

ORIGINAL

RANCHI WOMEN'S COLLEGE, RANCHI

SYLLABUS

M.Sc ZOOLOGY

Choice Based Credit System

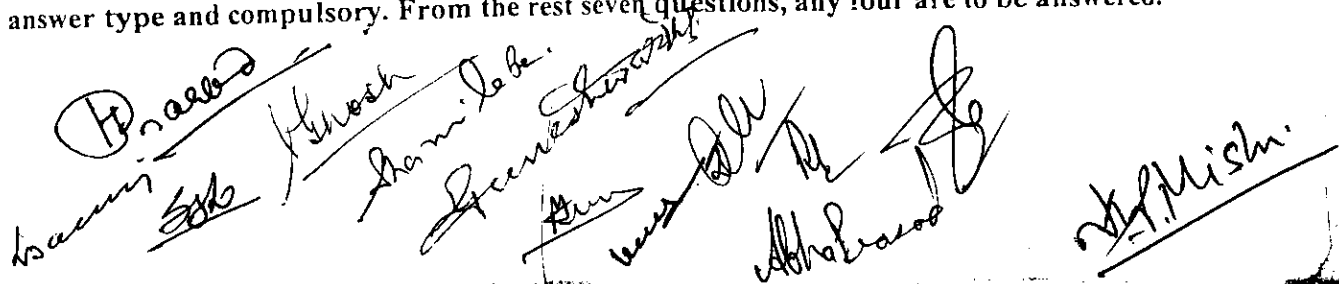
(2016-2018)

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)									
Code	Theory/ Practical	Teaching scheme		Credit	Examination Scheme			Full marks	Pass marks
		Theory	Practical		Hours / Week	Internal (SIA) 1 hour.	External (ESUE) 3hrs.		
FC-1 (Compulsory)	Systematics Evolution Bioinformatics	✓		5	5(L) + 1(T)	20 (exam) 05 (assign.) 05 (perform.)	70	100	
CC-1 (Core course- 1)	Invertebrate Structure & Function Quantitative biology	✓		5	5(L) + 1(T)	20 (exam) 05 (attend.) 05 (perform.)	70	100	
CC-2 (Core course- 2)	Biotechniques Histology & Histochemistry	✓		5	5(L) + 1(T)	20 (exam) 05 (attend.) 05 (perform.)	70	100	
CC(P)-3 (Core course P- 3)	Practical based on theory papers- CC1 and CC2.		✓	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.



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)
 - DD Concept of Cytotaxonomy, Chemical and Molecular taxonomy
 - 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 - PERL

M. Sc. Zoology Semester I (ZOOL)

CC- 1 (Core course)

Invertebrate Diversity

- Trochophore larva and Protostomates
 - Origin of coelom - Acoela, Pseudocoela, Schizocoela and Enterocoela.
- 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

Handwritten notes and signatures:
 Invertebrate Diversity
 Trochophore larva and Protostomates
 Origin of coelom - Acoela, Pseudocoela, Schizocoela and Enterocoela.
 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
 Invertebrate Diversity
 Trochophore larva and Protostomates
 Origin of coelom - Acoela, Pseudocoela, Schizocoela and Enterocoela.
 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
 Invertebrate Diversity
 Trochophore larva and Protostomates
 Origin of coelom - Acoela, Pseudocoela, Schizocoela and Enterocoela.
 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, 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

M. Sc. Zoology Semester I (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

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 I (ZOOL)

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

Practical based on theory papers CC1 and CC2.

Practical

Practical

Practical

Practical

Practical

Practical

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

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

Bioinformatics

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

Handwritten signatures and notes:

Alshah
Alha Prasad
Jhanila Ban
Arshad
Arshad
Arshad
Arshad
Arshad
Arshad

M. Sc. Zoology Semester II (ZOOL)

EC - 1 (Elective course-SE)

Cellular and Molecular biology

- Cell Biology*
- Biomembranes and cell matrix adhesion
 - Cell Cycle: Mitosis and Meiosis
 - Protein Synthesis and trafficking
 - Cell Signalling and Cell-Cell Interactions
 - 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.

Microbiology

- SR*
- 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
- M.K.* Electric organ & Electro-Receptors in fishes
- Organs of Distance Touch Orientation in fishes
- DD* Reproductive adaptations - Internal fertilization, Viviparity
- Amphibian* - Paedomorphosis and neoteny
- M.K.* Endocrine control of metamorphosis of the tadpole
- M.K.* Aerodynamics and energetic of flying and gliding in birds
- M.K.* 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.

Prasad
Sharma
Sharma
Sharma
Sharma
Sharma
Sharma

- 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 DISTRIBUTION

ITEMS		MARKS
Anatomical observation	(2 x 10)	20
Physiology experiments - 2	(2 x 10)	20
Colorimetric estimation [Protein/ Glucose/ Cholesterol/ Triglyceride/ Na/ K/ Mg/ DNA/ RNA] - 1		20
Records and Sessional work		20
Viva voce		20

Prasad
Abha Prasad
Shanika Bar
Green
Prasad
Prasad

List of Practicals**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, *Cheilonia*, 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)

ITEMS

1. Microbiology

3 marks

2. Molecular biology

3 marks

3. Cell Biology

3 marks

4. Spotting (2 slides- Bacteria & 2 slides mitosis & meiosis) (1x4)

4 marks

5. Records

3 marks

6. Viva- voice

4 marks

Total Marks – 20Anand
S.S.S.
AnPrasad
DollyAnand
AlphabandShanika
SureshS. S. S.
S.S.S.

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: Diphenylamine 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.

~~Human~~
~~Egg~~
~~Amn~~
 P. naco
 K. Koch
 Grasshopper
 Onion
 Trypan blue

~~Human~~
~~Egg~~
~~Amn~~
 P. naco
 K. Koch
 Grasshopper
 Onion
 Trypan blue

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

- HP
- 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 gametes, sperm-egg fusion, capacitation, Acrosomal reaction , prevention of polyspermy.

- DD
- Cell differentiation : Myogenesis (skeletal muscle - formation, regeneration and hypertrophy), Differentiation of erythrocytes (Stem cells and their diversification, control of haemoglobin synthesis, erythrocyte membrane)

- NK
- Post-embryonic Development : Metamorphosis – Anuran and Insect

- Regeneration: morphallaxis and epimorphosis
- Sex determination in *Bcnellia*; Arrhenotoky

Prasad
Ammini

Shweta
Anu

Aditya

Alha Prasad

Amila
Parvathi

Umesh

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 quaternary 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 presentation
 Cytokines

- Hypersensitivity reaction
- Acquired immune systems
 - B-cells, type and receptors
 - T-cells, type and receptors
 - Antigens, antigenicity and immunogenicity
 - Epitopes, and Haptens types, structures, functions and diversity of antibody
- Immunoglobins: Ig genes, Differential expression of Ig genes

Prasad
Immunology
2016

Prasad
Prasad

Prasad
Prasad

Prasad
Prasad

End term (external) assessment

Exam Duration: 3.00 hrs
Full Marks: 80+20
MARKS DISTRIBUTION

ITEMS		
Endocrinology		10
Developmental Biology		10
Biochemistry	(2x10)	20
Immunology		10
Spotting	(2x10)	20
Records		10
Viva voce		20

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, 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)

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 Ouchterlony double diffusion (ODD)

Prasad
 Khosh
 Abha Boroel
 Jankh...
 ...
 ...
 ...

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

Biotechnology

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 : Monoclonal antibody production

Gene Therapy

Handwritten signatures and notes:
 Hosaini
 Egg
 An
 H. H. H. H. H.
 Alpha Rosod
 Quirle box
 S. R.
 S. R.

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
- ▷▷ 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.

M.Sc. Zoology Semester IV (ZOOL)

EC – 3 (Elective course GE/ DC)

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.

(Handwritten signatures and notes at the bottom of the page)

Prasad
 Anush
 Akha Prasad
 Shariq
 Prakash
 Mishra

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

MARKS DISTRIBUTION

ITEMS	MARKS
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

[Handwritten signatures and marks are present over the table and below it.]

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 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 quadrature 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

Prasad
Prasad
Prasad

Prasad
Prasad
Prasad

Prasad
Prasad
Prasad

Prasad
Prasad
Prasad

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
3. Pagano M. & Gauvreau K. – Principles of Biostatistics. 2nd edn. Thomson 2007
4. Sundar Rao P.S.S. & Richard J. – An Introduction to Biostatistics. 4th edn. PHI 2006
5. Forthofer R.N., Lee E.U. & Hernandez M. – Biostatistics : A guide to Design, Analysis and Discovery. Elsevier/ Academic Press 2007

Bioinformatics

1. Attwood T.K. & Parry-Smith D.J. – Introduction to Bioinformatics. Pearson 2001
2. Sundararajan S. & Balaji R. - Introduction to Bioinformatics 1st edn. Himalaya 2002
3. Murthy C.S.V. – Bioinformatics 1st edn. Himalaya 2004

Cell Biology

1. Lodish H., Berk A., Matsudaira P. Kaiser C.A., Krieger M., Scott M.P., Zipurky S.L., & Darnell J. – Molecular Cell Biology. 5th edn. W.H. Freeman 2004
2. Sadava D.E. – Cell Biolgy. Organelle, Structure and Function. Jones and Bartlett 1997
3. Cooper G.M. – The Cell: A molecular approach. ASM Press 1997
4. Freifelder D. & Malacinski G.M. – Essentials of Molecular Biology 2nd edn. Panima 1993
5. Becker W.M., Reece J.B. & Poenic M.F. – The World of the Cell. 3rd edn. Benjamin 1996
6. Twyman R.M. – Advanced Molecular Biology. Viva 2003
7. De Robertis E.D.P. & De Robertis Jr. E.M.E. – Cell and Molecular Biology. 8th edn. Lippincott Williams and Wilkins 2001
8. Alberts B., Johnson A., Lewis J., Raff M., Roberts K. – Molecular Biology of the Cell. 4th edn. Garland Science 2002

Molecular Biology

1. Lewin B. – Genes VI – XII. Oxford 2000 - 2008
2. Watson J.D., Baker T.A., Bell S.P., Gann A., Levine M. & Losick R. – Molecular Biology of the Gene 5th edn. Pearson 2004
3. Tamaria R.H. – Principles of Genetics. 7th edn. Tata McGraw-Hill 2002

Ethology

1. Manning A. & Dawkins M.S. – An Introduction to Animal Behaviour. Cambridge 1995
2. Prasad S. – Animal Behaviour. CBS 2004
3. Mathur R. – Animal Behaviour. Rastogi 2002

Physiology

1. Kay I. – Introduction to Animal Physiology. Bios Scincetific Publ Ltd 1998
2. Sherwood L., Klandorf H. & Yancey P.H. – Animal Physiology: From Genes to Organisms. Thomson 2005
3. Schimdt-Nelson K. - Animal Physiology: Adaptation and Environment. 5th edn. Cambridge Univ. Press 1998
4. Hoar W.S. – General Comparative Physiology. 3rd edn. Prentice Hall India 1983

Prasad
Prasad
Prasad

Prasad
Prasad

Prasad
Prasad
Prasad

Prasad
Prasad

5. Prosser C.L. – Comparative Animal Physiology. 3rd edn. Satish Books 1984
- 6 Chaudhuri S.K. – Concise Medical Physiology. 5th edn. New Central Agency 2004
- 7 Keele C.A. & Neil E. – Samson Wright's Applied Physiology. ELBS / Oxford 1972
- 8 Soper R.(ed) – Biological Science. 3rd edn. Cambridge Univ Press 1997
- 9 Guyton A.C. & Hall J.E. – Text Book of Medical Physiology. 9th edn. Saunders 1996
- 10 Talwar G.P. & Srivastava L.M.(ed.) – Text Book of Biochemistry and Human Biology. 3rd edn. Prentice Hall India 2003

Biochemistry

- 1 Murray R.K., Granner D.K., Mayes P.A. & Rodwell V.N. – Harper's Biochemistry. 21st edn. Lange 1988
- 2 Nelson D.L. & Cox M.M. – Lehninger Principles of Biochemistry. 3rd edn. 2000
- 3 Wilson K. & Walker J. – Principles of Biochemistry and Molecular Biology. 6th edn. Cambridge Univ. Press 2007
- 4 Matthews C.K., van Holde K.E. & Ahren K.G. – Biochemistry. 3rd edn. Pearson 2003
- 5 Voet D., Voet J. & Pratt C.W. – Fundamentals of Biochemistry. Life at the Molecular Level. 2nd edn. Wiley Asia 2006
- 6 Metzler
- 7 Norris D.O. – Vertebrate Endocrinology. 4th edn. Elsevier / A.P. 2007
- 8 Bolander F.F. – Molecular Endocrinology. 3rd edn Elsevier / A.P. 2006
- 9 Hadley M.E. – Endocrinology. 5th edn. Pearson 2000
- 10 Gorbman A., Dickhoff W.W., Vigna S.R., Clark A.B. & Ralph C.L. – Comparative Endocrinology. John Wiley 1983
- 11 Korf H.-W., Schomerus C. & Stehle – The Pineal Organ, Its Hormone Melatonin and Photoneuroendocrine System. Springer Verlag 1998
- 12 Ramaswami L.S. – Vertebrate Neurosecretion: A Review. INSA 1980
- 13 Fry B.E. – Hormonal Control in Vertebrates. Macmillan 1967

Immunology:

- 1 Davey Basiro – Immunology. Open University Press 1989
- 2 Delves P.J., Martin S.J., Burton D.R. & Roitt I.M. – Roitt's Essential Immunology. 11th edn. Oxford 2006
3. Shetty N. – Immunology: Introductory Text Book. Revised 2nd edn. New Age 2008
4. Kuby, J. – Immunology

Evolution and ecology

- 1 Riddle M. – Evolution. 2nd edn. Blackwell 1996
- 2 Piyanka E.R. - Evolutionary Ecology 5th edn Harper Collins 1994
- 3 Simmons I.G. - The Ecology of Natural Resources 2nd edn ELBS / Edward Arnolds 1983
- 4 Dash M.C. & Mishra P.C.- Man and Environment McMillian 2001
- 5 Stiling P. – Ecology : Theories and Applications 4th edn Prentice Hall India 2002

Fish and Fisheries

- 1 Wootton R.J. - Fish Ecology Blackie 1992
- 2 Nikolsky G.V. – The Ecology of Fishes Academic Press 1963
- 3 Greenwood P.H. – Norman's History of Fishes 3rd edn Ernest 1975
- 4 Lagler, Bardach, Miller & May Passino – Ichthyology Wiley 2003
- 5 Pillay – Aquaculture : Principle and Practices of Fishing 1st Indian edn New Books 2006

to
Eto
An

Boasad

Boasad

Abha Boasad

Shanti Jais

Shanti Jais

Shanti Jais

Shanti Jais

