

Syllabus for
Bachelor of Science in Zoology (Honours)
Four Year Under Graduate Programme

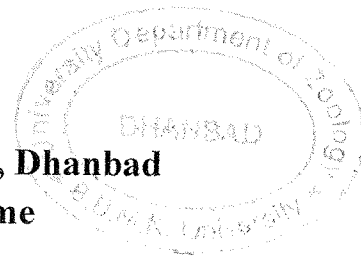
Academic Session

w.e.f. 2022-2026



For
All Constituent / Affiliated Colleges under
Binod Bihari Mahto Koyalanchal University,
Dhanbad

Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
NEP, 2022



List of Members of Board of Studies of NEP under Four Year Undergraduate Programme Syllabus

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2.	Dr. A. C. Gorai Retrd. Professor, Vinoba Bhave University, Hazaribag	Expert Member	
3.	Dr. Shailendra Kumar Sinha – Associate Professor Head University Dept. of Zoology BBMKU, Dhanbad	Member	
4.	Dr. Navita Gupta Associate Professor, University Dept. of Life Science, BBMKU, Dhanbad.	- Member	
5.	Dr. Rupam Mallik, Assistant Professor, University Dept. of Zoology, BBMKU, Dhanbad.	- Member	
6.	Dr, Sarita Murmu, Assistant Professor, University Dept. of Zoology, BBMKU, Dhanbad.	- Member	

Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
NEP UG Syllabus
Semester I

Major – 1 (MJ - 1) Systematics and Diversity of Life- Protists to Chordates
Credit – 4 **Lectures – 60 Hours**

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be very short answer type consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of short answer type of **5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning Outcomes:

After successfully completing this course, the students will be able to understand:

1. Develop understanding on the diversity of life with regard to Protists, non chordates and chordates.
2. Group animals on the basis of their morphological characteristics/ structures.
3. Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
4. Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
5. Understand how morphological change due to change in environment helps drive evolution over a long period of time.
6. The project assignment will also give them a flavour of research to find the process involved in studying biodiversity and taxonomy besides improving their writing skills. It will further enable the students to think and interpret individually due to different animal species chosen.

Unit	Topic	Total no. of Lectures
Unit 1: Origin of Life on Earth, Products of evolutionary process		
1.1	Origin: 1.1.1: Origin of life on Earth: Arrival of simple form from primordial chemicals. 1.1.2: Multicellularity 1.1.3: Biological Diversity	03

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1.2	1.2.1: Systematics and taxonomy	04
	1.2.2: Species concept	
	1.2.3: Clades	
Unit 2: Diversity in Protists and Acoelomate Metazoa		Total no. of Lectures
2.1	Protozoa: 2.1.1 Structure and diversity in Protists.	02
	2.1.2 General Account of Locomotion	04
2.2	Porifera: 2.2.1 Canal System in Sponges	02
2.3	Coelenterata: 2.3.1: Structure, Life Cycle & Meatgenesis in Obelia	04
	Corals and Coral Reefs: 2.3.2: Types, Distribution and Formation	02
Unit 3: Diversity In Pseudocoelomate and Coelomate Non-Chordates		Total no. of Lectures
3.1	Aschelminthes: 3.1.1: Morphology and Life Cycle of Ascaris	06
3.2	Annelida: 3.2.1: Segmental Organs & Metamerism in Pheretima	02
3.3	Arthropoda: 3.3.1: Nervous System in Palaemon	04
	3.3.2: Larval Forms in Crustacea	02
3.4	Mollusca: 3.4.1: Respiration in Pila	04
	3.4.2: Torsion & Detorsion in Gastropods	02
3.5	Echinodermata: Water Vascular System in different classes of Echinodermata	03
Unit IV: Diversity in Protochordates and Chordates		Total no. of Lectures
4.1	Hemichordates: 4.1.1: General Organization	02
	4.1.2: Affinities	
4.2	Urochordates: 4.2.1: General Organization	01
	4.2.2: Retrogressive Metamorphosis in Herdmania	02

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4.3	Fishes:	01
	4.3.1: Basic organization and Diversity of Fishes.	
	4.3.2: Accessory Respiratory Organs in Teleosts	02
4.4	Amphibia:	
	4.4.1: Amphibian's Diversity and Adaptability to Dual Mode of Life.	02
	4.4.2: Origin & Evolution of Amphibia	02
4.5	Reptiles :	01
	4.5.1: Poisonous & non Poisonous snakes of India	
	4.5.2: Poisonous Apparatus in Snakes	01
	4.5.3: Biting Mechanism	01
	4.5.4: Types of Venom & their Toxic Effects	01
4.6	Aves:	
	4.6.1: Flight Adaptations in Birds	03
4.6.2: Mechanism of Flight		
4.7	Mammalia:	
	4.7.1: Distribution General Characters, Classification & Affinities	04
4.7.2: Special features: <ul style="list-style-type: none"> • Prototheria • Metatheria • Eutheria 		
4.8	Comparative Anatomy of Vertebrates	06
	4.8.1: Heart	
	4.8.2: Aortic Arches	
	4.8.3: Kidney	

Books Recommended

Systematics (Animal Taxonomy)

1. Dalela & Sharma: Animal Taxonomy and Museology (1976, Jai Prakash Nath).
2. Kapoor: Theory and Practicals of Animal Taxonomy (1988, Oxford & IBH).
3. Simpson: Principles of Animal Taxonomy (1962, Oxford).
4. Mayer & Ashlock: Principles of Systematic Zoology (1991, McGraw Hill).

Non Chordates

1. Ruppert and Barnes, RD (2006) Invertebrate Zoology, VIII edition .Holt Saunders International edition
2. Barnes ,R.S.K., Calow, P.Olive., Golding, D.W. and Spicer, J.LI. (2002) The Invertebrates; E.J.W, III Edition ,Blackwell Science
3. Nigam: Biology of Non-chordates (1997, S Chand)
4. Miller and Harley : zoology (6th Ed. 2005, W.C. Brown)
5. Parker & Haswell: Text Book of Zoology, Vol. I (2005, Macmillan)

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Chordates:

1. Miller & Harley: Zoology (6thed. 2005, W.C. Brown)
2. Nigam: Biology of Chordates (1997, S Chand)
3. Parker & Haswell, A Text Book of Zoology Vol.II (2005, Macmillan)
4. Sinha, A.K., & Adhikari, S and Ganguli, B.B Biology of Animals Vol.II New Central Agency, Calcutta
5. Vishwanath – vertebrate Zoology

ONLINE TOOLS AND WEB RESOURCES

- Swayam (MHRD) Portal
- Animal Diversity (<https://swayam.gov.in/courses/5686-animal-diversity>)
- Advances in Animal Diversity, Systematics and Evolution (<https://swayam.gov.in/courses/5300-zoology>)
- ePGPathshala (MHRD) Module 10, 18, 19 of the paper P-08 (Biology of Parasitism) <https://epgp.inflibnet.ac.in/ahl.php?csno=35>

Practical

Semester I

Major – 1 (MJ - 1) P (Practical) Systematics and Diversity of Life- Protists to Chordates
Credit – 2 **Lectures – 30 Hours**

FM= 100 [75 +25]

F.M. = 25

Practical Marks	Distribution
1. Dissection/ Project:	05
2. Slide Preparation (Mounting):	03
3. Spotting:	5×2=10
a. Museum Specimen: (03)	
b. Slides (02)	
5. Class record & Viva Voce	07
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	Total=25

Suggested Practical:

MJ 1

Study of Available Museum Specimen of animals:

Non Chordates:

Sycon, Physalia, Metridium, Fasciola, Taenia solium, Nereis, Aphrodite, Pheretima, Lingula, Chiton, Pila, Unio, Sepia, Loligo, Octopus, Eupagurus, Limulus, millipedes, centipedes, Palaemon, Antedon, Asterias, Echinus, Holothuria

Chordates:

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1. **Protochordate:** Balanoglossus, Herdmania
2. **Agnatha:** Petromyzon and Myxine
3. **Pisces:** *Scoliodon*, *Torpedo*, *Chimaera*, *Labeo rohita*, *Cirrhinus mrigala*, *Labeo bata*, *Hippocampus*, *Exocoetus*, *Syngnathus*, *Heteropneustes*, *Clarias batrachus*, *Anabas*, *Echeneis*, *Channa*, *Notopterus*
4. **Amphibia:** *Necturu*, *Proteus*, *Ambystoma*, *Axolotl larva*, *Salamandra*, *Alytes*, *Hyla*, *Bufo* (Toad), *Rana* (Frog)
5. **Reptiles:** *Kachuga*, *Calotes*, *Draco*, *Phrynosoma*, *Chameleon*, *Typhlops*, *Naja naja*, *Bungarus* (Krait), *Vipera* (Chandrabora), *Hydrophis*, *Crocodylus*, Python.
6. **Aves:** *Columba livia*, *Psittacula* (Parrot), *Bubo* (Great Horned owl), *Alcedo* (Kingfisher), *Dinopium* (Woodpecker), *Passer* (House Sparrow), *Pycnonotus* (Bul-Bul), Ostrich model. Types of beaks and claws
7. **Mammals:** Prototheria Models of Duck-Bill Platypus, Spiny Anteater, *Pteropus* (Megachiroptera), *Manis* (Pangolin), *Funambulus* (squirrel), *Hystrix* (Porcupine), *Cavia* (Guinea Pig), *Rattus rattus* (rat).

Study of the following through permanent slide

Paramecium (wm), Conjugation of *Paramecium*, *Obelia* colony, Medusa, Gemmules of Sponges, Miracidium larva, Sporocyst larva, Redia larva, Cercaria larva, Trochophore larva, Glochidium larva, Nauplius, Zoea larva, Mysis larva, Megalopa larva, Bipinnaria larva, Echinopluteus larva, Ophiopluteus larva,

Mounting:

Mounting of Nephridia & Ovary of Earthworm, Trachea And Salivary Gland of *Periplaneta americana*,
Cycloid and Placoid

Collection of five species (preferably invertebrates, insects) belonging to a clade. A project work on their generic identification, description and illustration with a note on their locality. Also the assessment of their relationship by constructing a cladogram using characters and character states.

Study of animals in nature during a survey of a National Park or Forest area.

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Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
NEP UG Syllabus
Semester II

Major – 2 (MJ - 2) Cell Biology and Histology
Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type** of **5 marks each**.
- **Group B** will contain **descriptive type five questions** of **15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to understand:

1. Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanisms involved.
2. Acquire the detailed knowledge of different pathways related to cell signaling and apoptosis thus enabling them to understand the anomalies in cancer.
3. Develop an understanding how cells work in healthy and diseased states and to give a 'health forecast' by analyzing the genetic database and cell information.
4. Get new avenues of joining research in areas such as genetic engineering of cells, cloning, vaccines development, human fertility programme, organ transplant, etc.
5. Understand how tissues are produced from cells in a normal course and about any malfunctioning which may lead to benign or malignant tumor.

Unit	Topic	No. of periods
Unit 1: Prokaryotic and Eukaryotic Cells.		
1.1	General structure of prokaryotes, bacteria, Archaea and eukaryotes.	02
1.2	Ultrastructure and Functions:	10
	1.2.1: Endoplasmic Reticulum	
	1.2.2: Ribosome	
	1.2.3: Golgi Apparatus	

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	1.2.4: Lysosome,	
1.3	Mitochondria: Origin, Structure, Composition and Function.	02
1.4	Nucleus: Size, Shape, Structure and Functions	02
Unit 2: Cell Membrane and Transport Mechanism		
2.1	Plasma Membrane:	04
	2.1.1: Origin	
	2.1.2: Structure	
	2.1.3: Composition	
	2.1.4: Function	
	2.1.5: Fluid Mosaic Model.	
2.2	2.2.1: Transport Across Membrane: Diffusion And Osmosis.	02
	2.2.2: Active And Passive Transport, Endocytosis And Exocytosis	
Unit 3: Cell Cycle, Cell Signaling		
3.1	3.1.1: Cell Cycle, Cell Division- Mitosis And Meiosis.	10
	3.1.2: Cell Divisions Check Points And Their Regulation. Role Of Growth Factors	
3.2	Programmed Cell Death (Apoptosis).	
3.3	Cell Regulation and Cell Signaling: Signaling Molecules and their Receptors.	
Unit 4: Structural and Functional Significance of Animal Tissues		
4.1	Introduction to tissues. Epithelial Tissue: Types, Structure And Characteristics. Surface Modifications.	06
4.2	Basement membrane: Structure and Characteristics	
4.3	Cell junctions.	
4.4	Connective tissue cells. Structure and function of loose, dense and adipose tissue.	
4.5	Muscular tissue: Ultrastructure of	04
	4.5.1: Smooth Muscles	
	4.5.2: Skeletal Muscles	
	4.5.3: Cardiac Muscles	

Books Recommended

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1. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments (6th edition) John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006) Cell and Molecular Biology (8th edition) Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. (5th edition) ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M.; Kleinsmith, L.J.; Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. (7th edition) Pearson Benjamin Cummings Publishing, San Francisco.

**Practical
Semester II**

Major – 2 (MJ - 2) Cell Biology and Histology
Credit – 2

Lectures – 30 Hours

FM= 100 [75 +25]

F.M.= 25

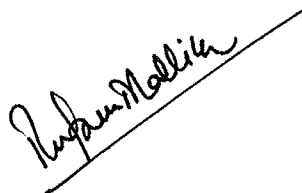
Practical Marks	Distribution
1. Study of Meiosis stages through slides	05
2. Slide Preparation (Mounting):	03
3. Spotting:	05x02= 10
a. Slides (Tissues) (03)	
b. Slides (Eukaryotic & Prokaryotic Cells) (02)	
5. Class record & Viva Voce	07
	Total=20

Suggested Practical

Cell Biology

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis.
2. Study of slides of prokaryotic-Bacteria
3. Study of slides of Unicellular Eukaryotic cell- *Amoeba*, *Paramecium*, *Euglena*
4. Study of various stages of cell division through permanent slides Mitosis and Meiosis.
5. Study of types of tissue through permanent slides: epithelial, connective, muscular, nervous etc.











Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
NEP UG Syllabus
Semester III

Major – 3 (MJ - 3) Genetics and Biochemistry
Credit – 4
FM= 100 [75 +25]

Lectures – 60 Hours
T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

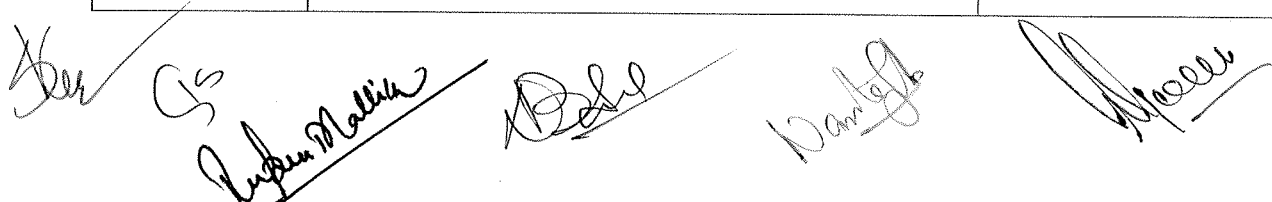
- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type** of **5 marks each**.
- **Group B** will contain **descriptive type five questions** of **15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to:

1. Understand how DNA encodes genetic information and the function of mRNA and tRNA
2. Apply the principles of Mendelian inheritance.
3. Understand the cause and effect of alterations in chromosome number and structure.
4. Discuss and analyse the epigenetic modifications and imprinting and its role in diseases.
5. Get new avenues of joining research in related areas such as genetic engineering of cells, cloning, genetic disorders, human fertility programme, genotoxicity, etc
6. And understand about the importance and scope of biochemistry.
7. Understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids.
8. Understand the concept of enzyme, its mechanism of action and regulation
9. Learn the preparation of models of peptides and nucleotides.
10. Learn biochemical tests for amino acids, carbohydrates, proteins and nucleic acids.
11. Learn measurement of enzyme activity and its kinetics.

Unit	Topic	No. of periods
Unit 1: Concept of Genes, Genomics and recombination and interaction of Genes		
1.1	Classical and Modern concept of: 1.1.1: Gene (Cistron, Muton, Recon) 1.1.2: Alleles	01



1.2	Classical Genetics: 1.2.1: Mendel's laws of inheritance 1.2.2: Chromosomal basis of inheritance and its applications Exceptions to Mendelian Inheritance: 1.2.1: Incomplete dominance 1.2.2: Codominance 1.2.3: Multiple allelism & Lethal alleles 1.2.4: Epistasis - Recessive, Double recessive and Double Dominant. 1.2.5: Pleiotropy	08
1.3	Linkage and crossing over	02
1.4	Sex Chromosomes and sex-linkage: 1.4.1: XX/XO, XX/XY, ZZ/ZW 1.4.2: Haploidy/Diploidy Types 1.4.3: Gene Dosage Compensation 1.4.4: Epigenetics	04
1.5	Genetic Alterations: 1.5.1: Structural Alterations of Chromosomes 1.5.2: numerical Alterations of Chromosomes, Genetic Disorders: 1.5.3: Chromosomal Aneuploidy (Down, Turner And Klinefelter Syndromes), And 1.5.4: Chromosome Translocation (Chronic Myeloid Leukemia) 1.5.5: Deletion, Gene Mutation (Sickle Cell Anemia).	08
1.6	Autosomal & Sex Linked Inheritance: 1.6.1: Autosomal Dominant and Autosomal recessive, 1.6.2: X-linked Dominant, and X-linked recessive. 1.6.3: Haplodiploidy, Genic Balance Theory, Intersex & Gynandromorphs.	04
1.7	Role of environmental factors- Crocodile	
Unit 2: Human Population Genetics		
3.1	Human Genetics: 3.3.1: Pedigree Analysis 3.3.2: Karyotype, Banding and Nomenclature of Chromosome Subdivisions.	
Unit 3: Biochemistry: Carbohydrates, Lipids and Proteins		

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3.1	3.1.1: Carbohydrates: Structure, Classification and Biological Importance.	04
3.2	3.2.1: Glycolysis, 3.2.2: Krebs cycle,	
3.3	Lipids: 3.3.1: Structure and Biological significance. Fatty acids- 3.3.2: Types, Nomenclature (Saturated and Unsaturated) and Classification	02
3.4	Amino acids – 3.4.1: Structure, Classification and Properties, Proteins: 3.4.2: Composition and Biological significance	02
3.5	Enzymes: 3.5.1: Nomenclature and Classification 3.5.2: General Properties 3.5.3: Specificity 3.5.4: Cofactors & Isozymes. 3.5.5: Mechanism of enzyme action	04
Unit 4: Nucleic acids		
4.1	Structure: Bases, nucleosides and nucleotides.	06
4.2	Types of Nucleic Acids	
	4.2.1: DNA Structure: Watson & Crick Model 4.2.2: Types of RNA: m-RNA, t- RNA & r- RNA	

Books Recommended:

Genetics

1. Brooker: Genetics : Analysis and Principles (1999, Addison-Wesley,)
2. Gardner *et al*: Principles of Genetics (1991, John Wiley)
3. Griffith *et al*: An Introduction to Genetic Analysis (2005, Freeman)
4. Hartl & Jones: Essential Genetics: A Genomic Perspective (2002, Jones & Bartlett)
5. Russell: Genetics (2002, Benjamin Cummings)
6. Lewin: Genes IX (2008, Jones & Bartlett)

Biochemistry

1. Boyer: Concepts in Biochemistry (3rd ed. 2006, Brooks/Cole)
2. Lehninger, Nelson & Cox: Principles of Biochemistry (4th ed, 2007, Worth),
3. Murray *et al*: Harper's Biochemistry (25th ed. 2000, Appleton & Lange)
4. Stryer: Biochemistry (5th ed. 2001, Freeman)
5. Harper's illustrated biochemistry

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**Practical
Semester III**

**Major – 3 (MJ - 3) Genetics and Biochemistry
Credit – 2**

Lectures – 30 Hours

FM= 100 [75 +25]

F.M. = 25

Practical	Marks Distribution
1. Statistical Verification of Law Of Segregation:	05
2. Biochemistry Practical	05
3. Genotype analysis through Pedigree chart/ Ishihara test/ Structural of chromosomal aberrations	05
5. Class record	05
6. Viva Voce	05
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	Total=25

Suggested Practical:

Genetics:

1. Experiment Verification of Principles of Segregation and Independent Assortment Using Colored Beads and Chi-Square Test.
2. Preparation of Linkage Maps Based on this Data from Drosophila/Maize.
3. Study of Pattern of Inheritance in Human Population of the Traits Rolling Of Tongue And Mid Digital Hair, Hypertrichosis, Widow's Peak
4. Genotype Analysis in the Pedigree Chart of the Victorian Family Affected With Haemophilia Study of Colour Blind by Isihara Chart.
5. Study of structural chromosome aberrations (dicentric, ring chromosomes and inversions in polytene chromosomes) from prepared slides/photographs
6. Study of human karyotypes and numerical alterations (Down syndrome, Klinefelter syndrome and Turner syndrome)

Biochemistry:

Detection of biomolecules in the unknown sample-

- a. Benedict's test for reducing sugars.
- b. Ninhydrin test for α amino acids.
- c. Iodine test for starch

Preparation of model of nitrogenous bases, nucleosides and nucleotides.

Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
NEP UG Syllabus
Semester IV

Major – 4 (MJ - 4) Mammalian Physiology & Endocrinology

Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)

Instructions:

- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type of 5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to:

- Understand the physiology at cellular and system levels.
- Understand the mechanism and regulation of breathing, oxygen consumption and determination of respiratory quotient.
- Understand how mammalian body gets nutrition from different biomolecules.
- Understand the process of digestion and excretion.
- Understand the organization of nervous system and process of nerve conduction.
- Learn the determination of hemoglobin content, blood groups and blood pressure.
- Understand neurohormones and neurosecretions.
- Learn about hypothalamo and hypapophysial axis.
- Understand about different endocrine glands and their disorders.
- Understand the mechanism of hormone action.

Unit	Topic	No. of periods
Unit 1: Mammalian Physiology: Digestion & Excretion Reproduction		
1.1	Nutrition: 1.1.1: Concept of BMR	02
	1.1.2: Concept of Balanced Diet	
1.2	Physiology of Digestion & Absorption: 1.2.1: Carbohydrates	05
	1.2.2: Proteins	
	1.2.3: Fats	

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1.3	Physiology of Excretion: 1.3.1: Anatomy of Kidney	03
	1.3.2: Physiology of Urine Formation	
1.4	Reproductive Physiology: 1.4.1: Histo-Physiology of Testis	03
	1.4.2: Histo-Physiology of Ovary	
Unit 2: Respiration, Circulation & Nervous System		
2.1	Body Fluids: 2.1.1: Composition & Function of Lymph	08
	2.1.2: Composition & Function of Blood	
	2.1.3: Blood Clotting Factors	
	2.1.4: Blood Clotting Mechanism	
2.2	Respiration: 2.2.1: Mechanism & Regulation of Breathing	04
2.3	Transport of Gases: 2.3.1: Transport of Oxygen	04
	2.3.2: Oxygen Dissociation Curve	
	2.3.3: Transport of Carbon Dioxide	
	2.3.4: Carbon Dioxide Dissociation Curve	
2.4	Nerve Physiology: 2.4.1: Structure & Types of Neuron	04
2.5	Origin of Action Potential and its Propagation 2.5.1: Myelinated & Non – Myelinated Nerve Fibers	04
	2.5.2: Saltatory Conduction	
2.6	Synapse: 2.6.1: Types of Synapse and Synaptic Transmission	02
Unit 3: Endocrinology: Hormones & Endocrine Glands		
3.1	Hormones: 3.1.1: Hormones, Properties & Classification of Hormones	04
	3.1.2: Nature and Mechanism of Hormones	
3.2	Endocrine Glands: 3.2.1: Structure & Histo-Physiology of Thyroid	08
	3.2.2: Structure & Histo-Physiology of Pituitary	
	3.2.3: Structure & Histo-Physiology of Adrenal	
	3.2.4: Structure & Histo-Physiology of Endocrine Pancreas	
3.3:	Gastrointestinal Hormones: 3.3.1: Gastrin	04
	3.3.2: Cholecystokinin	
	3.3.3: Secretin	
	3.3.4: Motilin	
Unit 4: Disease Associated With Hormonal Abnormality		
4.1	4.1.1: Cretinism, Goitre & Myxedema	

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	4.1.2: Gigantism, Dwarfism & Acromegaly	06
	4.1.3: Diabetes Insipidus Vs Diabetes Mellitus	
	4.1.4: Addison's Disease & Grave Disease	

Books Recommended:

Mammalian Physiology

1. Nielson: Animal Physiology – Adaptation and Environment (5th ed. 2008, Cambridge)
2. Marshall and Hughes: Physiology of Mammals and Vertebrates (2nd ed. 1980, Cambridge)
3. Prosser: Comparative Animal Physiology (4th ed. 1991, Satish Book)
4. C.C.Chaterjee Medical physiology
5. Guyton– a book on medical physiology

Endocrinology

1. Hadley: Endocrinology (5th ed. 2000, Prentice Hall)
2. Turner and Bagnara: General Endocrinology, 6th ed.1984, Saunders)
3. C.C.Chaterjee Medical physiology

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Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
NEP UG Syllabus
Semester IV

Major – 5 (MJ - 5) Behaviour and Chronobiology and Ecology

Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be very short answer type consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of short answer type of **5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to:

- Learn a wide range of theoretical and practical techniques used to study animal behaviour.
- Develop skills, concepts and experience to understand all aspects of animal behaviour.
- Objectively understand and evaluate information about animal behaviour and ecology encountered in our daily lives.
- Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild.
- Consider and evaluate behaviour of all animals, including humans, in the complex ecological world, including the urban environment
- Know the evolutionary and functional basis of animal ecology.
- Analyse a biological problem, derive testable hypotheses and then design experiments and put the tests into practice
- Acquire an in-depth knowledge on the diversity and relationships in animal

Unit	Topic	No. of periods
Unit 1: Behaviour & Chronobiology		
1.1	1.1.1: Patterns of behavior	02
	Kinds of behaviour: 1.1.2: Foraging Behaviour,	04
	1.1.3: Territorial Behaviour.	
	1.1.4: Mate Selection and Courtship Behaviour.	
1.2	Biological clocks: 1.2.1: Advantages of Biological Rhythms	04
	1.2.2: Circadian and Circannual Rhythms.	

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1.3	Migratory Behaviour in Birds and Fishes.	04
1.4	Innate Behaviour:	06
	1.4.1: Communication (Honey bee and Ants)	
	1.4.2: Mimicry and Colouration	
	1.4.3: Parental care in Amphibians & Fishes	
1.5	Learnt Behaviour:	02
	1.5.1: Types of learning -Habituation, Imprinting	
1.6	Social organization	04
	1.6.1: Honey bee	
	1.6.2: Termites	
Unit 2: Ecology		
2.1	Concept of Ecosystem:	10
	2.1.1: Introduction and Scope of Ecology.	
	2.1.2: Structure and Function of Ecosystem;	
	2.1.3: Abiotic factors affecting survival and sustenance of organisms e.g., Water, Temperature, Light, pH and Salinity	
2.2	2.2.1: Energy flow in ecosystem,	04
	2.2.2: Food chain and food web.	
2.3	Population Characteristics:	04
	2.3.1: Density, Natality, Mortality, Life Tables, Fecundity Tables, Survivorship Curves.	
2.4	Attributes of Population:	02
	Mortality, Age Ratio, Sex Ratio, Dispersal	
2.5	Ecotone and edge effect	01
2.6	Types of interaction:	02
	2.6.1: Positive interactions	
	2.6.2: Negative interactions	
2.7	Pollution:	04
	2.7.1: Air, Pollution and their Control	
	2.7.2: Water Pollution and their Control	
	2.7.3: Noise and their Control	

Books Recommended:

1. McFarland, D. (1999) Animal Behaviour (3rd edition) Pitman Publishing Limited, London, UK.
2. Freeland: Problems in Practical Advanced Level Biology (1985, Hodder & Stoughton,)
3. Manning, A. and Dawkins, M. S. (2012) An Introduction to Animal Behaviour (6th edition) Cambridge, University Press, UK
4. Sherman, P. W. and Alcock, J. (2013) Exploring Animal Behaviour (6th edition) Sinauer Associate Inc., Massachusetts, USA.
5. Kumar, V. (2002). Biological Rhythms: Narosa Publishing House, Delhi/ Springer - Verlag, Germany.

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**Practical
Semester IV**

**Major – 4 & 5 (MJ – 4 & 5 P) (Practical) Mammalian Physiology & Endocrinology
Credit – 4** **Lectures – 30 Hours**

F.M. = 50

Practical	Marks Distribution
1. Physiological Experiment:	10=05 = 15
2. Ecological Experiment:	10=05 =15
3. Study on Geo-taxis/ photo-taxis:	05
4. Spotting:	02x05= 10
a. Permanent slide (02)	
b. Behaviour (02)	
c. Bee hive/ Mound (01)	
5. Class record & Viva Voce	05

Total=50

Suggested Practical

MJ 4

Mammalian Physiology

1. Preparation of Haemin Crystal
2. RBC count by using haemocytometer
3. Estimation of Haemoglobin using Sahil's method
4. Record of blood pressure by Sphygmomanometer
5. Determination of Bleeding time in human
6. Determination of Coagulation time in human
7. Study of permanent slide of section of organs: Stomach, lung, liver, kidney, intestine

Endocrinology

Study of permanent slide of Endocrine gland: Thyroid, Pancreas, Adrenal, Pituitary, testis, ovary and uterus.

MJ 5

Animal Behaviour & Chronology

1. Study Of Geo-Taxis & Photo-Taxis In Animals
2. Locomotory Behavior of Dipteran Larvae (Housefly/Blowfly/Fruitfly)
3. Specimen Showing Behaviour –Prey Mantis, *Hippocampus*, *Alytes*, Migratory Fish
4. Study of Bee Hive & Mound of Termites
5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.

Ecology

1. Collection & Identification of different biotic components of the Pond ecosystem.
2. Study of an aquatic ecosystem-phytoplankton and zooplankton
3. Total hardness, turbidity, alkalinity
4. Determination of PH of water.
5. Estimation of Dissolved and Free Carbon Dioxide of water..

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Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
NEP UG Syllabus
Semester V

Major – 6 (MJ - 6) Reproductive System & Developmental Biology

Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be very short answer type consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of short answer type of **5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning outcomes

Upon successful completion of this course, students should be able to:

- Explain and contrast the processes of spermatogenesis, oogenesis.
- Demonstrate an understanding of the hormonal control of reproduction in males and how this is regulated;
- Distinguish between the main stages of embryonic, foetal and neonatal development and causes of foetal disorders.
- Understand the origin and characteristics of common congenital malformations;
- Know how sexually transmitted diseases may contribute to altered neonatal or reproductive function.
- Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.


Unit	Topic	Total no. of Lectures
Unit 1: Reproductive System: Gamete Formation & Fertilization		
1.1	1.1.1: Female Reproductive System in Human 1.1.2: Male Reproductive System in Human	06
1.2	Gametes:	04
	1.2.1: Structure,	
	1.2.2: Formation	
	1.2.3: Types	
	1.2.4: Competence	

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1.3	Fertilization:	08
	1.2.1: Attraction of Gametes,	
	1.2.2: Fertilizin and Anti Fertilizing Reaction,	
	1.2.3: Capacitation & Acrosomal Reaction	
	1.2.4: Cortical Reaction	
1.2.5: Amphimixis & Block to Polyspermy		
1.4	Fate Map in Amphibia & Birds	04
1.5	1.4.1: In vitro Fertilization & Amniocentesis; 1.4.2: Gamete intra – fallopian transfer (GIFT)	04
Unit 2: Early Development		Total no. of Lectures
2.1	Development:	06
	2.1.1: Direct Development	
	2.1.2: Indirect Development	
	2.1.3: Cleavage: Types and Patterns	
	2.1.4: Role of Yolk in Cleavage	
2.1.5: Body Plan and Symmetries.		
2.2	2.2.1: Placenta: Type's Structure and Functions.	04
	2.2.2: Germ layer differentiation.	
2.2	Morphogenesis:	02
	2.2.3: Epiboly	
	2.2.4: Emboly/ Invagination	
	2.2.5: Involution	
	2.2.6: Ingression	
2.3	Organogenesis: 2.3.1: formation of Gut, Heart, Kidney And Muscles In Frog	04
Unit 3: Early & Late Developmental Processes		Total no. of Lectures
3.1	Metamorphosis in Insect	02
3.2	Formation & Role of Extra Embryonic Membranes in Chick	04
3.3	Regeneration: Epimorphosis, Morphollaxis and Compensatory Regeneration.	04

Books Recommended:

1. Gardner, E.J. *et al.* (2006) Principles of Genetics (John Wiley).
2. Russell, P.J. (2010) Genetics (Benjamin Cummings).
3. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. (VIII edition) Wiley India.



4. Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. (V edition) John Wiley and Sons Inc.
5. Klug, W.S., Cummings, M.R. and Spencer, C.A. (2012). Concepts of Genetics. (X edition) Benjamin Cummings.
6. Gilbert, S.F. (2016) Developmental Biology (11th edition) Sinauer.

Rufan Malik Abdul Namirah

Abdul Abdul Abdul

Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
NEP UG Syllabus
Semester V

Major – 7 (MJ - 7) Microbiology, Parasitology and Immunology

Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type of 5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to:

- Carry out common procedures for culturing, purifying and diagnostics of micro-organisms understand the disease-causing potential of bacteria and viruses, and the responses of the immune system.
- Describe the mechanisms for transmission, virulence and pathogenicity in pathogenic micro-organisms.
- Diagnose the causative agents, describe pathogenesis and treatment for important diseases like malaria, leishmaniasis, trypanosomiasis, filariasis etc.
- Assess the importance of incidence, prevalence and epidemiology in microbiological diagnostic activities.
- Know how resistance development and resistance transfer occur.
- Identify the major cellular and tissue components which comprise the innate and adaptive immune system.
- Understand how are immune responses by CD4 and CD8 T cells, and B cells, initiated and regulated.
- Understand how does the immune system distinguish self from non-self.
- Gain experience at reading and evaluating the scientific literature in the area.

Unit	Topic	No. of periods
Unit 1: Microbiology		
1.1	Diversity of microbes- viruses and bacteria.	
1.2	Host pathogen interaction: invasion, antigenic heterogeneity, toxins and enzymes secretions.	

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1.3	Viral Diseases: AIDS & chicken pox, with Emphasis on Their Causative Agents, Pathogenesis, Diagnosis, Prophylaxis and Chemotherapy	10
1.4	Bacterial diseases caused by <i>Salmonella typhi</i> , <i>Mycobacterium tuberculosis</i> & <i>Vibrio cholerae</i> .	
Unit 2: Parasitology		
2.1	Introduction to parasites and parasitic diseases. Mode of transmission, portal of entry and implications of parasitism	06
2.2	Protozoan Diseases: Amoebiasis, Malaria, Leshmaniasis & Ascariasis,	
Unit 3: Immunology		
3.1	Cells And Organs Of Immune System- Primary And Secondary Lymphoid Organs.	10
3.2	Innate immunity: First and second lines of defense.	
3.3	Characteristics of antigen- antigenicity and immunogenicity, epitopes, haptens, adjuvant.	
3.4	Classical and Molecular Structure of Immunoglobulin. Classification, Properties and Functions of Immunoglobulins.	
3.5	Antigenic Determinants: Isotype, Allotype and Idiotype. Antigen and Antibody Interactions,	04
3.6	Complement System (Classical, Alternative and Lectin Pathways).	
Unit 4: Acquired immunity & Autoimmune disorders		
4.1	Acquired immunity: Humoral and cell mediated immune response.	08
4.2	MHC complex and molecules with classification and function.	
4.3	Autoimmune disorders. Monoclonal antibodies	

Books Recommended:

1. Jawetz, M. and Adelberg (2015) Medical Microbiology (27th edition)
2. Chatterjee, K.D (2015) Parasitology (13th edition)
3. Goldsby, R.A.; Kindt, T.J. and Kuby, J. (2006) Immunology (6th edition).
4. Roitt, I.; Brostoff, J. and Male, D. (2012) Immunology (8th edition).

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**Practical
Semester V**

Major – 6& 7 (MJ – 6 & 7) (Practical) Reproductive System & Developmental Biology & Microbiology, Parasitology and Immunology

Credit – 4

Lectures – 30 Hours

F.M. = 50

Practical	Marks Distribution
1. Comments on Embryological slides	02x05=10
2. Immune blood cells:	03x2 =06
3. Study of life stages:	10
4. Comments on:	02x06= 12
a. Development stages (02)	
b. Vectors (02)	
c. Permanent slides (02)	
5. Sessional Record	06
6. Viva voce	06
	Total=50

Suggested Practical

MJ 6

Reproductive System & Developmental Biology

1. Study of chick embryological slides (21, 24, 28 33, 36, 48 72 and 96 hours of incubation)
2. Study of WM & section of developmental stages of frog through permanent slides Morula, Gastrula, Cleavage, Neurula & Tadpole (Internal and External gills)
3. Study of different section of placenta (photographs/slides)
4. Transverse Sections of ovary, fallopian tube, uterus
5. Permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems

MJ 7

Microbiology:

1. Vectors (Bacteria): *Salmonella typhi*, *Mycobacterium tuberculosis* & *Vibrio cholerae*.
2. Vectors (Virus): HIV & Varicella-zoster Virus

Parasitology:

1. Study of life stages of: *Entamoeba histolytica*, *Leishmania donovani*, *Plasmodium*, *Ascaris lumbricoids*.

Immunology:

1. Study of blood film to study various types of immune blood cells through slides/photographs.
2. Demonstration of ELISA

3. Histological study of spleen, thymus & lymph nodes through slides/photographs
Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
NEP UG Syllabus
Semester VI

Major – 8 (MJ - 8) Molecular Biology & Biotechnology

Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type of 5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to:

- Develop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario.
- Get well versed in recombinant DNA technology which holds application in biomedical & genomic science, agriculture, environment management, etc. Therefore, a fundamental understanding of Molecular Biology will help in career building in all these fields.
- Apply their knowledge in problem solving and future course of their career development in higher education and research.
- Get new avenues of joining research in related areas such as therapeutic strategies or related opportunities in industry.

Unit	Topic	No. of periods
Unit 1: Molecular Biology: Nucleic acids & Chromosomes; DNA Replication, Recombination, Repair etc.		
1.1	Central Dogma of Molecular Biology.	12
	Structure and Function of DNA, DNA forms: Plasmid DNA, Genomic DNA and Repetitive DNA.	
	Structure and Function of RNA, Ribosomal RNA (rRNA), Transfer RNA (tRNA), Messenger RNA (mRNA), Noncoding RNA.	

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1.2	Chromosomes, Chromatin, Histones, Histone-modifications	
1.3	1.3.1: DNA Replication in Prokaryotes	
	1.3.2: DNA recombination.	
Unit 2: DNA Damage & Repair		
2.1	2.1.1: Base Excision Repair	04
	2.1.2: Single Strand- and Double Strand DNA Repair	
	2.1.3: Nucleotide Excision Repair	
	2.1.4: Thymine Dimer Repair	
Unit 3: RNA Transcription		
3.1	Transcription, RNA polymerase I, II, III, transcription factors,	04
3.2	Regulation of gene expression in prokaryotes and eukaryotes.	
3.3	Genetic Code, triplet codons,	
Unit 4: Biotechnology		
4.1	Cloning Vectors And Enzymes	06
	4.1.1: Cloning Vectors	
	4.1.2: Restriction Enzyme	
	4.1.3: Endonuclease	
	4.1.4: DNA Polymerase	
4.1.5: Ligase.		
4.2	Dolly- The Transgenic clone	01

Books Recommended:

1. Watson, J.D. *et al.* (2013) Molecular Biology of the Gene (7th edition) CSHL Press Pearson.
2. Green, M. R and Sambrook, J. (2012) Molecular Cloning: a Laboratory Protocol (4th edition) CSHL Press.
3. Walter, P. (2007) Molecular Biology of the Cell (5th edition) Garland Science.
4. Gardner *et al*: Principles of Genetics (1991, John Wiley)
5. Griffith *et al*: An Introduction to Genetic Analysis (2005, Freeman)

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Rupen Mallik

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Van Singh

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Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
NEP UG Syllabus
Semester VI

Major – 9 (MJ - 9) Biostatistics and Applied Zoology

Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

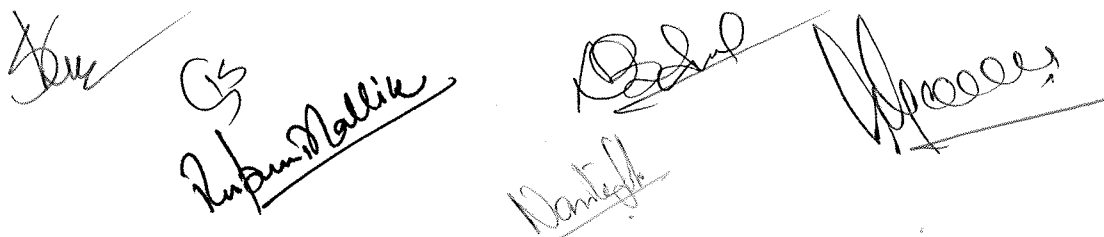
- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type of 5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to:

- Know basic concepts of probability and statistics.
- Describe statistical methods and probability distributions relevant for molecular biology data.
- Know the applications and limitations of different statistical methods.
- Understand data mining tool and its practical application in a case study
- Apply the knowledge in future course of their career development in higher education and research.
- Understand the culture techniques of pearl and fish.
- Understand the Bee keeping equipments and apiary management.
- Understand silkworms rearing and their products
- Learn various concepts of lac cultivation.
- Be aware of a broad array of career options and activities in human medicine, biomedical research and allied health professions.

Unit	Topic	No. of periods
Biostatistics		
Unit 1: Sampling		
1.1	1.1.1: Collection and classification of data.	08
	1.1.2: Graphical representation of data: Pie chart, Bar diagram & Histogram	
1.2	1.2.1: Measures of central tendency: Arithmetic Mean,	
	1.2.2: Median	
	1.2.3: Mode	



1.3	1.3.1: Measures of dispersion: Standard Deviation	
Unit 2: Test of Significance		
2.1	Correlation	04
2.2	Regression	
Applied Zoology		
Unit 3: Aquaculture & Apiculture		
3.1	Fish culture: 3.1.1: Composite Fish farming 3.1.2: By Products of fishing industry 3.1.3: Pearl Culture	08
3.2	Apiculture: 3.2.1: Species of honey bees in India 3.2.2: Life cycle of honey bee (Apis) 3.2.3: Bee Products and their uses 3.2.4: Social Behavior Of Honey Bees.	08
Unit 4: Lac Culture & Sericulture		
4.1	Lac culture: 4.1.1: Lac Insect and its Life Cycle 4.1.2: Cultivation of Lac Insect 4.1.3: Host Plants, Processing and Uses of Lac	06
4.2	Sericulture: Types: 4.2.1: Silk 4.2.2: Silkworms 4.2.3: Their Host Plants 4.2.4: Life history of silkworm	06

Books Recommended:

MJ 8

Biostatistics:

1. Daniel, W.W. (2012) Biostatistics: A Foundation for Analysis in Health Sciences (10th edition) John Wiley.
2. Milton, J.S. & Tsokos, J.O. (1992) Statistical Methods in the Biological and Health Sciences (2nd edition) McGraw Hill.
3. Rastogi, V.B.-Methods in Biostatistics, MedTec, New Delhi.
4. Mount, D.W. (2006) Bioinformatics (2nd edition) CBS.

MJ 9

Applied Zoology:

1. Shukla, G.S. and Upadhyaya, V.B. (1999-2000). Economic Zoology (Rastogi Publishers).
2. Mani, M.S. (2006). Insects, NBT, India.
3. Jabde, P.V. (2005) Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture.

**Practical
Semester VI**

**Major – 8 & 9 (MJ –8&9) (Practical) Molecular Biology & Biotechnology and
Biostatistics and Applied Zoology**

Credit – 4

Lectures – 30 Hours

F.M. = 50

Practical	Marks Distribution
1. Molecular Biology Experiment	08
2. Comments on transgenic animals/cloned animals Photographs	02x05=10
3. Calculate or present the given data as per instructions:	10
4. Study of life cycle:	06
5. Comments on: Major Carps/ Castes of Honey bee/ lac stick/ cocoon/Honey comb	02x03=06
6. Sessional Record	05
7. Viva voce	05
	Total=50

Suggested Practical

Molecular biology & Biotechnology

1. Demonstration of DNA separation on Gel
2. Use of micropipette
3. Protein estimation by Colorimeter
4. Study of transposition through Maize specimens/Photographs
5. Study of cloned animals through photographs
6. Study of transgenic animals through photographs

Biostatistics:

1. Determination of Mean, Median and Mode.
2. To Perform Chi-Square Test For A Given Set Of Data.
3. To Learn Graphical Representations of statistical data with the help of computers (eg.MS Excel).
4. Determination of Deviation.

Applied Zoology:

1. Identification of two major carps – *Labeo rohita* and *Catla catla* and their life cycles.
2. Castes (through charts/specimens) study of bees
3. Life cycle of mulberry silkworm, *Bombyx mori* (model/chart/specimens) and life cycle of tasar silkworm, *Antheraea mylitta*.
4. Study Of Infested Lac Stick, Cocoon, Honey Comb.
5. Report on Field Visit To Sight Of Sericulture, Apiculture, Lac Culture


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Binod Bihari Mahto Koyalancha University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
Advance Major
Semester VII

Advance Major – 1 (AMJ - 1) Evolutionary Biology
Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

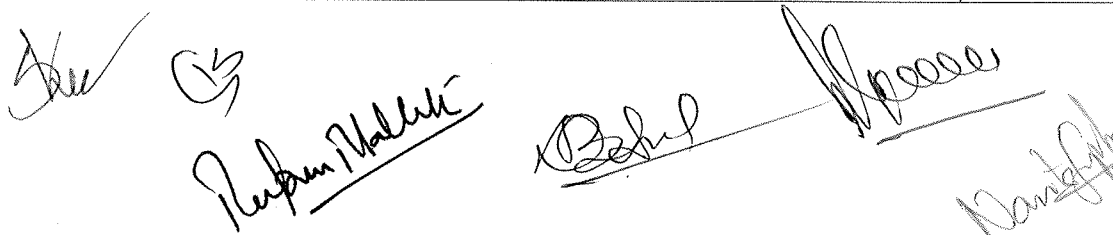
- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type of 5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to understand:

1. Acquire an in-depth knowledge on the diversity and relationships in animal world.
2. Develop a holistic appreciation on the phylogeny and adaptations in animals.
3. Enable the students to understand the evolution of universe and life.
4. Understanding on the process and theories in evolutionary biology.
5. Develop an interest in the debates and discussion taking place in the field of evolutionary biology.

Unit	Topic	No. of periods
Unit 1: Geological History And Evidences Of Evolution		
1.1	Geological Time, Scale & Geological Era.	12
1.2	Fossils	
	1.2.1: Types of Fossils	
	1.2.2 Modes of Formation of Fossils	
	1.2.3: Age Determination of Fossils	
1.3	Fossil History of Evolution of Horse	



1.4	Evolution of Man	
Unit 2: Theory & Sources of Evolution		
2.1	Theories of Evolution	10
	2.1.1: Lamarckism	
	2.1.2: Neo- Lamarckism	
	2.1.3: Darwinism	
2.1.4: Neo- Darwinism		
2.2	Sources of Variations:	
	2.2.1: Mutation	
	2.2.2: Recombination	
2.3	Reproductive Isolation & Its Role in Evolution	
Unit 3: Evolutionary Forces		
3.1	Hardy – Weinberg Law of Equilibrium	10
3.2	Genetic Drift	
	3.2.1: Bottle- Neck Phenomenon	
	3.2.2: Founder's Principle	
3.3	Natural selection	
	3.3.1: concept of fitness & selection coefficient,	
	3.3.2: Types of Selection	
	3.3.3: Kin Selection	
	3.3.4: Sexual Selection	
Unit 4: Levels & Pattern Of Evolution		
4.1	Microevolution:	06
	4.1.1: Species concept	
	4.1.2: Isolating mechanisms	
	4.1.3: Modes of Speciation—	
	• Allopatric,	
	• Sympatric,	
	• Parapatric	
4.2	Macroevolution	06
4.3	Mega-Evolution	
4.4	Basic Pattern of Evolution:	
	4.4.1: Divergent Evolution,	
	4.4.2: Adaptive Radiation,	
	4.4.3: Parallel Evolution	
	4.4.4: Convergent Evolution	

Books Recommended

Evolution

1. Moody: Introduction to Evolution (1978, Kalyani).
2. Savage: Evolution (1963, Holt, Reinhart and Winston)
3. Rastogi: Organic Evolution (1988, Kedarnath & Ramnath)
4. Strickberger: Evolution (2004, Jones & Bartlett)

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**Department of Zoology
Advance Major
Semester VII**

Advance Major – 2 (AMJ - 2) Agrochemicals and Pest Management

Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)

Instructions:

- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be very short answer type consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of short answer type of **5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to understand:

1. Gain knowledge and expertise on the agrochemicals and their modes of action and their fates in the agro-ecosystem.
2. Have the knowledge of pesticide families and be able to differentiate among families based on their specific modes of activity.
3. Aware of the laws and regulations governing the proper use of pesticides.
4. Develop appropriate pesticide management strategies by evaluating specific pest type.
5. Understand the factors involved in calibrating equipment for pesticide applications.
6. Estimate the potential hazards to humans, wildlife, and the environment.

Unit	Topic	No. of periods
Unit 1: Fundamentals of Pest management		
1.1	Pest: 1.1.1: Definition, Types of Pest According to Damage (Sub-Economic, Occasional, Perennial) 1.1.2: Economic Threshold.dioxide; Respiratory quotient	06
Unit 2: Practical Approach To Pest Management		

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2.1	Integrated Pest Management:	10
	2.1.1: Cultural	
	2.1.2: Biological	
	2.1.3: Chemical	
2.1.4: Genetic Control.		
2.2	Agrochemicals:	
	2.2.1: Common Pesticides and Insecticides	
	2.2.2: Mode of Their Action.	
Unit 3: Study of Pest in Laboratory and Field		
3.1	3.1.1: Visit to Agriculture Field to Study Biology,	08
	3.1.2: Damage and Management Practices of Pests of Agriculture Crops.	
3.2	Rearing Of Stored Grain Pests and Study of Different Stages	
3.3	Role of Pheromone in Pest Surveillance	

Books Recommended:

Agro chemical & Pest Management

1. Pradhan, S. (1969). *Insect Pests of Crops*. National Book Trust, India Book House.
2. Atwal, A.S. (1993) *Agricultural pest of India and South East Asia*. Kalyani Pub., New Delhi.
3. Dennis, S. Hill. (2005) *Agricultural Insect pests of the tropics and their management*, Cambridge University press.
4. Pedigo L. P. (2002). *Entomology and Pest Management*, Prentice Hall Publication
5. Robert F. Norris, Edward P. Caswell-Chen and Marcos Kogan, *Concepts of Integrated Pest Management*, Prentice Hall of India.

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**Practical
Semester VII**

Advance Major – 1 (AMJ – 1P) Evolutionary Biology and Agrochemicals and Pest Management

Credit – 4

Lectures – 30 Hours

F.M. = 50

Practical	Marks Distribution
1. Study of: Serial homology/ Homologous and Analogous organs	10
2. Study of fossils/Evolution of horse (models)	10
3. Study of Pest/ infested plants	10
4. Instrument used pest management	10
5. Class record	05
6. Viva Voce	05
	Total=50

Suggested Practical:

AMJ 1

Evolution

1. Fossils study: *Trilobites, Archaeopteryx, Tyrannosaurus rex, Stegosaurus*
2. Evolution of Horse-through models
3. Study of Serial homology exhibited by appendages of Prawn.
4. Study of Homologous and Analogous organ

AMJ 2

AGRO CHEMICAL AND PEST MANAGEMENT

1. Collection Preservation and Slide Preparation of Pest.
2. Study of Pest / infested Plant.
3. Study of Instrument Used In Pest Management.
4. Trip to ICAR Governing Field of Your Locality.

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**Department of Zoology
Advance Major
Semester VIII**

Advance Major – 3 (AMJ - 3) Wildlife Conservation and Management

Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

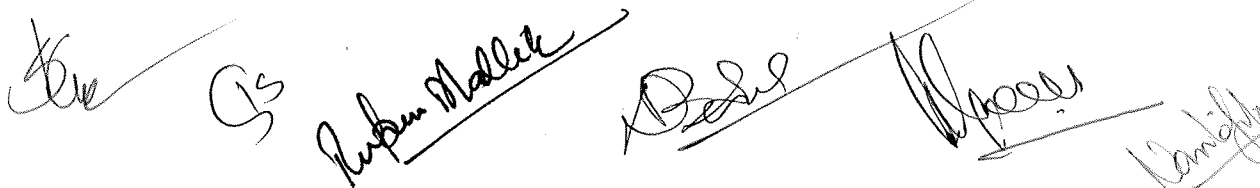
- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type of 5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to understand:

1. Develop an understanding of how animals interact with each other and their natural environment
2. Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues
3. Develop the ability to work collaboratively on team-based projects
4. Demonstrate proficiency in the writing, speaking, and critical thinking skills needed to become a wildlife technician
5. Gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management
6. Develop an ability to analyze, present and interpret wildlife conservation management information.

Unit	Topic	No. of periods
Unit 1: Introduction to Wildlife		
1.1	Values of Wildlife - Positive and Negative	04
1.2	Conservation Ethics	
1.3	Causes of Depletion	
1.4	Importance of Conservation	



1.5	World Conservation Strategies.	
Unit 2: Evaluation and Management of Wildlife		
2.1	Habitat Analysis	10
2.2	Physical Parameters:	
	2.2.1: Topography	
	2.2.2: Geology	
2.3	2.2.3: Soil and Water	
	Biological Parameters:	
2.4	2.3.1: Food, Cover, Forage, Browse	
	2.3.2: Cover Estimation	
2.4	Standard Evaluation Procedures:	
	2.4.1: Remote Sensing	
	2.4.2: GIS	
UNIT 3: Population Estimation		
3.1	Faecal Analysis of Ungulates and Carnivores	08
	3.1.1: Faecal Samples	
	3.1.2: Slide Preparation.	
3.2	Pug Mark	
3.3	Census Method.	
Unit 4: Wildlife Management And Planning		
4.1	Ecotourism / Wildlife Tourism in Forests	08
4.2	Common Diseases of Wild Animal	
4.3	National Parks & Sanctuaries	
4.4	Tiger Conservation –	
	4.4.1: Tiger Reserves in India	

Books Recommended:

1. Techniques for Wildlife Census in India: A Field Manual by W A Rdgers
2. Wildlife Ecology, Conservation, and Management by A. R. E. Sinclair and Graeme James Caughley
3. Conservation biology in theory and practice by Graeme James Caughley
4. Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
5. Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing

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**Department of Zoology
Advance Major
Semester VIII**

Advance Major – 4 (AMJ - 4) Aquatic Biology

Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

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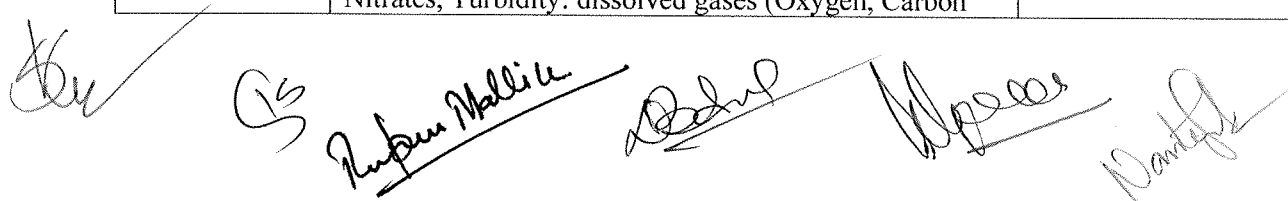
- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type of 5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to understand:

1. Understand and apply relevant scientific principles in the area of aquatic biology
2. Employ scientific methodologies such as experimentation and data analysis in the area of aquatic biology
3. Critically analyse, interpret and evaluate information relevant to aquatic biology
4. Appreciate the multidisciplinary nature of the study of aquatic biology and engage positively with people and ideas beyond their own discipline.
5. Explore some of the unique environmental problems dealing with aquatic environments.
6. Develop *employable skills* in freshwater biological water quality analysis.

Unit	Topic	No. of periods
Unit 1: Abiotic Conditions of Aquatic Ecosystems		
1.1	Brief introduction of the aquatic ecosystems.	04
1.2	Freshwater ecosystems (lakes, wetlands, streams and rivers).	
1.3	Physico-chemical Characteristics of Fresh, Marine & Estuaries water bodies Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity: dissolved gases (Oxygen, Carbon	



	dioxide)	
Unit 2: Aquatic organisms		
2.1	Feeding in aquatic organisms	10
2.2	Planktons:	
	2.2.1: Zooplanktons	
	2.2.2: Phytoplankton	
2.3	Respiration in aquatic organisms Aquatic respiration in aquatic arthropoda & Mollusca Respiration in bony & Cartilaginous fishes	
2.4	Osmoregulation in freshwater and Marine organisms	
UNIT 3: Adaptations in Fishes		
3.1	Electric organs	08
3.2	Adaptation of deep sea organisms	
3.3	Adaptation of hill-stream fishes.	
3.4	Bioluminescence	
3.5	Transgenic Fishes	
Unit 4: Management of Aquatic Resources		
4.1	4.1.1: Aquatic pollution - Causes of pollution: Agricultural, Industrial, Sewage,	08
	4.1.2: Eutrophication	
4.2	Conservation of water	
4.3	Water pollution acts of India	

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**Practical
Semester VIII**

Advance Major – 3 & 4 (AMJ – 3 & 4P) (Practical) Wildlife Conservation and Management and Aquatic Biology
Credit – 4

Lectures – 30 Hours

F.M. = 50

Practical	Marks Distribution
1. Identification of wild fauna on the basis of pugmark/Pellets/nests	05
2. Comment on fishes/air breathing fishes/planktons	10
3. Study of Endangered species	10
4. Water quality analysis	05
5. Types of Scales	05
6. Instrument used in wildlife management	05
7. Class record	05
8. Viva Voce	05
	Total=50

Suggested Practical:

AMJ 3

Wildlife Conservation and Management

1. Identification of Flora, Mammalian Fauna, Avian Fauna, Herpeto-Fauna.
2. Demonstration of Basic Equipment Needed In Wildlife Studies Use, Care And Maintenance (Compass, Binoculars, Spotting Scope, Range Finders, Global Positioning System, Various Types Of Cameras And Lenses)
3. Familiarization and Study of Animal Evidences in the Field; Identification of Animals through Pug Marks, Pellet Groups, Nest.
4. Study of Endangered species through photographs
5. Visit to National Parks/ Sanctuaries/ Protected Areas

AMJ 4

Aquatic Biology:

1. Morphometric Characters of Fishes
2. Identification of *Petromyzon*, *Myxine*, *Pristis*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas*
3. Study of Different Types of Scales (Through Permanent Slides/ Photographs).
4. Study of Planktons
5. Water Quality Criteria for Aquaculture: Assessment of Ph, Alkalinity, Salinity, DO. CO₂.
6. Study of Air Breathing Fishes: *Channa*, *Heteropneustes*, *Anabas* and *Clarias*
7. Project Report on a Visit to Any Fish Farm/ Pisciculture Unit/Zebrafish Rearing Lab

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Binod Bihari Mahto Koyalancha University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
Advance Major
Semester VII

Advance Major – 1 (AMJ - 1) Evolutionary Biology
Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type of 5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to understand:

1. Acquire an in-depth knowledge on the diversity and relationships in animal world.
2. Develop a holistic appreciation on the phylogeny and adaptations in animals.
3. Enable the students to understand the evolution of universe and life.
4. Understanding on the process and theories in evolutionary biology.
5. Develop an interest in the debates and discussion taking place in the field of evolutionary biology.

Unit	Topic	No. of periods
Unit 1: Geological History And Evidences Of Evolution		
1.1	Geological Time, Scale & Geological Era.	12
1.2	Fossils	
	1.2.1: Types of Fossils	
	1.2.2 Modes of Formation of Fossils	
	1.2.3: Age Determination of Fossils	
1.3	Fossil History of Evolution of Horse	

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1.4	Evolution of Man		
Unit 2: Theory & Sources of Evolution			
2.1	Theories of Evolution	10	
	2.1.1: Lamarckism		
	2.1.2: Neo- Lamarckism		
	2.1.3: Darwinism		
2.2	Sources of Variations:		
	2.2.1: Mutation		
2.3	2.2.2: Recombination		
	Reproductive Isolation & Its Role in Evolution		
Unit 3: Evolutionary Forces			
3.1	Hardy – Weinberg Law of Equilibrium		10
3.2	Genetic Drift		
	3.2.1: Bottle- Neck Phenomenon		
3.3	3.2.2: Founder’s Principle		
	Natural selection		
	3.3.1: concept of fitness & selection coefficient,		
	3.3.2: Types of Selection		
3.3.3: Kin Selection			
3.3.4: Sexual Selection			
Unit 4: Levels & Pattern Of Evolution			
4.1	Microevolution:	06	
	4.1.1: Species concept		
	4.1.2: Isolating mechanisms		
	4.1.3: Modes of Speciation—		
4.2	• Allopatric,		
	• Sympatric,		
	• Parapatric		
4.2	Macroevolution		
4.3	Mega-Evolution		
4.4	Basic Pattern of Evolution:		06
	4.4.1: Divergent Evolution,		
	4.4.2: Adaptive Radiation,		
	4.4.3: Parallel Evolution		
4.4.4: Convergent Evolution			

Books Recommended

Evolution

1. Moody: Introduction to Evolution (1978, Kalyani).
2. Savage: Evolution (1963, Holt, Reinhart and Winston)
3. Rastogi: Organic Evolution (1988, Kedarnath & Ramnath)
4. Strickberger: Evolution (2004, Jones & Bartlett)

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Department of Zoology
Advance Major
Semester VII

Advance Major – 2 (AMJ - 2) Agrochemicals and Pest Management

Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions** of **1 mark each**.
- **Question no. 2 & 3** will be of **short answer type** of **5 marks each**.
- **Group B** will contain **descriptive type five questions** of **15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to understand:

1. Gain knowledge and expertise on the agrochemicals and their modes of action and their fates in the agro-ecosystem.
2. Have the knowledge of pesticide families and be able to differentiate among families based on their specific modes of activity.
3. Aware of the laws and regulations governing the proper use of pesticides.
4. Develop appropriate pesticide management strategies by evaluating specific pest type.
5. Understand the factors involved in calibrating equipment for pesticide applications.
6. Estimate the potential hazards to humans, wildlife, and the environment.

Unit	Topic	No. of periods
Unit 1: Fundamentals of Pest management		
1.1	Pest: 1.1.1: Definition, Types of Pest According to Damage (Sub-Economic, Occasional, Perennial) 1.1.2: Economic Threshold.dioxide; Respiratory quotient	06
Unit 2: Practical Approach To Pest Management		

2.1	Integrated Pest Management:	10
	2.1.1: Cultural	
	2.1.2: Biological	
	2.1.3: Chemical	
2.1.4: Genetic Control.		
2.2	Agrochemicals:	
	2.2.1: Common Pesticides and Insecticides	
	2.2.2: Mode of Their Action.	
Unit 3: Study of Pest in Laboratory and Field		
3.1	3.1.1: Visit to Agriculture Field to Study Biology,	08
	3.1.2: Damage and Management Practices of Pests of Agriculture Crops.	
3.2	Rearing Of Stored Grain Pests and Study of Different Stages	
3.3	Role of Pheromone in Pest Surveillance	

Books Recommended:

Agro chemical & Pest Management

1. Pradhan, S. (1969). *Insect Pests of Crops*. National Book Trust, India Book House.
2. Atwal, A.S. (1993) *Agricultural pest of India and South East Asia*. Kalyani Pub., New Delhi.
3. Dennis, S. Hill. (2005) *Agricultural Insect pests of the tropics and their management*, Cambridge University press.
4. Pedigo L. P. (2002). *Entomology and Pest Management*, Prentice Hall Publication
5. Robert F. Norris, Edward P. Caswell-Chen and Marcos Kogan, *Concepts of Integrated Pest Management*, Prentice Hall of India.

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**Practical
Semester VII**

Advance Major – 1 (AMJ – 1P) Evolutionary Biology and Agrochemicals and Pest Management
Credit – 4

Lectures – 30 Hours

F.M. = 50

Practical	Marks Distribution
1. Study of: Serial homology/ Homologous and Analogous organs	10
2. Study of fossils/Evolution of horse (models)	10
3. Study of Pest/ infested plants	10
4. Instrument used pest management	10
5. Class record	05
6. Viva Voce	05
	Total=50

Suggested Practical:

AMJ 1

Evolution

1. Fossils study: *Trilobites, Archaeopteryx, Tyrannosaurus rex, Stegosaurus*
2. Evolution of Horse-through models
3. Study of Serial homology exhibited by appendages of Prawn.
4. Study of Homologous and Analogous organ

AMJ 2

AGRO CHEMICAL AND PEST MANAGEMENT

1. Collection Preservation and Slide Preparation of Pest.
2. Study of Pest / infested Plant.
3. Study of Instrument Used In Pest Management.
4. Trip to ICAR Governing Field of Your Locality.



**Department of Zoology
Advance Major
Semester VIII**

Advance Major – 3 (AMJ - 3) Wildlife Conservation and Management

Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

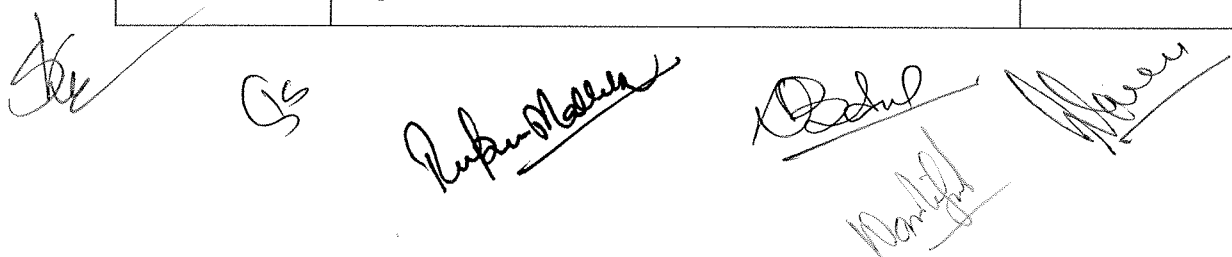
- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type of 5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to understand:

1. Develop an understanding of how animals interact with each other and their natural environment
2. Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues
3. Develop the ability to work collaboratively on team-based projects
4. Demonstrate proficiency in the writing, speaking, and critical thinking skills needed to become a wildlife technician
5. Gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management
6. Develop an ability to analyze, present and interpret wildlife conservation management information.

Unit	Topic	No. of periods
Unit 1: Introduction to WildLife		
1.1	Values of Wildlife - Positive and Negative	04
1.2	Conservation Ethics	
1.3	Causes of Depletion	
1.4	Importance of Conservation	



1.5	World Conservation Strategies.	
Unit 2: Evaluation and Management of Wildlife		
2.1	Habitat Analysis	10
2.2	Physical Parameters:	
	2.2.1: Topography	
	2.2.2: Geology	
2.3	2.2.3: Soil and Water	
	Biological Parameters:	
2.4	2.3.1: Food, Cover, Forage, Browse	
	2.3.2: Cover Estimation	
2.4	Standard Evaluation Procedures:	
	2.4.1: Remote Sensing	
	2.4.2: GIS	
UNIT 3: Population Estimation		
3.1	Faecal Analysis of Ungulates and Carnivores	08
	3.1.1: Faecal Samples	
	3.1.2: Slide Preparation.	
3.2	Pug Mark	
3.3	Census Method.	
Unit 4: Wildlife Management And Planning		
4.1	Ecotourism / Wildlife Tourism in Forests	08
4.2	Common Diseases of Wild Animal	
4.3	National Parks & Sanctuaries	
4.4	Tiger Conservation – 4.4.1: Tiger Reserves in India	

Books Recommended:

1. Techniques for Wildlife Census in India: A Field Manual by W A Rdgers
2. Wildlife Ecology, Conservation, and Management by A. R. E. Sinclair and Graeme James Caughley
3. Conservation biology in theory and practice by Graeme James Caughley
4. Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
5. Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing

**Department of Zoology
Advance Major
Semester VIII**

Advance Major – 4 (AMJ - 4) Aquatic Biology

Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type of 5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning outcomes

After successfully completing this course, the students will be able to understand:

1. Understand and apply relevant scientific principles in the area of aquatic biology
2. Employ scientific methodologies such as experimentation and data analysis in the area of aquatic biology
3. Critically analyse, interpret and evaluate information relevant to aquatic biology
4. Appreciate the multidisciplinary nature of the study of aquatic biology and engage positively with people and ideas beyond their own discipline.
5. Explore some of the unique environmental problems dealing with aquatic environments.
6. Develop *employable skills* in freshwater biological water quality analysis.

Unit	Topic	No. of periods
Unit 1: Abiotic Conditions of Aquatic Ecosystems		
1.1	Brief introduction of the aquatic ecosystems.	04
1.2	Freshwater ecosystems (lakes, wetlands, streams and rivers).	
1.3	Physico-chemical Characteristics of Fresh, Marine & Estuaries water bodies Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity: dissolved gases (Oxygen, Carbon	

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Unit 2: Aquatic organisms		
2.1	Feeding in aquatic organisms	10
2.2	Planktons:	
	2.2.1: Zooplanktons	
	2.2.2: Phytoplankton	
2.3	Respiration in aquatic organisms Aquatic respiration in aquatic arthropoda & Mollusca Respiration in bony & Cartilaginous fishes	
2.4	Osmoregulation in freshwater and Marine organisms	
UNIT 3: Adaptations in Fishes		
3.1	Electric organs	08
3.2	Adaptation of deep sea organisms	
3.3	Adaptation of hill-stream fishes.	
3.4	Bioluminescence	
3.5	Transgenic Fishes	
Unit 4: Management of Aquatic Resources		
4.1	4.1.1: Aquatic pollution - Causes of pollution: Agricultural, Industrial, Sewage,	08
	4.1.2: Eutrophication	
4.2	Conservation of water	
4.3	Water pollution acts of India	

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**Practical
Semester VIII**

Advance Major – 3 & 4 (AMJ – 3 & 4P) (Practical) Wildlife Conservation and Management and Aquatic Biology

Credit – 4

Lectures – 30 Hours

F.M. = 50

Practical	Marks Distribution
1. Identification of wild fauna on the basis of pugmark/Pellets/nests	05
2. Comment on fishes/air breathing fishes/planktons	10
3. Study of Endangered species	10
4. Water quality analysis	05
5. Types of Scales	05
6. Instrument used in wildlife management	05
7. Class record	05
8. Viva Voce	05
	Total=50

Suggested Practical:

AMJ 3

Wildlife Conservation and Management

1. Identification of Flora, Mammalian Fauna, Avian Fauna, Herpeto-Fauna.
2. Demonstration of Basic Equipment Needed In Wildlife Studies Use, Care And Maintenance (Compass, Binoculars, Spotting Scope, Range Finders, Global Positioning System, Various Types Of Cameras And Lenses)
3. Familiarization and Study of Animal Evidences in the Field; Identification of Animals through Pug Marks, Pellet Groups, Nest.
4. Study of Endangered species through photographs
5. Visit to National Parks/ Sanctuaries/ Protected Areas

AMJ 4

Aquatic Biology:

1. Morphometric Characters of Fishes
2. Identification of *Petromyzon*, *Myxine*, *Pristis*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas*
3. Study of Different Types of Scales (Through Permanent Slides/ Photographs).
4. Study of Planktons
5. Water Quality Criteria for Aquaculture: Assessment of Ph, Alkalinity, Salinity, DO. CO₂.
6. Study of Air Breathing Fishes: *Channa*, *Heteropneustes*, *Anabas* and *Clarias*
7. Project Report on a Visit to Any Fish Farm/ Pisciculture Unit/Zebrafish Rearing Lab

Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
NEP UG Syllabus
Minor Paper
Semester IV

Minor – 1 (MN - 1) Animal Classification & Diversity and Cell Biology
Credit – 4 **Lectures – 60 Hours**

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type of 5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning Outcomes:

After successfully completing this course, the students will be able to understand:

1. Develop understanding on the diversity of life with regard to Protists, non chordates and chordates.
2. Group animals on the basis of their morphological characteristics/ structures.
3. Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
4. Examine the diversity and evolutionary history of a taxon through the construction of a basic phylogenetic/ cladistics tree.
5. Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanisms involved.
6. Acquire the detailed knowledge of different pathways related to cell signaling and apoptosis thus enabling them to understand the anomalies in cancer.
7. Understand how tissues are produced from cells in a normal course and about any malfunctioning which may lead to benign or malignant tumor

Unit	Topic	Total no. of Lectures
Unit 1: Classification & Diversity of Non-Chordates		

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1.1	General characters and classification (up to classes) of the following phyla Protozoa, Porifera, Coelenterate, Platyhelminthes, Annelida, Mollusca, Arthropoda, Echinodermata & Hemichordate with examples	03
1.2	Non Chordates Form & function 1.2.1: Protozoa: Pathogenicity , treatment & prevention of diseases caused by <i>Entomeba histolytica</i> & <i>Leishmania dono-vani</i> 1.2.2: Porifera: Canal System of <i>sycon</i> 1.2.3: Coelenterata: Life Cycle of <i>obelia</i> & Metagenesis 1.2.4: Aschelminthes: <i>Ascaries</i> - life cycle & their pathogenicity 1.2.5: Annelida: <i>Pheretima</i> - Excretory system 1.2.6: Arthropoda: <i>P. alaemon</i> - Respiratory System 1.2.7: Mollusca: <i>Pila</i> - Respiratory system 1.2.8: Echinodermata: <i>Asterias</i> - Water vascular System	04
Unit 2: Classification & Diversity of Chordates		
2.1	General characters and classification of living chordates of the following Classes upto Mammalia	
2.2	Chordate forms & Function 2.2.1: Pisces: Respiratory & Accessory Respiratory organs 2.2.2: Reptilia: Biting mechanism of snake, Poison gland , Venom 2.2.3: Aves: Flight Adaptation in Birds 2.2.4: Mammals: Characters, distribution and affinities of prototheria	
Unit 3: Cell Biology		
3.1	Study of structure & function of Plasma membrane	
3.2	Study of cell Organelle-Mitochondria, ribosomes, lysosomes	
3.3	Ultra structure of Chromosomes	
Unit 4: Cell Cycle & Cell Signalling		
4.1	Cell Cycle, Cell Division- Mitosis And Meiosis.	
4.2	Cell Signaling: Signaling Molecules and their Receptors	

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Practical

Semester IV

Minor – 1 (MN – 1P) (Practical) Animal Classification & Diversity and Cell Biology
Credit – 2 Lectures – 30 Hours

F.M = 25

Practical	Marks Distribution
1. Study on stages of mitosis	05
2. Slide Preparation (Mounting):	05
3. Spotting:	05x02= 10
a. Museum Specimen (03)	
b. Permanent Slides (02)	
5. Class record & Viva Voce	05

Total=25

Suggested Practical

Non- Chordates

1. **Mounting:** Spicules of porifera; Obelia colony, Daphnia, trachea and salivary gland of Cockroach
2. **Museum Specimens:** Sycon, Euspongia, Aurelia, Gorgonia, Porpitta, Vallela, Metridium, Fungia, Tubipora, Pennatula, Meandrina, Tapeworm, Fasciola, Ascaris, Pheretima, Hirudinaria, Neries, Pila, Unio, Loligo, Sepia, Octopus, Hermit Crab, Prawn, Asretias, Sea Urchin, Brittle star
3. **Permanent slides:** Paramecium Slide (WM), L.S of Sycon, Obelia Colony, Medusa, Fasciola (W.M), Proglottids of Tapeworm,

Chordates:

1. **Pisces:** *Scoliodon, Torpedo, Labeo rohita, Cirrhinus mrigala, Hippocampus, Exocoetus, Clarias batrachus, Anabas,*
2. **Amphibia:** *Necturu, Ambystoma, Axolotl larva, Alytes, Hyla, Bufo (Toad), Rana (Frog)*
3. **Reptiles:** *Kachua, Calotes, Draco, Chameleon, Typhlops, Naja naja, Bungarus (Krait), Hydrophis, Crocodylus, Python.*
4. **Aves:** *Columba livia, Psittacula (Parrot), Bubo (Great Horned owl), Alcedo (Kingfisher) Ostrich model.*
5. **Mammals:** *Prototheria Models of Duck-Bill Platypus, Spiny Anteater, Pteropus (Megachiroptera), Manis (Pangolin), Funambulus (squirrel), Hystrix (Porcupine), Rattus rattus (rat).*

Cell Biology:

1. Study of permanent slides of Cell division (Mitosis)

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Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
NEP UG Syllabus
Minor Paper
Semester V

Minor – 2 (MN - 2) Genetics, Ecology and Evolution
Credit – 4

Lectures – 60 Hours

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

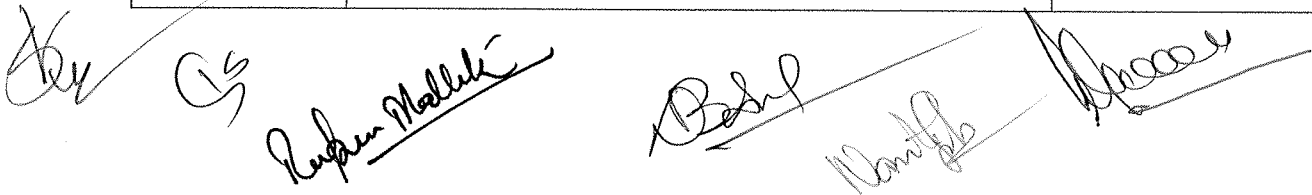
- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type of 5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning Outcomes:

After successfully completing this course, the students will be able to understand:

1. Understand how DNA encodes genetic information and the function of mRNA and tRNA
2. Apply the principles of Mendelian inheritance.
3. Understand the cause and effect of alterations in chromosome number and structure. .
4. Discuss and analyse the epigenetic modifications and imprinting and its role in diseases.
5. Get new avenues of joining research in related areas such as genetic engineering of cells, cloning, genetic disorders, human fertility programme, genotoxicity, etc
6. Know the evolutionary and functional basis of animal ecology.
7. Analyse a biological problem, derive testable hypotheses and then design experiments and put the tests into practice
8. Understand what makes the scientific study of animal ecology a crucial and exciting endeavour.
9. Acquire an in-depth knowledge on the diversity and relationships in animal world.

Unit	Topic	Total no. of Lectures
Unit 1: Genetics: Principle of Genetics		08
1.1	Mendel's Law of Inheritance	
1.2	Linkage and Crossing Over	
1.3	DNA: Structure & function	



Unit 2: Concept of gene expression		
2.1	Semi conservative DNA Replication in prokaryotes	08
2.2	Transcription in Prokaryotes	
2.3	Translation in Prokaryotes	
Unit 3: Ecology		
3.1	General Concept:	08
	3.1.1: Ecosystem	
	3.1.2: Food Chain & food Web & Ecological Pyramids	
	3.1.3: Energy Flow	
3.2	Population & Communities 3.2.1: Ecological Succession	03
3.3	Environmental Pollution:	08
	3.3.1: Pollution Sources	
	3.3.2: Impacts of Environmental Pollution-Air & Water	
	3.3.3: Green House Gases and Effects	
Unit 4: Evolution		
4.1	Theory of organic evolution	08
4.2	Lamarckism's theory of inheritance of acquired characters	
4.3	Darwin's theory of natural selection	

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Practical

Semester V

Minor – 2 (MN – 2P) (Practical) Genetics, Ecology and Evolution

Credit – 2

Lectures – 30 Hours

F.M= 25

Practical	Marks Distribution
1. Pedigree analysis	05
2. Ecological Experiment	05
3. Comment on: homologous/analogous organ/ fossils /extinct models	05
5. Class record	05
6. Viva Voce	05

Total=25

Suggested Practical

Genetics

1. Study of sex linked characters :Haemophilia and colour blindness through Pedigree Analysis

Ecology

1. Determination of pH in soil and water
2. Estimation of free carbon dioxide
3. Model of Food chain

Evolution

1. Study of homologous and analogous organ
2. Study of some fossils /extinct models: Dinosaurs, Archeopteryx

Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
NEP UG Syllabus
Minor Paper
Semester VI

Minor – 3 (MN - 3) Biochemistry, Physiology & Developmental Biology
Credit – 4 **Lectures – 60 Hours**

FM= 100 [75 +25]

T= 75 {60Ext. +15 Int.} (10+05)}

Instructions:

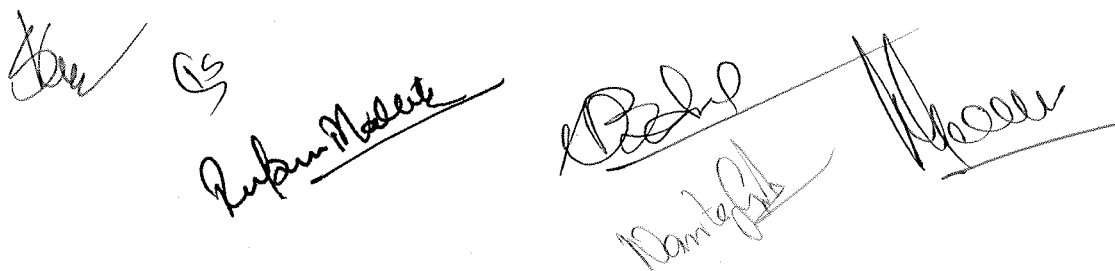
- There will be two groups of questions. **Group A** is compulsory which will contain **three questions**.
- **Question no. 1** will be **very short answer type** consisting of **five questions of 1 mark each**.
- **Question no. 2 & 3** will be of **short answer type** of **5 marks each**.
- **Group B** will contain **descriptive type five questions of 15 marks each**, out of which **any three are to answer**.

Learning Outcomes:

After successfully completing this course, the students will be able to understand:

1. Understand about the importance and scope of biochemistry.
2. Understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids.
3. Understand the structure and function of immunoglobulins.
4. Understand the concept of enzyme, its mechanism of action and regulation.
5. Understand the physiology at cellular and system levels.
6. Understand the mechanism and regulation of breathing, oxygen consumption and determination of respiratory quotient.
7. Understand how mammalian body gets nutrition from different biomolecules.
8. Understand the process of digestion and excretion.
9. Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.

Unit	Topic	Total no. of Lectures
Unit 1: Biochemistry		15
1.1	Structure and Classification of Biomolecules	
	1.1.1: Protein	
	1.1.2: Carbohydrates	
	1.1.3: Lipids	



1.2	Metabolism	
	1.2.1: Glycolysis	
1.2.2: Kreb's Cycle		
Unit 2: Physiology		
2.1	Blood composition , Blood Coagulation	18
2.2	Respiration: Transport of gases (O ₂ & CO ₂)	
2.3	Digestion of food : Protein, carbohydrate and lipid	
2.4	Excretion: Nephron & Urine formation	
Unit 3: Developmental biology		
3.1	Fertilization	10
3.2	Cleavage	
3.3	Placenta & their Function	

Practical

Semester VI

Minor – 3 (MN – 3 P) (Practical) Biochemistry, Physiology & Developmental Biology
Credit – 2

Lectures – 30 Hours

F.M. = 25

Practical	Marks Distribution
1. Biochemistry Experiment	05
2. Physiology Experiment	05
3. Comment on: Permanent slides of Chick Embryo/ Histology	2x5 = 10
5. Class record & Viva Voce	05
	<hr/> Total=25

Suggested Practical

Biochemistry:

- Biochemical test for Protein carbohydrate (Starch & Glucose) & Lipids
- Study of Haemin crystals

Physiology:

- Records of Blood pressure in Normal & after exercise
- Study of Permanent slides : Kidney, lungs, liver, stomach & Blood types

Developmental Biology:

- Study of Permanent slides of Chick Embryo (WM) -18 hrs , 24 hrs, 36 hrs & 72 hrs
- Types of placenta

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Binod Bihari Mahto Koyalanchal University, Dhanbad
Four Year Undergraduate Programme
Department of Zoology
NEP UG Syllabus
Introductory Regular Course

Introductory Regular Course: Zoology

Credit – 3

Unit	Topic	Total No. of Lectures
Unit 1: Diversity in the Living World		
1.1	Living World: Taxonomic Categories	04
	1.1.1: What is living?	
	1.1.2: Diversity in the living world	
	1.1.3: Taxonomic Categories	
1.2	Biological Classification	04
	1.2.1: Kingdom Monera	
	1.2.2: Kingdom Protista	
	1.2.3: Kingdom Fungi	
	1.2.4: Kingdom Plantae	
	1.2.5: Kingdom Animalia	
1.3	Animal Kingdom	02
	1.3.1: Basis of Classification	
	1.3.2: Classification of Animals	
Unit 2: Cell Biology		
2.1	Cell: Structure & Function	04
	2.1.1: Cell Theory	
	2.1.2: Prokaryotic Cell	
2.2	Biomolecules:	08
	2.2.1: Biomacromolecules: Proteins, Carbohydrates, Lipids, Nucleic Acids, Enzymes	

2.3	Cell Cycle & Cell Division	02
Unit 3: Human Physiology		
3.1	Digestion & Absorption	06
	3.1.1: Alimentary Canal & Digestive Glands	
	3.1.2: Digestion of Food	
	3.1.3: Absorption	
3.2	3.1.4: Associated Disorders	08
	Respiration & Transport of Gases	
	3.2.1: Respiratory Organs	
	3.2.2: Mechanism of Breathing	
	3.2.3: Exchange of Gases	
	3.2.4: Transport of Gases	
3.3	3.2.5: Regulation of Respiration	08
	3.2.6: Associated Disorders	
	Body Fluids & Circulation	
	3.3.1: Blood	
	3.3.2: Lymph	
	3.3.3: Circulatory Pathways	
3.4	3.3.4: Double Circulation	08
	3.3.5: Regulation of Cardiac Activity	
	3.3.6: Associated Disorders	
	Excretory System:	
	3.4.1: Human Excretory System	
	3.4.2: Urine Formation	
3.5	3.4.3: Function of the Tubules	06
	3.4.4: Counter Current Mechanism	
	3.4.5: Regulation of Kidney Function & Micturition	
	3.4.6: Associated Disorders	
	Nervous System	
3.6	3.5.1: Human Neural System	06
	3.5.2: Neuron	
	3.5.3: Central Nervous System	
	3.5.4: Sensory Reception & Processing	
	Reproductive System	
	3.6.1: Types of Reproduction	
3.6	3.6.2: Male Reproductive System	06
	3.6.3: Female Reproductive System	
	3.6.4: Gametogenesis	
	3.6.5: Menstrual Cycle	
	3.6.6: Fertilization, Implantation & Parturition	
Unit 4: Genetics & Evolution		
4.1	Principles of Inheritance and Variation	
	4.1.1: Mendel's Law of Inheritance	

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	4.1.2: Sex Determination	06
	4.1.3: Mutation	
	4.1.4: Genetic Disorders	
4.2	Molecular Basis of Inheritance 4.2.1: The DNA	06
	4.2.2: RNA World	
	4.2.3: Replication	
	4.2.4: Transcription	
	4.2.5: Genetic Code	
	4.2.6: Translation	
4.3	Evolution: Theories & Sources of Evolution <ul style="list-style-type: none"> • Lamarckism • Neo- Lamarckism • Darwinism • Neo-Darwinism 	
4.4	Sources of Variations: 2.2.1: Mutation 2.2.2: Recombination	
4.5	Reproductive Isolation & Its Role in Evolution	
4.6	Evolutionary Forces: <ul style="list-style-type: none"> • Hardy – Weinberg Law of Equilibrium 	
4.7	Genetic Drift 3.2.1: Bottle- Neck Phenomenon 3.2.2: Founder's Principle	

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