



CBCS CURRICULUM OF

M.Sc. ZOOLOGY PROGRAMME

SUBJECT CODE = ZOOL

FOR POST GRADUATE COURSES UNDER NILAMBER PITAMBER UNIVERSITY

**Members of Board of Studies of CBCS Under- Graduate Syllabus as
per Guidelines of the. Nilamber Pitamber University**

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HoD (Incharge)

University Department of Zoology, NPU

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26.3.2021

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26/03/2021

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26/03/2021

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COURSE STRUCTURE FOR M.Sc ZOOLOGY PROGRAMME

Semester	Courses	Paper	Paper Code	Credit	Hrs./week
I	Foundation Course	FC	FCZOO101	5	5 (L)+1(T)
	Core Course	CC1	CCZOO101	5	5 (L)+1(T)
	Core Course	CC2	CCZOO102	5	5 (L)+1(T)
	Practicals on Core Course	CC3-P	CCZOO103	5	10
II	Ability Enhancement Course	EC1	ECZOO201	5	5 (L)+1(T)
	Core Course	CC4	CCZOO204	5	5 (L)+1(T)
	Core Course	CC5	CCCHEM205	5	5 (L)+1(T)
	Practicals on Core Course	CC6-P	CCZOO206	5	10
III	Core Course	CC7	CCZOO307	5	5 (L)+1(T)
	Core Course	CC8	CCZOO308	5	5 (L)+1(T)
	Elective (GE/DC)	EC2	ECZOO302	5	5 (L)+1(T)
	Practicals on Elective (GE/DC)	EC3-P	ECZOO303	5	10
IV	Core Course	CC9	CCZOO409	5	5 (L)+1(T)
	Elective (GE/DC)	EC4	ECZOO404	5	5 (L)+1(T)
	Practicals on Elective (GE/DC)	EC5-P	ECZOO405	5	5 (L)+1(T)
	Project/Dissertation	CC10	CCZOO410	5	10

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	aper Code	Credit	Name of Paper	Mid Semester Evaluation (F.M.)	End Semester Evaluation (F.M.)	End Semester Practical/ Viva (F.M.)
I	FC	FCZOO101	5	Systematics, Evolution & Bioinformatics	30	70	----
	CC1	CCZOO101	5	Invertebrate Diversity & Quantitative Biology	30	70	----
	CC2	CCZOO102	5	Biotechniques, Histology & Histochemistry	30	70	----
	CC3P	CPZOO103	5	Practical-I	----	----	100
II	EC1	ECZOO1201	5	Cellular and Molecular Biology	30	70	
	CC4	CCZOO1204	5	Vertebrate Diversity, Ethology & Classical Genetics	30	70	----
	CC5	CCZOO1205	5	Environmental and General Vertebrate Physiology	30	70	----
	CC6	CPZOO1206	5	Practical-II	----	----	100
III	CC7	CCZOO1307	5	Endocrinology & Developmental Biology	30	70	----
	CC8	CCZOO1308	5	Biochemistry & Immunology	30	70	----
	EC2	ECZOO1302	5	A. Fish and Fisheries-I B. Ecology-I	30	70	-----
	EC3-P	ECZOO1303	5	A. Practical - Fish and Fisheries/-I B. Practical – Ecology -I	----	----	100
IV	CC9	CCZOO1409		Mammalian Reproductive Physiology & Biotechnology	30	70
	EC4	ECZOO1404	5	A. Fish and Fisheries-II B. Ecology-II	30	70	----
	EC5-P	EPZOO1405	5	A. Practical - Fish and Fisheries - II B. Practical – Ecology – II	----	----	100
	CC10	CCZOO1410	5	Project Work	----	----	100

SEMESTER I

I. FOUNDATION COURSE

[FCZOOOL101]:

(Credits: Theory-04, Tutorial-01)

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

Pass Marks (MSE : 17 + ESE : 28) = 45

MID SEMESTER EXAMINATION (MSE)

The Mid Semester Examination shall have three components: (a) Two Semester Internal Assessment Test (SIA) of 20 marks each. "Better of Two" shall be applicable for computation of marks for SIA. (b) Attendance / Regular Interactions of 05 marks and (c) Assignment of 05 marks.

END SEMESTER EXAMINATION (ESE)

A total of **EIGHT** questions will be set in which Question 1 will be **Short Answer Type** and **COMPULSORY**. Any **four** questions shall have to be answered by the examinees out of the remaining seven questions. The questions will be of equal marks and will be so framed that the students are able to answer them within the stipulated time.

SYSTEMATICS, EVOLUTION & BIOINFORMATICS

Theory: 60 Hours; Tutorial: 15 Hours

UNIT 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

UNIT 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

UNIT III Bioinformatics

Principles of bioinformatics and its
application Biological databases:
Nucleic acid sequence databases
Protein sequence databases
Data retrieval systems: Search engines, Entrez
Molecular sequence analysis software packages and tools: BLAST, RasMol,
Biologist's workbench PERL

References :

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

II. CORE COURSE [CCZOO101]:

(Credits: Theory-04, Tutorial-01)

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

Pass Marks (MSE : 17 + ESE : 28) = 45

MID SEMESTER EXAMINATION (MSE)

The Mid Semester Examination shall have three components: (a) Two Semester Internal Assessment Test (SIA) of 20 marks each. "Better of Two" shall be applicable for computation of marks for SIA. (b) Attendance / Regular Interactions of 05 marks and (c) Assignment of 05 marks.

END SEMESTER EXAMINATION (ESE)

A total of **EIGHT** questions will be set in which Question 1 will be **Short Answer Type** and **COMPULSORY**. Any **four** questions shall have to be answered by the examinees out of the remaining seven questions. The questions will be of equal marks and will be so framed that the students are able to answer them within the stipulated time.

INVERTEBRATE DIVERSITY & QUANTITATIVE BIOLOGY

Theory: 60 Hours; Tutorial: 15 Hours

UNIT 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

Respiration: Arthropods, Mollusca

UNIT 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,

Evaluation of Biodiversity indices: Shannon –Weiner index, index of dominance,

, Association index: 2 x 2 contingency table

References :

- Barrington E.J.W. - Invertebrate structure and function, 2nd edn. ELBS/Nelson 1973
- Ruppert E.E. & Barnes, R.D. - Invertebrate Zoology. 6th edn. Harcourt Asia 1994
- Hyman L. H. – The Invertebrata. vols I – VI McGraw-Hill 1940 - 1967
- Pough F.H., Janis C.M. & Heiser J.B. – Vertebrate Life. 6th edn. Pearson 2003
- Romer A.S. – The Vertebrate body. 3rd edn. Vakils 1962
- Young J. Z. – Life of Vertebrates. 3rd edn. Oxford 1982

III. CORE COURSE [CCZOO102]:

(Credits: Theory-04, Tutorial-01)

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

The Mid Semester Examination shall have three components: (a) Two Semester Internal Assessment Test (SIA) of 20 marks each. "Better of Two" shall be applicable for computation of marks for SIA. (b) Attendance / Regular Interactions of 05 marks and (c) Assignment of 05 marks.

END SEMESTER EXAMINATION (ESE)

A total of **EIGHT** questions will be set in which Question 1 will be **Short Answer Type** and **COMPULSORY**. Any **four** questions shall have to be answered by the examinees out of the remaining seven questions. The questions will be of equal marks and will be so framed that the students are able to answer them within the stipulated time.

BIOTECHNIQUES, HISTOLOGY & HISTOCHEMISTRY**Theory: 60 Hours; Tutorial:15 Hours****UNIT 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,

Separation techniques: Ion- exchange and HPLC)
Electrophoresis (Agarose and SDS PAGE)
Centrifugation: Basic principles, differential and density gradient centrifugation
ELISA

UNIT 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 Protein end groups -
Mercury Bromophenol Blue, Ninhydrin-Schiff, Performic acid-Schiff
Lipid moieties - by Sudan Black B method
Nucleic acids - DNA and RNA by Methyl green pyronin-Y, DNA by Feulgen reaction.

Reference :

- ☐ Pearse A.G.E. - Histochemistry – Theoretical and Applied. vols I – III Churchill
- ☐ Bancroft J.D. & Stevens A. – Theory and Practice of Histological techniques.4th edn. Churchill Livingstone 1996
- ☐ Barka T. & Anderson P.J. – Histochemistry, Theory Practice and Bibliography.
- ☐ Harper and Raw 1965
- ☐ Sharma A.K. & Sharma A. – Chromosome Techniques. Theory and Practice. 3rd edn. Butterworths 1980
- ☐ Verma G.P. – Fundamentals of Histology. New Age 2001

IV. CORE COURSE PRACTICAL [CPZOO103]:

(Credits: Practical-05)

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

End Term (External) Assessment**PRACTICAL-I**

Marks Distribution

Scheme of examinations**Items**

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**Invertebrate Diversity**General anatomy of:Leech/ Prawn/ Squilla/ Scorpion/ Aquatic Beetle/ *Mytilus*/ *Aplysia*/ Sea urchinMuseum 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

Biotechniques

Use of Ph meter, water bath, autoclave, balance, centrifuge, colorimeter, spectrophotometer

Measurement, figure drawing, and photography through microscope

Separation of amino acids, DNA by Gel electrophoresis

Histology and Histochemistry

Preparation of fixatives for histological and different histochemical staining

Paraffin sectioning

Fixation of tissue

Dehydration, clearing and embedding, microtomy

Staining of paraffin sections

Preparation of stains for histological and different histochemical staining

Histochemical staining of:

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

Carbohydrate moieties using PAS, Alcian blue at different pH.

Bioinformatics

Use of search engines

Use of data bases – Gene Bank, PubMed.



SEMESTER II

I. ECZOL201 (ELECTIVE COURSE):

(Credits: Theory-05)

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

Pass Marks (MSE : 17 + ESE : 28) = 45

MID SEMESTER EXAMINATION (MSE)

The Mid Semester Examination shall have three components: (a) Two Semester Internal Assessment Test (SIA) of 20 marks each. "Better of Two" shall be applicable for computation of marks for SIA. (b) Attendance / Regular Interactions of 05 marks and (c) Assignment of 05 marks.

END SEMESTER EXAMINATION (ESE)

A total of **EIGHT** questions will be set in which Question 1 will be **Short Answer Type** and **COMPULSORY**. Any **four** questions shall have to be answered by the examinees out of the remaining seven questions. The questions will be of equal marks and will be so framed that the students are able to answer them within the stipulated time.

CELLULAR AND MOLECULAR BIOLOGY

Theory: 60 Hours; Tutorial: 15 Hours

Biomembranes and cell matrix adhesion

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. Lac Operon, Tryptophan Operon and Arabinose Operon.

b. Control of Gene Expression in Eukaryotes: Conserved Mechanisms in Transcriptional Regulation.

Reference :

- ☐ 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
- ☐ Cooper G.M. – The Cell: A molecular approach. ASM Press 1997
- ☐ Becker W.M., Reece J.B. & Poenie M.F. – The World of the Cell. 3rd edn. Benjamin 1996
- ☐ De Robertis E.D.P. & De Robertis Jr. E.M.E. – Cell and Molecular Biology. 8th edn. Lippincott Williams and Wilkins 2001
- ☐ Lewin B. – Genes VI – XII. Oxford 2000 - 2008
- ☐ Watson J.D., Baker T.A., Bell S.P., Gann A., Levine M. & Losick R. – Molecular Biology of the Gene. 5th edn. Pearson 2004
- ☐ Tamaria R.H. – Principles of Genetics. 7th edn. Tata McGraw-Hill 2002

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

Pass Marks (MSE : 17 + ESE : 28) = 45

MID SEMESTER EXAMINATION (MSE)

The Mid Semester Examination shall have three components: **(a)** Two Semester Internal Assessment Test **(SIA)** of 20 marks each. “Better of Two” shall be applicable for computation of marks for SIA. **(b)** Attendance / Regular Interactions of 05 marks and **(c)** Assignment of 05 marks.

END SEMESTER EXAMINATION (ESE)

A total of **EIGHT** questions will be set in which Question 1 will be **Short Answer Type** and **COMPULSORY**. Any **four** questions shall have to be answered by the examinees out of the remaining seven questions. The questions will be of equal marks and will be so framed that the students are able to answer them within the stipulated time.

VERTEBRATE DIVERSITY, ETHOLOGY & CLASSICAL GENETICS

Theory: 60 Hours; Tutorial:15 Hours

UNIT I

Vertebrate Diversity

Neomorphic air breathing organs in fish

Electric organ & Electro-Receptors 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

Sensory system in birds - Vision, Olfaction, Hearing, Special senses used in navigation

Dentition in mammals, Aquatic mammals.

UNIT 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:

UNIT III

Classical Genetics

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

Extra chromosomal inheritance – inheritance of mitochondrial and chloroplast gene

References :

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

III. CORE COURSE [CCZOO205]: (Credits: Theory-04, Tutorial-01)**Marks 30 (MSE 20 1 Hr + 5 Attd. + 5 Assign) + 70 (ESE : 3 Hrs) = 100****Pass Marks (MSE : 17 + ESE : 28) = 45****MID SEMESTER EXAMINATION (MSE)**

The Mid Semester Examination shall have three components: (a) Two Semester Internal Assessment Test (SIA) of 20 marks each. "Better of Two" shall be applicable for computation of marks for SIA. (b) Attendance / Regular Interactions of 05 marks and (c) Assignment of 05 marks.

END SEMESTER EXAMINATION (ESE)

A total of **EIGHT** questions will be set in which Question 1 will be **Short Answer Type** and **COMPULSORY**. Any **four** questions shall have to be answered by the examinees out of the remaining seven questions. The questions will be of equal marks and will be so framed that the students are able to answer them within the stipulated time.

ENVIRONMENTAL AND GENERAL VERTEBRATE PHYSIOLOGY**Theory: 60 Hours; Tutorial: 15 Hours****UNIT 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.

UNIT II**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. 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

Reference :

- Kay I. – Introduction to Animal Physiology. Bios Scincetific Publ Ltd 1998
- Guyton A.C. & Hall J.E. – Text Book of Medical Physiology. 9th edn. Saunders 1996
- Talwar G.P. & Srivastava L.M.(edt.) – Text Book of Biochemistry and Human Biology. 3rd edn.

IV. CORE COURSE PRACTICAL [CCPZOOL206]: (Credits: Practical-05)

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

PRACTICAL-II**Practical: 60Hours****End Term (External) Assessment****Scheme of examinations**

Items

Time: 6Hrs

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**Vertebrate diversity****Museum SPECIMENS:**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

Physiology

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

method to show effects of exercise plotting time of acclimation

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

SEMESTER III

I. CORE COURSE [CCZOO307] (Credits: Theory-04, Tutorial-01)

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

Pass Marks (MSE : 17 + ESE : 28) = 45

MID SEMESTER EXAMINATION (MSE)

The Mid Semester Examination shall have three components: (a) Two Semester Internal Assessment Test (SIA) of 20 marks each. "Better of Two" shall be applicable for computation of marks for SIA. (b) Attendance / Regular Interactions of 05 marks and (c) Assignment of 05 marks.

END SEMESTER EXAMINATION (ESE)

A total of **EIGHT** questions will be set in which Question 1 will be **Short Answer Type** and **COMPULSORY**. Any **four** questions shall have to be answered by the examinees out of the remaining seven questions. The questions will be of equal marks and will be so framed that the students are able to answer them within the stipulated time.

ENDOCRINOLOGY & DEVELOPMENTAL BIOLOGY

Theory: 60 Hours; Tutorial:15 Hours

UNIT 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, and action.
Receptor types and structure, second messenger system, Pineal in vertebrates, It's hormones and function .
- Mammalian endocrine glands, their hormones and functions:
Adenohypophysis, Neurohypophysis; Thyroid; Adrenal; Parathyroid
- Physiological Endocrinology: Endocrinology of calcium regulation

UNIT II

Developmental Biology

- Fertilization : Specialization of egg, structural specialization of sperm, species-specific binding of gametes, 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)
- Postembryonic development: Metamorphosis of Anuran and Insect,

Reference

- ☐ Austin C. R. & Short R.V. – Reproduction in Mammal Books 1 to 7 Cambridge
- ☐ Nalbandov A.V. – Reproductive Physiology Taraporevala 1970
- ☐ Tienhoven A. V. – Reproductive Physiology of Vertebrates 2nd edn. Cornell Univ
- ☐ A Text-Book Reproduction in Farm Animals (Theriogenology)Varghese 1994
- ☐ Ramaswami L.S. – Vertebrate Neurosecretion: A Review INSA 1980
- ☐ Norris D.O. - Vertebrate Endocrinology 3rd edn. Elsevier / A,P. 2006
- ☐ Bolander F.F. - Molecular Endocrinology 3rd edn Elsevier / A,P. 2006
- ☐ Hadley M.E. – Endocrinology 5th edn. Prentice Hall Int. 2000
- ☐ Gorbman A., Dickhoff W.W., Vigna S.R., Clark A.B. & Ralph C.L. – Comparative Endocrinology John Wiley 1983.
- ☐ Gilbert – Developmental Biology
- ☐ Berril N. J. – Developmental Biology. Tata McGraw-Hill 1982



II. CORE COURSE [CCZOOL308]:

(Credits: Theory-04, Tutorial-01)

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

The Mid Semester Examination shall have three components: (a) Two Semester Internal Assessment Test (SIA) of 20 marks each. "Better of Two" shall be applicable for computation of marks for SIA. (b) Attendance / Regular Interactions of 05 marks and (c) Assignment of 05 marks.

END SEMESTER EXAMINATION (ESE)

A total of **EIGHT** questions will be set in which Question 1 will be **Short Answer Type** and **COMPULSORY**. Any **four** questions shall have to be answered by the examinees out of the remaining seven questions. The questions will be of equal marks and will be so framed that the students are able to answer them within the stipulated time.

BIOCHEMISTRY & IMMUNOLOGY**Theory: 60 Hours; Tutorial:15 Hours****UNIT I****Biological Chemistry : Biomolecules and metabolic regulations**

- a. Water – As a biological solvent; Unique physical and chemical properties
Ionization of water; Equilibrium constant and ionic product of water and pH;
- b. Biomolecules: Chemical bonds and bond energy
- c. 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
- d. Metabolism:
Biosynthesis and degradation of protein
Metabolism of fructose, glucose, and glycogen
- e. Enzymes:
Mechanism of action, regulation of enzyme activity; Enzyme Kinetics
Coenzymes and isoenzyme;.

UNIT 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, antigenicity and immunogenicity; Epitopes and Haptens; type, structure,function and diversity of antibody.
- Immunoglobins: Ig genes, Differential expression of Ig genes.

References :

- Wilson K. & Walker J. – Principles of Biochemistry and Molecular Biology. 6th edn. Cambridge Univ. Press 2007
 - Voet D., Voet J. & Pratt C.W. – Fundamentals of Biochemistry. Life at the Molecular Level. 2nd edn. Wiley Asia 2006
 - Metzler Norris D.O. - Vertebrate Endocrinology. 4th edn. Elsevier / A.P. 2007
 - Hadley M.E. – Endocrinology. 5th edn. Pearson 2000 Korf H.-W., Schomerus C. & Stehle – The Pineal Organ, Its Hormone Melatonin and Photoneuroendocrine System. Springer Verlag 1998
 - Ramaswami L.S. – Vertebrate Neurosecretion: A Review. INSA 1980
 - Fry B.E. – Hormonal Control in Vertebrates. Macmillan 1967
 - Davey Basiro – Immunology. Open University Press 1989
 - Delves P.J., Martin S.J., Burton D.R. & Roitt I.M. – Roitt's Essential Immunology. 11th edn. Oxford 2006
 - Shetty N. – Immunology: Introductory Text Book. Revised 2nd edn. New Age 2008 Kuby, J. – Immunology
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III. ELECTIVE COURSE [ECZOO302A]:

(Credits: Theory-04, Tutorial-01)

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

The Mid Semester Examination shall have three components: **(a)** Two Semester Internal Assessment Test **(SIA)** of 20 marks each. “Better of Two” shall be applicable for computation of marks for SIA. **(b)** Attendance / Regular Interactions of 05 marks and **(c)** Assignment of 05 marks.

END SEMESTER EXAMINATION (ESE)

A total of **EIGHT** questions will be set in which Question 1 will be **Short Answer Type** and **COMPULSORY**. Any **four** questions shall have to be answered by the examinees out of the remaining seven questions. The questions will be of equal marks and will be so framed that the students are able to answer them within the stipulated time.

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

Reference :

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

ELECTIVE COURSE [ECZOOOL302B]:**Marks 30 (MSE 20 1 Hr + 5 Attd. + 5 Assign) + 70 (ESE : 3 Hrs) = 100****Pass Marks (MSE : 17 + ESE : 28) = 45****MID SEMESTER EXAMINATION (MSE)**

The Mid Semester Examination shall have three components: **(a)** Two Semester Internal Assessment Test **(SIA)** of 20 marks each. “Better of Two” shall be applicable for computation of marks for SIA. **(b)** Attendance / Regular Interactions of 05 marks and **(c)** Assignment of 05 marks.

END SEMESTER EXAMINATION (ESE)

A total of **EIGHT** questions will be set in which Question 1 will be **Short Answer Type** and **COMPULSORY**. Any **four** questions shall have to be answered by the examinees out of the remaining seven questions. The questions will be of equal marks and will be so framed that the students are able to answer them within the stipulated time.

B. ECOLOGY - I**Theory: 60 Hours; Tutorial: 15 Hours****UNIT – I 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

UNIT – II 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.

Major Biomes of the world: Forests, Tropical, Tundra, Grassland and Deserts and adaptations.

UNIT – III 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.

UNIT – IV Habitat Ecology

Physico-chemical and Biological Characteristics of Freshwater and Marine System; Origin and Classification of Lakes, Types and significance of Freshwater Biota.

UNIT – V Biodiversity:

Definition, Status, monitoring and documentation, Major factors affecting biodiversity destruction, Biodiversity conservation and management strategies

UNIT – VI Pollution Ecology:

Air, Water and, Soil pollution. Concept of: Bioaccumulation, Biomagnification, Bioremediation, Biosensors.

Reference :

1. Mukherjee, B. Fundamentals of Environmental Biology, Silverline Publications, Allahabad 2011
2. Riddle M. – Evolution. 2nd edn. Blackwell 1996
3. Piyanka E.R. - Evolutionary Ecology 5th edn Harper Collins 1994
4. Simmons I.G. - The Ecology of Natural Resources 2nd edn ELBS / Edward Arnolds 1983

IV. ELECTIVE COURSE PRACTICAL [ECZOOL303A]: (Credits: Practical-05)**Marks: 30 (ESE: 20 Viva + 5Attd. + 5 Record) + 70 (ESE Pr: 6Hrs)=100****Pass Marks =45****FISH AND FISHERIES PRACTICAL****Practical: 60Hours****End Term (External) Assessment****Scheme of examinations****Time: 6Hrs****Items**

Anatomical observation

Gut analysis and determination of feeding habit

Temporary slides

Spotting

[Representative of major classes, histological slides, Endocrine section, fish showing adaptation, exotic/ornamental/ larvivorous fish]

Records and Sessional work

*Viva voce***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

ELECTIVE COURSE PRACTICAL IECZOO303Bl:

(Credits: Practical-05)

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

Pass Marks =45

ECOLOGY PRACTICAL**Practical: 60Hours****End Term (External) Assessment****Scheme of examinations****Time: 6Hrs**

Items

Biotic analysis

Bio-statistical analysis

Records and Sessional work

*Viva voce***List of Practicals****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

SEMESTER IV

I. CORE COURSE [CCZOO409]: (Credits: Theory-03, Practical-02)**Marks 30 (MSE 20 1 Hr + 5 Attd. + 5 Assign) + 70 (ESE : 3 Hrs) = 100****Pass Marks (MSE : 17 + ESE : 28) = 45**

MID SEMESTER EXAMINATION (MSE)

The Mid Semester Examination shall have three components: (a) Two Semester Internal Assessment Test (SIA) of 20 marks each. "Better of Two" shall be applicable for computation of marks for SIA. (b) Attendance / Regular Interactions of 05 marks and (c) Assignment of 05 marks.

END SEMESTER EXAMINATION (ESE)

A total of **EIGHT** questions will be set in which Question 1 will be **Short Answer Type** and **COMPULSORY**. Any **four** questions shall have to be answered by the examinees out of the remaining seven questions. The questions will be of equal marks and will be so framed that the students are able to answer them within the stipulated time.

MAMMALIAN REPRODUCTIVE PHYSIOLOGY & BIOTECHNOLOGY**Theory: 60 Hours; Tutorial:15Hours****UNIT I****Mammalian Reproductive Physiology**

- 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

UNIT 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; DNA library, PCR.

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

References :

- Austin C. R. & Short R.V. – Reproduction in Mammal Books 1 to 7 Cambridge
- Nalbandov A.V. – Reproductive Physiology Taraporevala 1970
- Tienhoven A. V. – Reproductive Physiology of Vertebrates 2nd edn. Cornell Univ
- A Text-Book Reproduction in Farm Animals (Theriogenology)Varghese 1994
- Ramaswami L.S. – Vertebrate Neurosecretion: A Review INSA 1980
- Norris D.O. - Vertebrate Endocrinology 3rd edn. Elsevier / A,P. 2006
- Bolander F.F. - Molecular Endocrinology 3rd edn Elsevier / A,P. 2006
- Hadley M.E. – Endocrinology 5th edn. Prentice Hall Int. 2000
- Gorbman A., Dickhoff W.W., Vigna S.R., Clark A.B. & Ralph C.L. – Comparative Endocrinology John Wiley 1983.
- Mitra S. – Genetic Engineering; Principle and Practice. Mac Millan 2002
- Smith J.E. – Biotechnology. 3rd edn. Cambridge Univ. Press 1986
- Balsubramanian D., Bryce C.F.A., Dharmalingam K., Green J. & Jayaraman . – Concepts in Biotechnology. Universities Press 2002
- Bains W. - Biotechnology: From A to Z. 2nd edn. Oxford 1998
- Kumar H.D. – A Textbook on Biotechnology. Affiliated East West 1991

II. ELECTIVE COURSE [ECZOO404A]:

(Credits: Theory-04, Tutorial-01)

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

The Mid Semester Examination shall have three components: (a) Two Semester Internal Assessment Test (SIA) of 20 marks each. "Better of Two" shall be applicable for computation of marks for SIA. (b) Attendance / Regular Interactions of 05 marks and (c) Assignment of 05 marks.

END SEMESTER EXAMINATION (ESE)

A total of **EIGHT** questions will be set in which Question 1 will be **Short Answer Type** and **COMPULSORY**. Any **four** questions shall have to be answered by the examinees out of the remaining seven questions. The questions will be of equal marks and will be so framed that the students are able to answer them within the stipulated time.

FISH AND FISHERIES-II**Theory: 60 Hours; Tutorial: 15 Hours****Fish and Fisheries**

- α. **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
- β. **Cultivable species**
 - Introduction of exotic species – Composite culture, extensive and intensive culture
- χ. **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
- δ. **Fishing technology** – nets, crafts, gears, acoustic and other recent techniques.

References :

- ☐ Wootton R.J. - Fish Ecology Blackie 1992
- ☐ Nikolsky G.V. – The Ecology of Fishes Academic Press 1963
- ☐ Greenwood P.H. – Norman's History of Fishes 3rd edn Ernest 1975

ELECTIVE COURSE [ECZOO404B]:

(Credits: Theory-04, Tutorial-01)

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

The Mid Semester Examination shall have three components: (a) Two Semester Internal Assessment Test (SIA) of 20 marks each. "Better of Two" shall be applicable for computation of marks for SIA. (b) Attendance / Regular Interactions of 05 marks and (c) Assignment of 05 marks.

END SEMESTER EXAMINATION (ESE)

A total of **EIGHT questions** will be set in which Question 1 will be **Short Answer Type** and **COMPULSORY**. Any **four** questions shall have to be answered by the examinees out of the remaining seven questions. The questions will be of equal marks and will be so framed that the students are able to answer them within the stipulated time.

ECOLOGY-II**Theory: 60 Hours; Tutorial: 15 Hours****Ecology****ε. Pollution Ecology****φ. Water Pollution:**

Types and sources of pollution; Biodegradable and Non-degradable pollutants; Eutrophication.

γ. Air Pollution:

Sources and Effects of Air Pollutants; control measures.

η. 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.

References

- ☐ Chapman – The Insects: Structure and Function 4th edn ELBS 1998
- ☐ Imms A.D. – A General Text Book of Entomology 2 volsw. Asia Publ 1997
- ☐ Wigglesworth - Principles of Insect Physiology ELBS 1972

III. ELECTIVE COURSE PRACTICAL [ECPZOO405A]: (Credits: Practical-05)

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

Pass Marks =45

FISH AND FISHERIES PRACTICAL

Practical: 60Hours

End Term (External) Assessment

Scheme of examinations

Time: 6Hrs

Items

Plankton identification

Taxonomic identification of fresh water fishes

Fish showing adaptive feature

Records and Sessional work

Viva voce

List of Practicals

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 Fisheries Research

ELECTIVE COURSE PRACTICAL [EPZOO405B]:

(Credits: Practical-05)

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

Pass Marks =45

ECOLOGY PRACTICAL

Practical: 60Hours

End Term (External) Assessment

Scheme of examinations

Time: 6Hrs

Items

Water analysis

Soil analysis

Adaptation Study Spotting (5 X 3)

Records and Sessional work

Viva voce

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

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 [CCZOOOL410]:

PROJECT

(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:

- α. Motivation for the choice of topic*
- β. Project dissertation design*
- γ. Methodology and Content depth*
- δ. Results and Discussion*
- ε. Future Scope & References*
- φ. Participation in Internship programme with reputed organization*
- γ. Application of Research technique in Data collection*
- η. Report Presentation*
- ι. Presentation style*
- φ. 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, Nilamber Pitamber University, for evaluation.

The paper will consist of

- (a) Field work/Lab work related to the project.
- (b) Preparation of dissertation based on the work undertaken.

Topics

Project work related to the following relevant to the topics of the Course, relevant topics may be given water pollution, water conservation, Territorial insect.

NB:- Students will select topics for the project work in consultation with a teachers and Staff of department.