M.Sc Zoology semester III (ZOOL)

EC-2 (Elective course-GE/DC)

2.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 Colcoptera

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, raicro-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 theremones

M.Sc Zoology semester III (ZOOL)

EC-2 (Elective course-GE/DC)

❖ 3.Ecology

Lindeman's Trophic Dynamic concept, Energy Flow in Ecosystem, Food chain, Food web, Food pyramid Concept of Limiting Factor: Shelford's Law of Folerance, Leibig's Law of Minimum

Fundamentals of Limnology: Origin and Classification of Lakes, Types and significance of Freshwater Biota.

Major Biomes of the world: Marine system, Forests, Tundra, Taiga, Grassland Water, Bioremediation, Biosensors, Bioaccumulation, Pollution Ecology: Air, Biomagnification

Population attributes,

Community Ecology: Component, Analytical and synthetic characters Biodiversity: Status, monitoring and documentation, Major factors for biodiversity changes, Biodiversity management approaches

- Basic Ecology Concept of Productivity: Primary, Secondary and Tertiary; Factors and Methods of measurement Concept of Ecological Niche: Niche Overlap, Niche Breadth, Ecological Release and Ecological Compression.
- Biome Ecology Physico-chemistry and Biological Characteristics of Freshwater and Marine System Characteristics of Desert, Grassland and Forest Biomes. Desert adaptation
- Population & Community Ecology Population Growth: Exponential, Sigmoid, Time lag Model, Stochastic Model Competition: Inira and Interspecific competition, Competitive ability, Lotka & Volterra models for competing species. Tillman's model. Natural Regulation of Population: Theories and Model for Population Regulation Community Ecology: Ecological Dominants, Species Diversity, Ecotypes and Ecotone, Edge Effect, Periodicity (Seasonal, Lunar and Diel)

M.Sc Zoology Semester III (ZOOL)

CC P -9 (Core course -9) Practical based on Theory Papers CC 7 & CC 8 Scheme of examinations

End term (external) assessment

| | | Exam Duration: 3.00 hrs |
|-----------------------|---------|-------------------------|
| | | Full Marks: 80+20 |
| | | MARKS DISTIRBUTION |
| ITEMS | | 10 |
| Endocrinology | • | 10 |
| Developmental Biology | (2x10) | 20 |
| Biochemistry | (2/11) | 10 |
| Immunology | (2x10) | 20 |
| Spotting | (2.110) | 10 |
| Records | | 20 |
| Viva voce | | |

List of Practical

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.

Development Biology

Study of permanent slides of: -

- Different stages of development in frog (cleavage, biastula, 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)

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

Immunology

Study of permanent slices: Thymus, Spleen, lymph node

Antigen antibody interaction (Blood group analysis)

Collection of serum & plasma

Blood film preparation and identification of cell types

Demonstration of ouch erlony double diffusion (ODD)

M.Sc. Zoology Semester IV (ZOOL)

Core course – 10 (CC10)

Mammalian Reproductive Physiology & Biotechnology

Unit A:

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

Biotechnelogy

Unit B:

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: Monocional antibody production

Gene Therapy

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M.Sc. Zoology Semester IV (ZOOL)

EC - 3 (Elective course GE/DC)

Fish and Fisheries

Cultivable water - quality and quantity

- Physical and chemical properties of water influencing fish culture
- Natural food for fish in pond
- ${\mathfrak H}^{{\overline{{\mathcal P}}}}$ Role of plankton, blooms and benthos in fish culture
 - AFertilizers 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

S 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.

M.Sc. Zoology Semester IV (ZOOL)

EC - 3 (Elective course GE/DC)

Entomology

R LEcological 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 (Chemosterilan

Attractants, Repellants, Antifeedants and Pheromones.

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M.Sc. Zoology Semester IV (ZOOL)

EC - 3 (Elective course GE/DC)

Ecology

Pollution Ecology

Water Pollution; Types and sources of Pollution

Biodegradable and Non degradable Pollutants

Eutrophication Air Pollution:

Sources and Effects of Air Pollutants

Ecotoxicology

Toxic and Xenobiotics

Routes and rate of administration

Environmental and behavioral factors affecting Toxicity

Effect and Response

Synergism and Antagonism

Basic Principle of Dose Response

Mechanism of action and Biotransformation of Toxicants

Translocation of Toxicants

Antidotes

Toxicity Tests

M.Sc Zoology Semester IV (ZOOL)

EC(P) - 4 (Elective Course GE/DC)

Practical based on theory papers EC 2 & EC 3

Ecology Special

Scheme of examinations

End term (external) assessment

Exam Duration: 3.00 hrs Full Marks: 80+20 **ITEMS** MARKS DISTIRBUTION Water analysis 10 Soil analysis 10 Biotic analysis 10 Bio-statistical analysis 15 Adaptation Study Spotting (5 X 3) 15 Records and Sessional work 20 Viva voce 20

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List of Practical

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 CaCO3 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

M.Sc Zoology Semester IV (ZOOL)

EC(P) - 4 (Elective Course GE/DC)

Practical based on theory papers EC 2 & EC 3

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Fish Special

Scheme of examinations

End term (external) assessment

Exam Duration: 3.00 hrs Full Marks: 80+20

ITEMS

MARKS DISTIRBUTION

| Anatomical observation Gut analysis and determination of feeding habit Temporary slides | 10 10 10 | |
|---|----------------|--|
| 4. Spotting - 5 [Representative of major classes - 1, histological slides - 1, | | |
| Endocrine section - 1, fish showing adaptation - 1, exotic/ornamental/larvivorous fish-1) | 15 | |
| 5. Plankton identification | 5 | |
| 6. Taxonomic identification of fresh water fishes (2x5) | 10 | |
| 7. Fish showing adaptive feature (2x5) | 10 | |
| 8. Records and Sessional work | 10 | |
| 9. Viva voce | 20 | |

List of Practical

Anatomical observation of a bony fish:

General anatomy, Digestive system of herbivors 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

Even Duration: 3 00 hre

M.Sc Zoology Semester IV (ZOOL)

EC(P) - 4 (Elective Course GE/DC)
Practical based on theory papers EC 2 & EC 3

Entomology Special

Scheme of examinations

End term (external) assessment

| | Exam Defauon, 7.00 ms |
|---|-----------------------|
| | Full Marks: 80+20 |
| ITEMS | MARKS DISTIRBUTION |
| 1. Adapting feature of aquatic/Semiaquatic/terrestrial insects | 10 |
| 2. Temporary mounting of any body parts of insects | 05 |
| 3. Calculation of species diversity of insects by shnnon-weiner index from generated da | ata 05 |
| 4. Taxonomic description of a member of any order studied | 10 |
| 5. Pest studies/life cycle of beneficial insects | 10 |
| 6. Spotting (2x10) | 0) 20 |
| 7. Practical Records | 20 |
| 8. Viva voce | 20 |

List of Practical

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 insents.

Study of the life cycles of Termites, Honeybee, Mosquitoes

Millish

Share Stranger

Recommended Reading

Invertebrate Biology

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Instrumentation

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3. Narayanan P. - Essentials of Biophysics. New Age 2000

4. Roy R.N. - Biophysics

- 5. Tembhare D.B. Techniques in Life Sciences. Himalaya 2008
- 6. Willard H.H., Merritt Jr. L.L., Dean J.A. & Settle Jr. F.A. Instrumental Methods of Analysis. 6th edn. CBS 1986

Quantitative Biology

- 1. Zar J.H. Biostatistical Analysis. 4th edn. Pearson 2005
- 2. Khan I.A. & Khanum A. Fundamentals of Biostatistics 2nd edn. Ukaaz Publ. 2007
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- 2 Sherwood L., Klandorf H. & Yancey P.H. Animal Physiology: From Genes to Organisms. Thomson 2005
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 6 Chaudhuri S.K. Concise Medical Physiology. 5th edn. New Central Agency 2004
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- 10 Talwar G.P. & Srivastava L.M.(edt.) Text Book of Biochemistry and Human Biology. 3rd edn. Prentice Hall India 2003

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