Maa Pateswari University, Balrampur

M.Sc. Syllabus Structure CBCS (NEP)
Subject: Zoology

Maa Pateswari University, Balrampur

M.Sc. Syllabus Structure CBCS (NEP)

Subject: Zoology

	PAPER CODE	PAPER	Credit
M.Sc. I YEAR (SEMESTER-I)			
Paper I	B050701T	NON-CHORDATA	4
Paper II	B050702T	BIOSTATISTICS AND COMPUTATIONAL BIOLOGY	4
Paper III	B050703T	COMPARATIVE ANIMAL PHYSIOLOGY	4
Paper IV	B050704T	BIOCHEMISTRY	4
Practical	B050705P	PRACTICAL	4
M.Sc. I YEAR (SEMESTER-II)			
Paper I	B050801T	CHORDATA	4
Paper II	B050802T	DEVELOPMENTAL BIOLOGY	4
Paper III	B050803T	GENETICS AND CYTOGENETICS	4
Paper IV	B050804T	ECOLOGICAL PRINCIPLES	4
Practical	B050805P	PRACTICAL	4
M.Sc. II YEAR (SEMESTER-III)			
PAPER I	B050901T	ANIMAL TAXONOMY, BEHAVIOUR AND CHRONOBIOLOGY	4
PAPER II	B050902T	ENVIRONMENTAL BIOLOGY, WILDLIFE AND ECONOMIC ZOOLOGY	4
PAPER III	B050903E (A)	MORPHOLOGY, PHYSIOLOGY AND DEVELOPMENT OF FISHES	4
PAPER III	B050903E (B)	PRINCIPLES OF ENDOCRINOLOGY	4
PAPER III	B050903E (C)	GENOME STRUCTURE AND REPLICATION OF DNA	4
PAPER III	B050903E (D)	INSECT MORPHOLOGY, PHYSIOLOGY, AND DEVELOPMENT THEORY	4
Paper IV	B050904E (A)	TAXONOMY AND FISH ECOLOGY	4
Paper IV	B050904E (B)	ENDOCRINE DISORDERS AND THEIR DIAGNOSIS	4
Paper IV	B050904E (C)	EXPRESSION OF GENOME	4
Paper IV	B050904E (D)	EVOLUTION.TAXONOMY AND INSECT ECOLOGY	4
Practical	B050905P	ZOOLOGY PRACTICAL	4
	B050906R	RESEARCH PROJECT	4
M.Sc. II YEAR (SEMESTER-IV)			
Paper I	B051001T	BIOINSTRUMENTATION AND BIOTECHNIQUES	4
Paper II	B051002T	COMPARATIVE ANATOMY OF VERTEBRATES	4
Paper III	B051003E (A)	APPLIED FISH AND FISHERIES	4
Paper III	B051003E (B)	REPRODUCTIVE ENDOCRINOLOGY I	4
Paper III	B051003E (C)	REGULATION OF GENE EXPRESSION	4
Paper III	B051003E (D)	ECONOMIC ENTOMOLOGY	4
Paper IV	B051004E (A)	AQUACULTURE FISHERIES	4
Paper IV	B051004E (B)	REPRODUCTIVE ENDOCRINOLOGY	4
Paper IV	B051004E (C)	APPLIED MOLECULAR BIOLOGY	4
Paper IV	B051004E (D)	APPLIED ENTOMOLOGY	4
	B051005P	ZOOLOGY PRACTICAL	4
	B051006R	RESEARCH PROJECT	4

Maa Pateswari University, Balrampur.

M.Sc. Syllabus Structure CBCS (NEP)

Subject: Zoology

Syllabus Developed/Proposed by				
S.*No.*	**Name of Expert/BOS Member**	**Designation**	**Department**	**College/ University**
1.	Prof. Ashok Kumar	Convener	Department of Zoology	M.L.K PG College, Balrampur
2.	Dr. Sadguru Prakash	Member	Department of Zoology	M.L.K PG College, Balrampur
3.	Dr. Abhinav Singh	Member	Department of Zoology	AND Kisan P.G. College, Babhnan, Gonda
4.	Shri Shishir Tripathi	Member	Department of Zoology	L.B.S.PG College Gonda
5.	Prof. Vinay Kumar Singh	Member	Department of Zoology	D D U Gorakhpur University
6	Dr. Ashutosh Srivastava	Member	Department of Zoology	Siddharth University, Kapilvastu, Siddharth Nagar
7	Prof. Arvind Kumar Sharma	Member	Department of Zoology	K.S. Saket P.G. College, Ayodhya
	Invited Member			
1	Prof. Mukul Sniha	Retd. Professor and Expert	Department of Zoology	L.B.S.PG College Gonda

Maa Pateswari University, Balrampur

M.Sc. Syllabus Structure CBCS (NEP)

Subject: Zoology

The M.Sc. The previous (Zoology) examination will consist of two semesters, called the first and second semesters. Their examinations will be held in December and May, respectively. In each of these semester examinations, there will be three compulsory theory papers and two elective papers (out of which the first elective will be a theory paper and the second elective will be a practical paper) to be selected from each group of optional papers. So, in total, there will be four theory papers and one practical paper. Each paper will be of three hours duration and 4 credits (maximum marks 75), except where stated otherwise.

There will be a 25% internal evaluation in each paper based on:

1. Attendance 05 Marks
2. Class Test/Assignment 10 Marks
3. Seminar 10 Marks

M.Sc. I Year (Semester-I) Paper I NON-CHORDATA

Course Code: B050701T	**Marks: 25+75 Credits: 4**	**Core Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Non-Chordata**	
Course objectives • To create in the student an appreciation of non-chordate diversity • To develop in the student an understanding of structural and functional diversity • To develop in the student an understanding of the evolutionary relationship amongst non-chordate groups		
Unit	Topics	No. of Lectures
I	Protozoa - Organization, osmoregulation, locomotion, nutrition and reproduction Porifera - Organisation and affinities Cnidaria - Origin of metazoa, polymorphism, coral reefs	15
II	Helminthes - General organisation and larval forms of trematodes and cestodes, parasitic adaptation Annelida -Adaptive radiation in polychaeta, segmental organs	15
III	Arthropoda -Larval forms in Crustacea, respiratory organs in Arthropods, mouthparts and modes of feeding in insects, economic importance of arthropods	15
IV	Mollusca-Modifications in the foot, nervous system and torsion in gastropods Echinodermata -Water vascular system, larval forms and their affinities Minor Phyla - Organisation and affinities of Rotifera, Ctenophora and Sipunculoidea	15

Student learning outcomes

The student, upon completion of the course, will be able to:

• Structural and functional diversity of non-chordate.
• Explain evolutionary relationshıp and larval forms amongst non-chordate groups.

Suggested Literature:

1. A life of invertebrates by W.D. Russel-Hunter, MacMillan Publishing Co., inc., New York.
2. Advances in invertebrates' reproduction by K.G. Adiyodi and R.G. Adiyodi, Peralam Kenoth Kerivellur, Kerala.
3. Biology of the invertebrates by Jan Pechenik, William C. Brown Publishers, Dubuque, Iowa.
4. Invertebrate Zoology by A. Kaestner, Interscience Publishers.
5. Invertebrates zoology by Alfred Kaestner, H.W.Levi & L.R. Levi, John Wiley & Sons Inc.
6. Invertebrates (Protozoa to Echinodermata) by Ashok Verma, Narosa Publishing House, New Delhi.
7. Invertebrates Learning by W.C. Corning and J.A.Dayal.

Maa Pateswari University, Balrampur

M.Sc. I Year (Semester-I)

Paper II BIOSTATISTICS AND COMPUTATIONAL BIOLOGY

Course Code: B050702T	**Marks: 25+75** **Credits: 4**	**Core Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title:** Biostatıstics and Computational Biology	

Course objectives

The course is designed so that students will learn:

- Representation of data in the form of a Table and a Graph
- Statistical Analysis
- Basics of Computers and Bioinformatics

Unit	**Topics**	**No. of Lectures**
I	Tabulation and graphical representation of the data: frequency distribution, tabulation, bar diagram, histogram, pie diagram and their significance, measure of central tendencies and variation in data, principle of probability, Probit log analysis	15
II	Test of Significance: t-test, analysis of variance, f-test, null hypothesis and chi-square test; distribution. normal, binomial and Poisson, correlation and regression ,	15
III	Basic components of computer hardware (CPU, input, output, storage device) and software (operating system); MS Excel: use of worksheet to enter, edit, copy, move data, Use of input statistical function for computation of mean, S.D., Correlation, Regression coefficient and graphical presentation	15
IV	Introduction to bioinformatics: Database: Nucleotide sequence database (Gene Bank, UCSC, EMBL, DDBJ) and protein sequence database (Swiss Prot, PDB, Blast, Ps1-Blast), FASTA, sequence alignment: pairwise and multiple sequence alignment	15

Student learning outcomes

Introduction to basic components of computers, Software (operating systems) and application software used in biological and statistical studies.

An overview of databank search, data mining, data management and interpretation.

An introduction and learning of Probit Log Analysis for the interpretation of toxicity data.

Books recommended :

1. P N Arora and P.K Malhan. Biostatics, Himalaya publishing house
2. Pagano M. Gauvreau, K (2000). Principles of Biostatistics, Duxbury press, USA
3. I A Khan and A Khanam, Fundamental of Biostatics, Ukaaz publıcation, Hyderabad
4. Batschelet, E., Introduction to mathematics for life scientists. Springer-Verlag, Berling.
5. Jorgensen, S.E., Fundamentals of ecological modeling, Elsevier, New York.
6. Swartzman, G.L., and S.P.O. Kaluzny, Ecological simulation primer, Mac mıllan, New York.

Maa Pateswari University, Balrampur.

M.Sc. I Year (Semester-I) Paper III Comparative Animal Physiology

Course Code: B050703T	**Marks: 25+75** **Credits: 4**	**Core Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title:** Comparative Animal Physiology	

Course objectives

To develop in the student an understanding of:

- Functioning of the organism's body
- The various homeostatic systems of the body
- Regulation of function in the body

Unit	**Topics**	**No. of Lectures**
I	• Digestion - Digestion and absorption of carbohydrates, proteins, lipids and nucleic acids • Excretion - Structure of the nephron, urine formation and its regulation • Acid-base balance and homeostasis • Thermoregulatory mechanism	15
II	• Respiration - Gaseous exchange through the respiratory membrane, respiratory pigments, respiratory adaptation to low oxygen tension, the mechanism and regulation of respiration • Circulation - Blood, lymph - composition. regulation of circulation: cardiac cycle	15
III	• Muscular System - Types and ultrastructure of muscle fibres, mechanism of muscular contraction, muscle twitch, summation, tetanus and fatigue	15
IV	• Nervous System - Structure and Functions of neurons, mechanism of conduction and transmission of nerve impulses, mechanism of synaptic transmission • Major endocrine glands, their secretion and functions (pituitary, thyroid, parathyroid, adrenal)	15

Student learning outcomes

The student, upon completion of the course, will be able to

- Understand various functional components of an organism's body
- Analyse the complexities and interconnectedness of these functional components
- Identify the mechanism underlying the maintenance of homeostasis of the body.
- Understand the regulatory mechanısms for maintenance of function in the body

Books recommended :

- Chatterjee C.C. (2016) Human Physiology Volume 1 & 2. 11th edition. CBS Publishers
- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company
- Tortora, G.J. & Grabowskı, S. (2006). Principles of Anatomy & Physiology. XI Edıtion John Wiley & Sons.
- C. Ladd Procsser. Comparative anımal physiology. Wiley Publication
- William Stewart Hoar. General and Comparative Physiology. Prentice Hall

Maa Pateswari University, Balrampur

M.Sc. I Year (Semester-I) Paper IV BIOCHEMISTRY

Course Code: B050704T	**Marks: 25+75** **Credits: 4**	**Core Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title:** Biochemistry	

Course objectives

To develop in the student an understanding of:

- an understanding of the biochemical basis of life
- role of stabilizıng interaction and biomolecular complexity
- biochemical processes as the foundation of all physiologıcal events occurring in anımals

Unit	Topics	No. of Lectures
I	• Thermodynamics -- Elementary thermodynamic system, second law and its applications, concept and calculation of free energy change during biologıcal redox reactions. Electrolytes - Concepts of Buffers, Henderson-Hasselbach Equation	15
II	• Carbohydrates- Glycolysis, Krebs' cycle, oxidative phosphorylation, gluconeogenesis, glycogenesis, glycogenolysis, hexose monophosphate pathway	15
III	• Amino Acids -Biosynthesis of amino acids (Phenylalanine, tryptophan and aspartate, and proline) • Proteins -Organisation and structure of proteins (a-helix, ß-sheet, motifs, folds, domains), Ramachandran plot	15
IV	• Lipid - Structure, classification and beta oxidation • Nucleic Acids - Structure, types and biosynthesis of nucleotides • Enzymes - Kinetics; inhibition; mechanism of action; Michaelis and Menton Equation; Isozyme: allosteric enzymes, ribozymes • Vitamins and coenzymes - Structure and functions	15

Student learning outcomes

The student, upon completion of the course, will be able to

- Understand various functional components of an organism's body
- Analyse the complexities and interconnectedness of these functional components
- Identify the mechanism underlying the maintenance of homeostasis of the body.
- Understand the regulatory mechanisms for the maintenance of function in the body
- In addition, the application of Biochemistry in understanding disease and medicine will be apprised

Books recommended :

- Berg et al. Biochemistry (5th Ed.), Freeman, 2001
- Davıd L. Nelson and Michael M. Cox. Lehninger Principles of Biochemistry (8rd Ed.), W.H. Freeman & Co Ltd; 2021
- Mathews et al.: Biochemistry (3rd Ed.), Benjamin/Cummings Publishing, 1990

- Watson et al: Molecular Biology of the Gene (2nd Ed.), Benjamin/Cummings, 1976
- Zubay et al: Principles in Biochemistry (2nd Ed.), WCB, 1995 7. Rawn: Biochemistry, Neil Patterson, 1989
- Primrose et al: Principles of gene manipulation (6th Ed.), Blackwell Scientific, 2001
- 11. Harpur's Illustrated Biochemistry McGraw-Hill (Ed 2018)

M.Sc. I Year (Semester-I) B050705P: ZOOLOGY Practical Syllabus	
Distribution of Marks:	**Time: 6 hours**
Exercise	**Marks**
Physiology Exercise	20
Biochemistry Exercise	20
Biostatistics and Computer Exercise	10
Slide preparation	06
Spotting (12 spots)	24
Viva voce	10
Class record	10
Total Marks	**100**

Non-chordata

General characters and classification of the non-chordate phyla (Protozoa to Echinodermata) with the help of museum specimens and slides.

1. **Protozoa**: Vital staining and staining preparation of Paramecium; Study of cyclosis and trichocysts in Paramecium; Permanent preparation of Ceratium, Noctiluca, Paramecium, Vorticella.
   Study of prepared slides: Balantidıum, Nyctotherus, Opalına, Paramecium - conjugation/bınary fission. Entamoeba histolytica, Entamoeba coli, Entamoeba gingivalis, Monocystis, Giardia, Trypanosoma, Leishmania, Trichomonas, Trichonympha, Plasmodium.
2. **Porifera:** Permanent preparation of gemmules and different kinds of spicules
   Study of museum specimens/models; Lecuosolania, Sycon, Grantia, Euplectella, Hyalonema, Oscarella, Chondrilla, Chliona, Chalina, Spongilla, Spongia, Hippospongia.
3. **Cnidaria and Ctenophora:** Study of nematocysts of Hydra, Permanent preparation of Hydra; Obelia and other hydrozoan colonies and Obelia Medusa
   Study of museum specimens/ models: Tubularia, Bougainvillia, Pennaria, Hydractınia, Sertularia, Campanularia, Millepora, Stylaster, Physalia, Porpita, Valella, Aurelia, Rhizostoma. Tubipora, Alcyonium, Gorgonia, Corallium, Pennatula, Zoanthus, Metridium, Adamsıa, Cerianthus, Fungia, Madrepora, Cestum.
4. **Helminths.** Permanent preparation of selected soil and plant nematodes, cestode and trematode parasites of cattle and poultry and different larval stages of liver fluke,
   Study of museum specimens/ whole mounts: Dugesia, Polystoma, Bipalium, Fasciola, Paramphistomum, Schistosoma, Taenia solium, Moniezia, Echinococcus, Trichurıs, Trichinella, Heterodera, Enterobius, Ascaris, Ancylostoma, Dracunculus, Wuchereria
   Study of prepared slides: Scolex of tapeworm, mature and gravid proglottid of tapeworm; Study of cysticercus larva, larval stage of Fasciola
5. **Annelida**: Study of museum specimens/models: Aphrodite, Tomopteris, Glycera, Chaetopterus, Arenicola, Sabella, Amphitrite, Serpula, Tubifex, Branchiobdella, Eisenia, Metaphire, Placobdella, Pontobdella, Branchellion, Polygordius,
   Study of prepared slides: T.S. of the body of a leech passing through various places.

6. **Arthropoda**. Study of museum specimens: Limulus, Palamnaeus, Lycosa, Apus, Argulus, Balanus, Sacculina. Mysıs, Gmmarus, Squilla, Prawn, Lobster, true crab, hermit crab, Julus, Scolopendra. Scutigerella, Lepısma, Mantis, stick insect, grass hopper, termites, Forficula, Pediculus, Ranatra, Dysdercus, Musca, Ladybird beetle, butterfly, wasp, Xenopsylla, life history of honey bee, lac insect and silk moth, spider
   Study of prepared slides: Mouth parts of male and female Anopheles and Culex, house fly, honey bee, butterfly, Cimex, Daphnia, Cypris, Cyclops, Pediculus,
7. **Mollusca:**study of museum specimens/models: Chiton, Dentalium, Pila, Aplysia, Dorıs, Lymnaea, Mytilus, Patella, Pecten, Limax, pearl oyster, Teredo, Nautilus, Loligo, Sepia, Octopus.
   Study of prepared slide: Radula, T.S of shell of Unio, T.S of gill lamina of Unio, T.S of body of Unio passing through middle region; Larvae of molluscs.
8. **Echinodermata:** Study of museum specimens/ models: Astropecten, Asterias, Ophiothrix, Opiura, Echinus, Clypeaster, Echınocardıum, Thyone, Holothuria, Antedon
   Study of prepared slides. Larvae of echinoderms: Aristotle's lantern
9. **Minor phyla** Representative specımens of Sipunculida (Sıpunculus)

Biostatistics and Computational Biology.

Numerical Based on: Matrices. Mean, median and mode. Mean deviation, variance, standard deviation and standard error. Representation of data: Bar diagrams, n-diagrams, Histograms, Frequency polygons, t-test, F-test, Chi-square test, ANOVA. Demonstration of PubMed in searching scientific literature using authors' names, fields, limits, etc. Demonstration of BLAST in comparing Protein Sequences. Use of Sigma Stat/Prism Software for Statistical analysis. Use of Search engines and online resources.

Physiology

1. Determination of the rate of Oxygen consumption of Albino rats/Fish
2. Study of the total count of erythrocytes and leukocytes of rats /Fish
3. Study of different leukocyte counts of rats/Fish
4. Determination of the Rh factor in human blood
5. Colourimetric estimation of haemoglobin content of the blood, colour index and mean corpuscular in rat/Fish.
6. Determination of respiratory rate of rat in relation to size and sex; Respiration rate in fish at different temperatures.

Biochemistry

1. Isolation and colorimetric determination of glycogen content of rat liver
2. Demonstration of the effect of epinephrine on the glycogen yield from the liver
3. Estimation of protein content liver of fish and rats
4. Quantitative estimation of total free amino chromatographic separation of these amino acids at acid in tissues of the cockroach and paper chromatographic separation of these amino acids.
5. Kinetic essay of salivary amylase and study of effects of time, temperature and pH. Estimation of total lipid in the fat body of the cockroach and the liver of fish and rat.

M.Sc. I Year (Semester-II) Paper I CHORDATA		
Course Code: B050801T	**Marks: 25+75** **Credits: 4**	**Core Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title:** CHORDATA	

Course objectives

To develop in the student an understanding of:

- an appreciation of chordate diversity
- an understanding of structural and functional diversity
- the understanding of the evolutionary relationship amongst chordates

Unit	Topics	No. of Lectures
I	• Origin of chordates: Pisces - ostracoderm, placoderms and Devonian fishes: general organization and affinities of holocephali, crossopterygii and dipnoi	15
II	• Origin of tetrapoda: general organisation of anura, peculiarities of urodela and apoda, neoteny in amphibia	15
III	• Origin and evolution of Reptilia: General organisation of Chelonia, Rhynchocephalia, Squamata and Crocodilia	15
IV	• Origin and Evolution of Birds: Aerodynamics in Birds: Flight Adaptations Origin and Evolution of Mammals: Characteristic Features of Monotremes, Marsupials and Placentals,Melon (echolocation system in dolphins).	15

Student learning outcomes

The student upon completion of the course, will be able to.
Demonstrate comprehensive identification abilities of chordate diversity
Explain the structural and functional diversity of chordates
Explain the evolutionary relationship amongst chordates

Books recommended :

Boolootian, R. A. and Stiles, K. A., College Zoology, 10th edition, Macmillan Publishing Co., Inc., New York, 1981.
Colbert, E H., Morales, M. and Minkoff, E. C. Colbert's Evolution of the Vertebrates. A history of the backboned animals through time, 5th edition, John Wiley & Liss, Inc., New York, 2002
Farner, D. S. and King, J. R., Avian Biology (in several volumes), Academic Press, New York, 1971.
Jordan, E. L. and Verma, P. S., Chordate Zoology. S. Chand & Company Ltd, 1998.
Kenneth V Kardong (2015). Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill
Kotpal, R. L. The Birds, 4th edition, Rastogi Publications, Shivaji Road, Meerut, 1999
Parker, T. S. and Haswell, W. A., Textbook of Zoology, Vol. II, ELBS, 1978.
Young, J. Z. The life of vertebrates, 3rd edition, ELBS with Oxford University Press, 1981

Maa Pateswari University, Balrampur

M.Sc. I Year (Semester-II) MZO412T Paper II DEVELOPMENTAL BIOLOGY

Course Code: B050802T	**Marks: 25+75** **Credits: 4**	**Core Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: DEVELOPMENTAL BIOLOGY**	

Course objectives

- The objective of this course is to provide insight into:
- How the single cell formed at fertilisation forms an embryo and then a fully formed adult organism.
- Integration of genetics, molecular biology, biochemistry, cell biology, anatomy and physiology during embryonic development, and
- The treatment of birth defects and infertility in humans.

Unit	Topics	No. of Lectures
I	Cellular differentiation, signalling, Potency, Induction, Competence, morphogenetic gradient, cell fate and cell lineages, Stem cells,	15
II	Structure and recognition of gametes, Sperm capacitation and acrosomal reaction, Fertilisation, Prevention of polyspermy, egg activation, Nature of Egg, Cleavage Pattern, Blastula formation, Gastrulation, Formation and fate of the germinal layers, Causes of fetal deformities	15
III	Organogenesis of vertebrate eye and heart, Evolution of viviparity in mammals, Cellular and Biochemical events in Amphibian and Insect metamorphosis.	15
IV	Determination of polarity and symmetry, Induction and Organiser concept, Regeneration of salamander limbs, morphallactic regeneration in Hydra, Transgenic animals, Ageing and cellular death	15

Student learning outcomes

The student, after the course, will be able to understand:

A variety of interacting processes, which generate an organism's heterogeneous shapes, size, and structural features,

How a cell behaves in response to an autonomous determinant or an external sıgnal, and

The scientific reasoning is exhibited in experimental life science.

Books recommended :

1. Gilbert Developmental Biology. Sinauers, 2003.
2. Kalthoff: Analysis of biological development. McGraw-Hill, 1996.
3. Wolpert: Principles of development. Oxford, 2002. Young, J. Z. The life of vertebrates, 3rd edition, ELBS with Oxford University Press, 1981
4. Roger A. Pedersen, Gerald P. Schatten. Current Topics in Developmental Biology: 1998 Elsevier.
5. Michael J. F. Barresi, Scott F. Gilbert. Developmental Biology. 2019, Oxford University Press T. Subramaniam. Developmental Biology. (Reprint) 2013, Narosa Publishing House Pvt. Ltd., New Delhi
6. Werner A Müller. Developmental biology: 2012, Springer Science & Business Media. 9. Jonathan M. Balansky. An introduction to embryology by, CBS college publishing

Maa Pateswari University, Balrampur

M.Sc. I Year (Semester-II) Paper III Genetics and Cytogenetics

Course Code: B050803T	**Marks: 25+75** **Credits: 4**	**Core Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Genetics and Cytogenetics**	

Course objectives

- To study the structure of genes and learn how the information contained within them gets transferred from one generation to another.
- Human genetics will impart knowledge about the human chromosome constitution that would help in applying basic principles of chromosome behaviour to the disease context.
- To create awareness of genetic diseases.

Unit	Topics	No. of Lectures
I	Mendelian Principles of Inheritance, Current status of Mendelism, Concept of gene, allele, multiple alleles, Pseudoalleles	15
II	Cytoplasmic Inheritance, Environment and heredity, lethal genes, chromosomal mapping, Extension of Mendelian principles-codominance, incomplete dominance, gene interactions, pleiotropy, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage	15
III	Euchromatin and heterochromatin, chromosomal aberration, DNA Replication, transposable elements in prokaryotes and eukaryotes	15
IV	Bacterial transformation, transduction, conjugation, mapping of genes interrupted, elements of eugenics, imprinting of genes, gene therapy	15

Student learning outcomes

The students will get the idea about Mendelism, cytoplasmic inheritance, aberration, and gene therapy

The students will have awareness about genetic diseases, their types and causes.

The principles of inheritance, linkage and crossing over, which lead to variations, will be made clear

as well as the application thereof in gene mapping.

Books recommended:

1. Brooker: Genetics: Analysis and Principles (Addison-Wesley, 1999)
2. Gardner et al: Principles of Genetics (John Wiley, 1991)
3. Griffith et al Modern Genetic Analysıs (Freeman, 2002) 4. Harti & Jones Essential Genetics: A Genomic Perspective (Jones & Bartlet, 2002)
4. Lewin, Genes VIII (Wiley, 2004) 6 Russell: Genetics (Benjamın Cummings, 2002)
5. Snustad & Simmons: Principles of Genetics (John Wiley, 2003).
6. Alberts et al: Essential Cell Biology (Garland, 1998)
7. Alberts et al: Molecular Biology ofthe Cell (Garland, 2002)
8. Bostock & Sumner: Eukaryotic Chromosome (North-Holland, 1987)
9. De Robertis & De Robertis. Cell and Molecular Biology (Lee & Febiger, 1987)
10. Karp. Cell and Molecular Biology (John Wiley & Sons, 2002)
11. Lewın, Genes VIII (Wiley, 2004)
12. Lodish et al: Molecular Cell Biology (Freeman, 2000) 8. Pollard & Earnshaw: Cell Biology (Saunders, 2002)

Maa Pateswari University, Balrampur

M.Sc. I Year (Semester-II) Paper IV ECOLOGICAL PRINCIPLES

Course Code: B050804T	**Marks: 25+75** **Credits: 4**	**Core Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: ECOLOGICAL PRINCIPLES**	

Course objectives

To develop in the student an understanding of:

- To develop in the student an understanding of Ecosystem structure and function, Ecologıcal development, Ecosystem modelling

Unit	**Topics**	**No. of Lectures**
I	• Concept of habitat and niche, ecosystem - structure and functions, concept of limiting factors, Liebig's law of the minimum; Shelford law of tolerance; energy flow, first and second law of thermodynamics, biogeochemical cycles (carbon, nitrogen and phosphorus)	15
II	• Characteristics of population, population growth curve, life history strategies (r and k selection), nature of community, community structure, edges and ecotones; ecological indicator	15
III	• Ecological pyramids, ecological succession-types, mechanism; species interaction; tritrophic interaction, concept of homeostasis and feedback	15
IV	• Ecosystem modelling, acclimation and acclimatization; different types of ecosystem -terrestrial and aquatic;	15

	conservation of natural resources; wetlands	

Student learning outcomes

- The students will get the idea about
- Ecological relationships between organisms and their environment.
- Explained and identified the role of the organism in energy transfers.
- Described the habitat ecology and resource ecology.

Books recommended :

- Clifford B. Knight. Basic concepts of Ecology, The Macmıllan Company, New York
- E.P. Odum. Fundamentals of Ecology, Oxford and IBN Publishing Co., New Delhi
- Grant, W.E. and Swannack. T.M Ecological Modelling. (2008), Blackwell.
- Benton and Werner. Field Biology and Ecology, McGraw-Hill Book Company
- Wilkinson, D.M. Fundamental processes in Ecology: An Earth system Approach, (2007). Oxford University PRESS, UK,
- Fahey, T.J. and Knapp, A.K. Principles and standards for Measuring Primary Production, (2007), Oxford University Press, UK.

M.Sc. I Year (Semester-II)	**Practical Syllabus**	**Credits: 4**
B050805P		
Distribution of marks:		**Time: 6 hours**
Exercise		**Marks**
Cytogenetics exercise		**10**
Ecology exercise		**15**
Embryology exercise		**15**
Preparation		**10**
Spotting (10 spots)		**25**
Viva-voce		**15**
Class Record		**10**
Total Marks		**100**

Chordata

1. **Urochordata:** Study of museum specimens/ whole-mount Oikopleura, Herdmania, Ascidia, Pyrosoma, Doliolum, Salpa
2. **Cephalochordate:** Study of museum specimen: Branchiostoma**.**
3. **Cyclostomata: Study of museum specimens /models:** Petromyzon, Myxine; Ammocoete larva.
4. **Pisces:**

a) Natural history of cartilaginous fishes (class Chondrichthyes): Scoliodon, Sphyrna (hammer headed shark), Torpedo (electric rays), Pristis, Rhinobatus, Raja (skate), Trygon (sting rays), Chimaera

b) Natural hıstory of bony fishes (class Osteichthyes)

Polypterus, Acipenser, Polydon, Amia, Lepidosteus, Salmo, Hilsa, Notopterus, Labeo, Catla, Cyprinus, Cırrhina, Heteropneustes, Clarias, Wallago, Mystus, Anguilla, Exocoteus.

Hippocampus, Channa, Amphipinus, Anabas, Synaptura, Echeneis, Syngnathus, Pleuronectes,

Lophius, Tetraodon, Diodon, Ostracion

c) **Lung Fishes:** Protopterus, Lepıdosiren, Neoceratodus
d) **Study of the disarticulated bone of a carp.**
5. **Amphibia: Study of museum specimens/models**: Ichthyophis, Uraeotyphlus, Cryptobranchus,

Ambystoma, Axolotl larva, Salamandra, Amphiuma, Triturus, Proteus, Necturus, Siren, Alytes,

Bufo, Hyla, Rhacophorus,

a) **Study of the disarticulated bone of a frog**
6. **Reptilia: Study of museum specimens/models:** Testudo, Chelone, Kachuga, Sphenodon,

Hemidactylus, Phrynosoma, Calotes, Draco, Iguanas, Chamaeleon, Heloderma, Varanus, Ophisaurus, Typhlops. Python, Ptyas, Natrix, Eryx, Hydrophis. Crotalus. Bungarus, Naja, Russell's Viper, Pit Viper, Crocodylus, Alligator, Gavialis.

a) **Study of disarticulated bones of Varanus**
7. **Aves: Study of museum specimens/models:**

Archaeopteryx, Phoenicopterus (Flamingo). Pavo (Peacock), Columba (Pigeon), Eudynamys

(Koel), Psittacula (Parrot), Bubo (Owl), Dendrocopus (Woodpecker), Passer domesticus (House

sparrow), Corvus (Crow)

a) **Study of disarticulated bones of fowl**
8. **Mammalians. Study of museum specimens/models:** Ornithorhynchus, Tachyglossus, Erinaceus.

Talpa, Sorex, Macropus, Pteropus, (Bat), Loris, Funambulus, Rattus, Oryctologus, Hystrix,

a) **Study of disarticulated bones of the rabbit**
9. **Developmental Biology**

a) Experiments on artificial ovulation and insemination in the study of the life history stages of the frog
b) Study of hormonal control of amphibian metamorphosis
c) Incubation and mounting of chick embryos;
d) Study of prepared slides of the embryology of frog, chick and mammals and mammalian
e) placentation
f) Microtomy of embryonic stages of chick embryo
g) Application of window techniques for in situ study of chick embryo with special reference to
h) morphogenetic movement
i) Determination of the effect of temperature on the embryonic development of the chick;
j) Study of the development of selective organs through preserved specimen and prepared slides:
k) Experiment on regeneration in earthworms; regeneration of lizards.

10. **Genetics and Cytogenetics**

a) Study of mitosis in onion root tip
b) Meiosis in the testis of the grasshopper with the acetocarmine squash method

c) Study of the salivary gland chromosomes of Drosophila and Chironomus.

11. Ecological Principles

a) Study of different structural adaptation of animals to ecological conditions
b) Study of micro and macro fauna of soil by the froth flotation method
c) Comparative estimation of physicochemical eco factor of/ in different localities; Temperature,
d) pH, Carbonate, sulphate, nitrate, and turbidity, in a freshwater sample; the moisture content of the soil
e) sample
f) Study of seasonal variation in plankton population, demonstration of parallax vision and height
g) perception
h) Analysis of plant community, biodiversity, and biomass
i) Study of seasonal plankton population, both qualitative and quantitative

Maa Pateswari University, Balrampur

M.Sc. II (Semester-III)

Paper I ANIMAL TAXONOMY, BEHAVIOUR AND CHRONOBIOLOGY

Course Code: B050901T	**Marks: 25+75** **Credits: 4**	**Core Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Animal Taxonomy, Behaviour and Chronobiology**	

Course objectives

This course introduces core concepts in biosystematics and animal behaviour, focusing on evolutionary and ecological perspectives. It covers modern methods in behavioural studies, the influence of environmental rhythms on biological processes, and how organisms respond to environmental cues. Students will also explore circadian physiology at different biological levels and examine how disruptions in internal clocks relate to health issues, including time-based treatments for lifestyle disorders.

Unit	Topics	No. of Lectures
I	Definition and basic concept of animal taxonomy, its importance and application in biology, species concept and taxonomic characters, procedure in taxonomy collection, preservation and identification and nomenclature: International Code of Zoological Nomenclature (ICZN), type concept	15
II	Introduction of behaviour, proximate and ultimate, causation, types of learning (non-associative and associative), social learning (cultural transmission), learning and memory - conditioning, habituation, insight learning, sensitisation	15
III	Pattern of communication - chemical, visual, light, audio, species-specific songs, evolution of language with respect to primates, social behaviour with respect to insects, sexual selection and kin selection, hormones and behaviour	15
IV	Introduction, scope of chronobiology, types and properties of biological rhythms (Circadian, Circatidal, Circalunar, Circannual), seasonal variation in fishes and birds, lifestyle disorders - Depression and sleep disorder, clock repaır, chronotherapy and Chrono medicine	15

Student learning outcomes

Students will gain an understanding of taxonomy principles for classifying organisms, learn to observe and analyse animal behaviour across species, and explore both the immediate and evolutionary causes of behaviour. The course includes designing experiments, studying biological timing systems at molecular to systems levels, and understanding how species adapt their activities to daily and seasonal cycles. Students will also learn to evaluate scientific literature, plan research on biological rhythms, interpret the impact of disrupted rhythms on health, and contribute to public awareness of circadian biology.

Books recommended :

1. Ernst Mayr. Principles of Systematic Zoology, McGraw Hill, New York
2. G.G. Simpson. Principles of Animal Taxonomy, Columbia University Press, Scientific Publisher
3. Mannıng and MS Dawkıns. An Introduction to Animal Behaviour Cambridge University Press,UK.
4. John Alcock. Animal Behaviour, Sinaer Association, INC.
5. Binkley, S. (1990): The clockwork sparrow: time, clocks, and calendars in biological organisms, Prentice-Hall, New Jersey.
6. Chandrashekaran, M. K. (1985): Biological rhythms, Madras Science Foundation, Chennai.
7. Shapiro, C. M and Heslegrave, R J. (1996): Making the shift work, Joli Joco Publications, Inc., Toronto.

Maa Pateswari University, Balrampur

M.Sc. II (Semester-III)

Paper II ENVIRONMENTAL BIOLOGY, WILDLIFE AND ECONOMIC ZOOLOGY

Course Code: B050902T	**Marks: 25+75** **Credits: 4**	**Core Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Environmental Biology, Wildlife and Economic Zoology**	

Course objectives

This course introduces core concepts in biosystematics and animal behaviour, focusing on evolutionary and ecological perspectives. It covers modern methods in behavioural studies, the influence of environmental rhythms on biological processes, and how organisms respond to environmental cues. Students will also explore circadian physiology at different biological levels and examine how disruptions in internal clocks relate to health issues, including time-based treatments for lifestyle disorders.

Unit	Topics	No. of Lectures
I	Meaning and scope of environmental biology, environmental problems (pollution, acid rain, greenhouse effect, global warming, depletion of the ozone layer, and climate change). environmental diseases with special references to carcinogenesıs and radiation injury, management of industrial and biochemical waste, environmental laws	15
II	General study of wildlife, wildlife conservation programmes, Project Tiger, Project Crocodile, Project Elephant, wildlife sanctuaries, national parks, biosphere reserves and zoos in India	15
III	Vermiculture -Ecology and distribution of earthworms: vermiculture and vermicomposting methods: chemical composition of waste-based vermicompost: species of earthworms for vermicomposting; use of earthworms in land improvement and reclamation	15
IV	Prawn, Pearl Culture, poultry farming and pharmaceuticals from the animals	15

Student learning outcomes

Students will gain an understanding of the complexity and interdependence of different

environmental layers and how they operate. They will explore major global environmental challenges, their underlying causes, impacts, and the importance of addressing and improving these issues. The course will also highlight the need for wildlife conservation and restoration. Additionally, students will learn about the distribution of wildlife across various ecological regions of India, the IUCN classification of species, and the roles of biosphere reserves, national parks, wildlife sanctuaries, and zoos.

Books recommended :

1 Stanley and Manahan, E. Environmental Chemistry. 2010. CRC, Taylor & Francis. London.
2 Raven, Berg. Johnson Envıronment, 1993, Saunders College Publishıng.
3. A.N. Moen. Wildlife ecology
4 E.G. Balen. Wildlife ecology and management
5 Ramesh Bedi. Indian wildlife
6. Rajesh Gopal Wildlife management.
7. Caughley, G., and Sinclair, A R.E. (1994). Wildlife Ecology and Management. Blackwell Science.

Maa Pateswari University, Balrampur

M.Sc. II (Semester-III)
B050903 E (A) Paper III
Elective Paper - Fish Biology
Paper I -Morphology, Physiology and Development of Fishes

Course Code: B050903 E	**Marks: 25+75** **Credits: 4**	**Elective Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Morphology, Physiology and Development of Fishes**	

Course objectives

The aim is to provide students with the knowledge of:
Biology and physiology of fishes.
Endocrıne gland and development of fishes.

Unit	Topics	No. of Lectures
I	• Scale-Types structure and composition • Different types of caudal fins, origin of paired fins • Accessory respiratory organs and swim bladder (structural modifications), function of the swim bladder • Weberian ossicles • Light and sound-producing organs	15
II	• Food and feeding habits in fishes, physiology of digestion, respiration, excretion, osmoregulation (freshwater and marıne fish).	15
III	• Gonads: Male and female, reproductive cycle and maturation, spawning, development in fishes, parental care.	15
IV	• Endocrine glands: structure, function and hormones secreted by these glands (hypophysis, thyroid, adrenal, ultimobranchial body,	15

	Corpuscles of Stannius (CS) and Urophysis)	

Student learning outcomes

The present course provides the basic concepts of fish biology and genetic resources, which will enable the students to:
Utilise the knowledge in fish biology research, manage the fish under controlled conditions, and understand the status of fish biogenetic resources of India

Books recommended:

1. Tony J. Pitcher. Behaviour of teleost fishes. Chapman and Hall.
2. Khanna, S.S. An Introduction to Fishes.
3. Srivastava, C.B.L. A. Textbook of Fishery Science and Indian Fisheries.
4. N.B. Marshal. Fish life, Environment and diversity. Agrobios (India).
5. W.S. Hoar & D.J. Randall. Fish Physiology, edited by Vol. I and II, Academic Press Inc.
6. Datta Munshi, J.S. and M.P. Srivastava. Natural History of Fishes and Systematics of Freshwater Fishes of Indıa, 2006, Narendra Publ House, New Delhi.
7. Norman, J.R. A History of Fishes.
8. Kyle, H.M.A. Biology of Fishes
9. Jhıngıran: Fish and Fisheries of India.
10. Lagler et. al Ichthyology
11. Brown ME 19 Physiology of fishes Volume 1 & Volume 2 Academic Press, New York.
12. Hoar WS, Randall DJ and Donaldson EM. 1983. Fish Physiology. Vol. IX. Academic Press, New York

Maa Pateswari University, Balrampur

M.Sc. II (Semester-III)
B050903 E(B) Paper III
Elective Paper - Endocrinology and Reproductive Physiology
Paper I - Principles of Endocrinology

Course Code: B050903E(B)	**Marks: 25+75** **Credits: 4**	**Elective Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Endocrinology and Reproductive Physiology**	

Course objectives

The course focuses on helping the students to understand the basics of endocrinology and impart knowledge about the endocrine regulation of different body functions. Besides, it aims to understand the integrative working of the signalling system in maintaining homeostasis

Unit	Topics	No. of Lectures
I	• Introduction to the Endocrine System • Classification of Hormones, synthesıs and secretion of hormones • Hormone receptor and mechanısm of Hormone Action • Neurotransmitters and Neuropeptides	15
II	• Thyroıd Gland- Hormone biosynthesis, Chemistry, Mechanısm of action, Functions Pancreas - Insulin, Glucagon, Regulation of Feeding and	15

	Digestion	
III	• Endocrıne Hypothalamus • Hormones of the Pituitary gland and their functions • Hypothalamic Regulation of the Pituitary gland	15
IV	• Hormones and Homeostasıs - Electrolytes and Water balance (Renin and Angiotensın System) • Energy Homeostasis • Parathyroid Gland - Calcium Homeostasis • Endocrine: Regulation of Bone development	15

Student learning outcomes

The course will enable the students to develop an understanding of the basic endocrinology the endocrine regulatory molecules mediating physiology and behaviour, the neural and endocrine components of physiological function, and neuroendocrıne regulation

• the role of hormones in metabolic regulation and maintaining homeostasis

• the integrative working of the signalling system

Books recommended:

1. Davıd O. Norrıs, James A. Carr. Vertebrate Endocrinology, 2013, 5th Edıtion, Academic Press
2. H. M. Kronenberg, S. Melmed, K. S. Polonsky and P. R. Larsen. Williams Textbook of Endocrınology 2008, 11th Edition, Saunders, Elsevier
3. P. J. Bentley. Comparative Vertrebrate Endocrinology, 3rd Edition, Cambridge University Press
4. Charles B. Nemeroff. Neuroendocrinology, xxxx, CRC, US
5. Rıchard E Brown. An Introduction to Neuroendocrinology, 2005, Cambridge University Press
6. Mac E. Hadley, Jon E. Levine. Endocrinology, 2009, 6th Edition, Pearson Education
7. F. F Bolander. Molecular Endocrinology, 3rd Edition, 2004, Elsevier Academic Press
8. Darville Brook, C.G & Marshall. Essential Endocrinology, Wiley Blackwell
9. Greensteın B. Endocrinology at a Glance, Wiley Blackwell
10. V. M. Montorı. Evidence-Based Endocrinology: (ed.), Humama Press
11. Ernst Knobil and Jimmy D. Neill. Encyclopedia of Reproduction, Volumes 1-4, Academic Press

Maa Pateswari University, Balrampur

M.Sc. II (Semester-III)

B050903 E (C) Paper III

Elective Paper - Molecular Biology

Paper I - Genome Structure and Replication of DNA

Course Code: B050903 E(C)	**Marks: 25+75** **Credits: 4**	**Elective Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Genome Structure and Replication of DNA**	

Course objectives

The Syllabus is designed in such a way that the student gets the chance to develop an understanding of the concept of molecular biology. It aims to enable the students to study the Genome Organızation, Genome replication, Genome expression and Genome regulation.

Unit	**Topics**	**No. of Lectures**

I	DNA: A carrier of genetic information, Chemical structure of DNA and Base composition, biologically important nucleotides, Watson-Crick model, Supercoiled DNA, structure of different types of nucleic acids, hydrolysıs of nucleic acids. Confirmation of nucleic acids: A-, B-, Z-, DNA, t-RNA, micro-RNA. Stability of nucleic acid structure, DNA Topology and Linking Number	15
II	Proteins involved in prokaryotic and eukaryotic DNA Replication	15
III	Mechanism of Prokaryotic and Eukaryotic DNA Replication; Unit of replication, replication orıgin and replication fork, fidelity of replication, extrachromosomal replicons	15
IV	The Mutability and Repair of DNA: Internal and external agents causing DNA damage, DNA damage (Oxidative damages, Depurinations, Depyrımidinations, 06-methylguanines, Cytosine deamination, single and double strand breaks), Mechanisms of DNA damage (transition, transversion, frameshift, nonsense mutations), Repair mechanisms (Photoreactivation, excision repair, mısmatch repair, post replication repair, SOS repair)	15

Student learning outcomes

The student, after the course, will be able to:

Understand the genome organisation and the difference between RNA and DNA

Understand how DNA replicates by DNA Polymerase, and also understand the base pairing of nitrogen bases in double-stranded DNA

Books recommended:

1. Benjamın A Pierce. Genetics: A Conceptual Approach
2. Karsten Rippe WileyVCH Verlag GmbH & Co. KGaA Genome organisation and function in the cell nucleus; edited, Germany 2012.
3. Bacterial Genomics: Genome Organisation and Gene Expression Tools by Aswin Sai Naraın Seshasayee, Publisher Cambridge University Press (2015) ISBN-10: 1107079837.
4. Genomes. 2nd edition. Brown TA, Oxford: Wiley-Liss; 2002.
5. Organisation of the Prokaryotic Genome by Robert L. Charlebois, ASM Press, 1999.

Maa Pateswari University, Balrampur

M.Sc. II (Semester-III)

B050903 E (D) Paper III

Elective Paper - Entomology

Paper I -INSECT MORPHOLOGY, PHYSIOLOGY, AND DEVELOPMENT THEORY

Course Code: B050903 E (D)	**Marks: 25+75** **Credits: 4**	**Elective Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: INSECT MORPHOLOGY, PHYSIOLOGY, AND DEVELOPMENT THEORY**	

Course objectives

The Syllabus is designed in such a way that the student gets the chance to develop an understanding of the morphology of an insect. It aims to enable the students to study the physiology of insects.

Unit	Topics	No. of Lectures
I	The integumentary system histology of the integument, physical property and chemical composition of cuticle, sclerotisation,	15

	colouration and moultıng, Morphology of the head, tentorium, antenna and mouth parts and their modification, thorax, tergites, legs and their modifications, wing structure and venation, their modifications, coupling mechanism and abdomen, pregenital abdominal appendages, external genıtalia	
II	Nervous system: the neurons, the central nervous system, and the peripheral nervous system. Sensory mechanısms: mechanoreceptors (tango reception, proprioception, sound perception), chemoreception, thermoreceptors, hygroreception and photoreception (compound eyes, image formation, stemmata, ocelli), Bioluminescence and sound production.	15
III	Alimentary system: nutrition, feeding behaviour, morphology of the gut and physiology of digestion and absorption, Circulatory system: dorsal vessel, accessory pulsating structures, sinuses and diaphragms. Mechanism of circulation, composition and function of haemolymph: Respıiratory system structure of trachea, tracheoles, air sacs, spiracles, physiology of respiration, respiratory adaptation of aquatic and parasitic insects; Excretory system: Malpighian tubules and their arrangements, physiology of excretion (nitrogenous excretion, salt and water balance)	15
IV	Reproductive system, male and female development, post-embryonic development, metamorphosis, types of larvae and pupae. Exocrıne glands: structure and function, pheromones Endocrine glands: structure and function of non-neural, neural and peptide hormones, regulation of general body function and metabolıc activities, moulting, polymorphism and diapause.	15

Student learning outcomes

The present course has been designed to.

The present course provides knowledge of the morphology of insects.

The knowledge about the physiology of insects.

Books recommended:

1. Mathur, R. A text Book of Entomology, Campus books
2. Nayar, K.K, T.N, Ananthkrıshnana & B.V. David. General and applied Entomology by (1979), Tata McGraw Hill publication Co Ltd., New Delhi
3. Mani, M.S. General Entomology (1982) Oxford and IBH publishing Co. Pvt. LTD. New Delhi
4. Kuzman H. General text book of Entomology, Apple academics

Maa Pateswari University, Balrampur

M.Sc. II (Semester-III)

B050904E (A) Paper IV

Elective Paper - FISH BIOLOGY

Paper II - TAXONOMY AND FISH ECOLOGY

Course Code: B050904E (A)	**Marks: 25+75**	**Credits: 4**	**Elective Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: TAXONOMY AND FISH ECOLOGY**		

Course objectives

The aim is to provide students with the knowledge of Taxonomy and ecology. Characteristics of Fishes Classification of Fishes, Adaptation, and Migration in Fishes

Unit	Topics	No. of Lectures
I	Characteristics and classification of fishes: detailed taxonomic studies of the following orders of fishes of U.P. up to families: Clupeiformes, Cypriniformes, Beloniformes, Cyprinodontiformes, Mugıliformes, Ophiocephaliformes. Symbranchiformes, Perciformes, Mastacembeleformes and Tetrodontıiformes.	15
II	Adaptation of fishes; Hill-stream and deep sea. Impact of pollution on aquatic organısm. Fish migration with particular reference to Salmon and Eel.	15
III	Hormonal regulation of fish migration. Influence of abiotic factors (density and pressure, temperature, salt content in water, light, sound, electric current, bottom deposits and particles suspended in water).	15
IV	Influence of biotic factors (interspecific and intraspecific interrelationship among fishes with different other organisms-parasıtısm, commensalism, mutualısm, predation and cannıbalism). Sewage fed fisheries	15

Student learning outcomes

The present course has been designed to

The present course provides the knowledge of the classification, adaptation and migration in fishes

The knowledge of biotic and abiotic factors. Influencing the life of fish.

Books recommended:

1. G.V. Nikolsky. Ecology of fishes. Academy Press, London.
2. Bria Mass. Ecology of Fresh Waters, Willey Blackwell
3. S.S. Khanna. Fish and fisheries
4. C.B.L Srivastava. Fish
5. Moyle PB. 1982. Fishes: An introduction to ichthyology. Priıntice-Hall, Englewood Cliffs.
6. Jayaram KC. 2008. Fundamentals of Fish Taxonomy
7. Gopal Ji Srivastava. 1995. Fishes of U.P. and Bihar.
8 Paul J.B. Hart and John D. Reynolds. 1979. Handbook of Fish Biology and Fisheries

Maa Pateswari University, Balrampur

M.Sc. II (Semester-III)

B050904E (B) Paper IV

Elective Paper - Endocrinology and Reproductive Physiology

Paper II - Endocrine Disorders and their Diagnostics

Course Code: B050904E (B)	Marks: 25+75 Credits: 4	Elective Paper
Total no. of Lectures (in hours per week) - 4	Course Title: Endocrine Disorders and their Diagnostics	

Course objectives

The key methods used in endocrine research include laboratory techniques for studying hormone function and regulation. It also covers common endocrine disorders, their underlying mechanisms, and the hormonal imbalances involved. Additionally, it explores different reproductive technologies applied in the treatment of infertility, the current advancements in the field of endocrinology and

reproductive biology, the health conditions that arise from abnormal hormone secretion, and the diagnostic tests used to identify and evaluate these hormonal disorders

Unit	Topics	No. of Lectures
I	Disorders of • Pituitary Gland • Thyroıd Gland • Adrenal Gland • Osteoporosıs • Polycystic Ovary Syndrome	15
II	Primary and Secondary Infertility: Implantation failure, Recurrent Abortion Reproductive Techniques: In vitro Fertilisation, Embryo Transfer, GIFT, ZIFT, Cryopreservation of Gametes and Embryos Contraceptives	15
III	Hormone Assay -RIA, ELISA, HPLC Hormone Pellet Construction Organ/Tissue Manipulation - Subcutaneous Injections Histological Methods Surgeries	15
IV	RNA Extraction- RTPCR, qPCR Hormone Localization - Northern Blot	15

Student learning outcomes

The present course has been designed to

The present course provides the knowledge of the classification, adaptation and migration in fishes

The knowledge of biotic and abiotic factors. Influencing the life of fish.

Books recommended:

1. David O. Norris, James A. Carr. Vertebrate Endocrınology, 2013, 5th Edition, Academic Press
2 H. M. Kronenberg, S. Melmed, K. S. Polonsky and P. R. Larsen. Williams Textbook of Endocrinology, 2008, 11th Edition, Saunders, Elsevier
3. P. J. Bentley. Comparative Vertbrate Endocrinology, 3rd Edition, Cambridge Universıty Press
4. Charles B. Neuroendocrınology. Nemeroff, xxxx, CRC, US
5. Richard E. Brown. An Introduction to Neuroendocrınology, 2005, Cambridge University Press
6 Mac E Hadley, Jon E Levine. Endocrinology, 2009, 6th Edition, Pearson Education

Maa Pateswari University, Balrampur

M.Sc. II (Semester-III)

B050904E(C) Paper IV

Elective Paper - MOLECULAR BIOLOGY

Paper II -EXPRESSION OF GENOME

Course Code: B050904E (C)	Marks: 25+75	Credits: 4	Elective Paper
Total no. of Lectures (in hours per week) - 4	Course Title: Paper II -EXPRESSION OF GENOME		

Course objectives

Organization of Prokaryotic and eukaryotic genes and how the genes are transcribed in prokaryotes and eukaryotes. How the hnRNA is processed in eukaryotes and how processed RNA is transported to the cytoplasm from the nucleus, where the translation of mRNA takes place.

Unit	Topics	No. of Lectures
I	Structure of Prokaryotic genes; Organisation of prokaryotic genes into operons, Structure Eukaryotic Genes;(introns, exons, UTRs, core & proximal promoters, enhancers), Transcription Factors	15
II	Prokaryotic and Eukaryotic Transcription; Transcriptional Machinery andMechanism of Transcription (Initiation, Elongation, Termination)	15
III	Post Transcriptional Modifications; Processing of hn RNA, tRNA, rRNA; 5'-Cap formation; 3'-end processing and polyadenylation; Splicing; RNAediting; Nuclear export of mRNA; mRNA stability	15
IV	Prokaryotic and Eukaryotic Translation; Ribosome Assembly and composition, Genetic codon. Translational Machinery, Mechanism of Translation: Initiation, Elongation and Termination	15

Student learning outcomes

The structure of eukaryotic and prokaryotic promoters and how RNA polymerase binds to promoter.

How the mature RNA is synthesised by the processing of the primary transcript, and this transcript is a cargo transport from the nucleus to the cytoplasm

The students use the scientific knowledge pf translation and transcription for their future research work

Books recommended:

1. Lewin's Genes XI (Jocelyn E. Krebs, Benjamin Lewin, Elliott S. Goldstein, Stephen T Kilpatrick)
3. Genomes 4 (T.A. Brown)
4. Molecular Biology of the Gene by James D. Watson, A. Baker Tania, P. Bell Stephen, Gann Alexander, Levine Michael, Losick Richard (Pearson 7th Edition)
5. Molecular Biology of the Cell by Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts - 6th Edition
6. Cell and Molecular Biology. Concepts and Experiments by Gerald Karp, James G. Patton -7th Edition

Maa Pateswari University, Balrampur

M.Sc. II (Semester-III)

MZO504E (D) Paper IV

Elective Paper - ENTOMOLOGY

Paper II - EVOLUTION.TAXONOMY AND INSECT ECOLOGY

Course Code: B050904E (D)	Marks: 25+75 Credits: 4	Elective Paper
Total no. of Lectures (in hours per week) - 4	Course Title: Paper II - EVOLUTION.TAXONOMY AND INSECT ECOLOGY	

Course objectives

This course explores the principles of evolution, biological classification (taxonomy), and insect ecology. Students will understand evolutionary processes, taxonomic systems, and ecological roles of insects, gaining skills to identify insect groups, analyze ecological interactions, and apply evolutionary

theory to entomological studies and biodiversity conservation.

Unit	Topics	No. of Lectures
I	Insects and the abiotic environment: effect of temperature, moisture and light on insect population; insect plant interaction; plant and insect herbivore relationship: primary and secondary metabolic plant products. Host selection by insects, chemical defence in plants; allocation of protective chemicals, primary role of toxic chemicals; response of insects to chemical defence; temporal avoidance of chemical semiochemicals.	15
II	Insect origin and evolution: Ancestry of insect origin and evolution of insects, relationship between entogonathous and ectogonathous apeterygotes, Outline classification of insects: classification, characters, and economic importance and examples of following: Entognatha (proturan, collembola, dıpluran); Thysanura (Lepısmatidae); Palaeoptera (Ephemeroptera, odonata) Orthoptera (schizodactylidae, tettigoniidai, gryllidae, gryllotalpidae, acrididae), phasmida (phasmidae, phyllidae); Dictyoptera (blattaria, Mantodea) Isoptera (kalotermitidae, Termitidae); Phthiraptera (Mallophaga, Anopluara- Haematopınidae, Pediculidae)	15
III	Classification, characters, economic importance, and examples of the following: Hemiptera (Fulgorıdae, Lophopidae, Cicadidae, Membracıdae, Cicadellıdac, Psyllidae, Aleyrodidate, Aphıdadae, Margarodidae, Kerridae, Pseducoccidae, Coccidae, Diaspididae, Redividae, Cimicidae, Anthocorıdae, Lygaeidae, Pyrrociridae, Coreidae, Scutelleridae, Pentatomidae, Gerrıdae, Notonectidae. Belostomatıdae, Nepidae); Thysanoptera (Terebrantıa-Thritidae, Tubulitera): Neuroptera(Chrysopidae); Coeoptera (Carabidae, Cicindellidae, Dytiscidae, Gyrinidae. Hydrophilıdae, Lucanidae, Scaribaeide. Buprestidae, Elateridae,Lampyridae. Dermestidae. Coccinellidae, Tenebrionidae, Meloidae. Cera mbycidae, Chrysomelidae,Bruchidae, Curculionidae.)	15
IV	Siphonophera (Pulicidae, Ceratophyllidae);Diptera(pschodidae,Culicıdae,Sı mulidae,Chironomidae, Bibionıdae, Myctophilıdae. Cecidomyıdae,Tabanidae, Asılidae,Bombyliidae,Syrphidae,Agromyzidae,Drosophilıdae,Gasterophilıdae, Muscidae, Calliphoridae,Hippoboscidae),Lepidoptera (tineidae, Psychidae, Plutellidae, Nymphalidae,Pierıdae, Papılonidae, Geomrtridae, Bombycidae, Sphingigae, Arctıdae, Noctuidae); Gelechidae; Pyrialıdae; Hymenoptera (tenthredinidae, ichnegumonidae, Braconidae, Evaniidae,Cynipidae, Chalacidae, Eulophidae, Trichogrammitidae, Scoliidae, Formicide Vespidae, Sphecide, Xylocopidae, Aphidae)	15

Student learning outcomes

The student at the completion of the course will be able to understand.

- Ecology of insects
- Evolution and taxonomy of insects

Books recommended:

1. Singh R. Elements of Entomology, (2015), Rastogi Publ, Meerut.
2. Ananthkrishnana, T N & A Raman. Dynamics of Insect-Plant Interaction (1988). Oxford & IBH Publishing Co Pvt Ltd., New Delhi.

3. Barbosa. P. and D.K. Letoumeau. Navel aspects of insect plant interaction (1988). John Wiley & Sons New York. 32
4. Boudreaux, B.H. Arthropoda Phylogeny (1997), with special reference to insects, Wiley and Sons, New York, pp. 320.
5. Grimaldi, D and Engel M. Evolution of the insects (2005), Cambrıdge University Press, New York and Cambridge, pp. 755.
6. Gupta, A. P. Arthropoda Phylogeny (1979), Van Nostrand reinhold, New York.
7. Price, P W. Insect Ecology 1984, 2nd edition, John Wiley & Sons, New York.

B050905 P Practical

Taxonomy, Animal Behaviour and Chronobiology

1. Study of Taxis, Kinesis, Habituation, Trial and error learning; Visual discrimination, Feeding
2. behaviour, Pheromonal communication concerning sexual/special behaviour.
3. To study the geotaxis behaviour of earthworms; to study the orientation responses of first instar noctuid larvae to photo stimulı.
4. To study the median threshold concentration of sucrose solution in eliciting feeding responses of the housefly
5. To study the orientation responses of larvae to volatile and visual stimuli

MZOL 505 A Elective paper Practical

Fish Biology

1. Identification of Indian common fish faunal resources from cold water, warm water, marıne
2. water and ornamental fishes
3. Physico-chemical parameters of freshwater bodies.
4. Collection of phytoplankton and zooplankton from natural resources and their identification.
5. Study of fishing gears and nets with the help of models.
6. Salınity tolerance in selected fishes.
7. Determination of age and growth
8. Experiments on chemoreception using different attractants and repellents.
9. Study of the organ system of Scoliodon, Labeo and Wallago;
10. Study of accessory respiratory organs and their blood supply in Heteropneustes. Clarias, Channa and Anabas
11. Study of air bladder and ear connection in Notopterus and Gudusia or Hilsa
12. Study of prepared microslides: osteology of Wallago.
13. Qualitative and quantitative study of freshwater planktons
14. Estimation of Dissolved oxygen, free carbon dioxide, and alkalinity in a local fish pond; oxygen consumption in local fish in different habitats.
15. Study of food and structural modifications due to feeding habits, gills and gill-rackers, mouth, eye, alimentary canal, olfactory organs, etc.
16. Study of amphibious, exotic, poisonous, venomous, larvivorous and sound-producing fishes.
17. Estimation of liver glycogen
18. Visit to a coastal/ fish farm
19. A collection of fish of different orders

20. Viva-voce
21. Practical record

Endocrinology and Reproductive Physiology

1. Dissection of endocrine glands in Vertebrate/Invertebrates with display and diagram.
2. Biochemical estimation of proteins, glycogen in endocrine tissue with colorimeter,
3. Determınation of blood sugar level
4. Microtomy of endocrine material

Molecular Biology

1. Preparation of Molecular Biology Buffers
2. Isolation of genomic DNA from Anımal tissue
3. DNA Extraction from Human blood sample by using salting out method.
4. Induction of mutants using chemical agents
5. Checking of DNA Purity and concentration - agarose and spectrophotometer
6. Problems on DNA Kinetics
7. Tm determination of DNA
8. Comet Assay for the Detection of DNA Damage
9. Plasmid DNA isolation
10. In silico primer designing exercise
11. Isolation of mRNA- trizol method
12. In sılico Analysıs Prokaryotic Promoter Sequence
13. In silico Analysis of Eukaryotic Promoter Sequence

ENTOMOLOGY

1. Detailed study of the external features of the grasshopper
2. Dissection of different systems of Gryllotalpa, Dysdercus, Housefly/Calliphora,
3. Moth/butterfly/caterpillar/Wasp, honey bee, Dung beetle, Water beetle.
4. Permanent preparation of the testis of the Cockroach, the salıvary gland of Dysdercus, ovary,
5. spermatheca and the accessory gland of the house fly.
6. The sting apparatus of the wasp/ honey bee.
7. Spiracles of the caterpillar and wing scales of a lepidopteran insect
8. Legs of terrestrial and aquatic insects show simple adaptation concerning locomotion.
9. Study of prepared slides: T.S. / L.S. of integument and the various regions of gut, ovary, testis and brain.
10. Whole mounts of thoracıc/ abdominal spıracles, different types of antennae, legs, moth
11. parts, wings and sting apparatus of the honey bee/ wasp.
12. Determination of pH of insect guts and haemolymph.
13. Qualitative assay of free amino acids and haemolymph and fat body.
14. Quantitative estimation of glycogen, protein and lipid.
15. Qualitative determination of uric acid from fat body/ Malpighian tubules.
16. Determination of the rate of passage of food through the gut.

B050905 P	
Exercise	**Marks**
Dissection (Major + Minor) (For Fish Biology, Entomology, and Endocrinology)	15+5
OR	
Molecular Biology Exercise	20
Preparation	10
Behaviour Exercise	15
Taxonomy (Identification of 2 Fish/ Insect)	10
OR	
Isolation of Nucleic Acid	10
Microtomy	05
Spotting (10 Spots)	20
Viva-voce	10
Class Records	10
Total Marks:	**100**

M.Sc. II Year Semester III (Paper VI)

B050905 R	Credit: 4 Project	Project
	Course Title: Research Project	
Each Student will do a research project under the guidance of a supervisor. Evaluation of the research project will be done after the fourth semester.		

- **Educational tour is in Paper II MZO502T (Environmental biology, Wildlife and Economic Zoology)**

Maa Pateswari University, Balrampur **M.Sc. II (SEMESTER - IV)** **Paper I BIOINSTRUMENTATION AND BIOTECHNIQUES**		
Course Code: B051001T	**Marks: 25+75** **Credits: 4**	**Core Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Bioinstrumentation and Biotechniques**	
Course objectives To explain the principles and working of instruments in a biology laboratory.		
Unit	**Topics**	**No. of Lectures**
I	Fluorescence and Electron Microscopy (SEM and TEM) with Principles and working	15

II	Chromatography- Paper and thin layer chromatography, lon exchange chromatography, High-performance liquid chromatography (HPLC), Electrophoresis and Centrifugation	15
III	Histochemical and Immuno techniques Enzyme-linked immunosorbent assay (ELISA), Radioimmunoassay (RIA), Western blot, Chromatin Immunoprecipitation (CHIP), flow cytometry, Fluorescence in sıtu hybridisation (FISH) and Genomic in situ hybridisation (GISH), Polymerase Chain Reaction (PCR)	15
IV	Absorption Spectrophotometry with Principle and Working	15

Student learning outcomes

To get the ideas of separation and identification of biomolecules by Chromatography: Paper and thin-layer Chromatography. This course is useful in various competitıve exams like CSIR-NET etc. To get the ideas of microscopy, like the electron microscope and fluorescence.

Books recommended :

1. Boyer: Modern Experimental Biochemistry and Molecular biology (2nd Ed),Benjamin/Cumın, 1993
2. Freifelder: Physical Biochemistry (2nd Ed.), Freeman, 1982
3. Holme and Peck: Analytical Biochemistry (3rd Ed.), Tata McGraw-Hill, 1998
4 Plumer: An Introduction to Practical Biochemistry (3rd Ed.), Tata-McGraw Hill, 1990
5 Switzer and Garrity: Experimental Biochemıstry 92nd Ed.), Freeman, 1999
6. Wilson and Walker: Practical Biochemistry (3rd Ed.), Cambridge Univ. Press, 2000.

Maa Pateswari University, Balrampur

M.Sc. II (SEMESTER- IV)

Paper II COMPARATIVE ANATOMY OF VERTEBRATES

Course Code: B051002T	**Marks: 25+75** **Credits: 4**	**Core Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: COMPARATIVE ANATOMY OF VERTEBRATES**	

Course objectives

Comparative anatomy of different systems in Vertebrates

Unit	Topics	No. of Lectures
I	Comparative Anatomy of the following systems of the vertebrates (Fish, Amphibia, Reptile, Birds and Mammals) Integumentary System and Skeletal System	15
II	Comparative Anatomy of the following systems of the vertebrates (Fish, Amphibia, Reptile, Birds and Mammals) Circulatory System and Excretory System	15
III	Histochemical and Immuno techniques Enzyme-linked immunosorbent assay (ELISA), Radioimmunoassay (RIA), Western blot, Chromatin Immunoprecipitation (CHIP), flow cytometry, Fluorescence in sıtu hybridisation (FISH) and Genomic in situ hybridisation (GISH), Polymerase Chain Reaction (PCR)	15
IV	Comparative Anatomy of the vertebrates (Fish, Amphibia, Reptile, Birds	15

	and Mammals) Reproductive System	

Student learning outcomes

To understand the applications of this course in different field of Science and Technology
Think and develop new ideas in this subject, benefits of this course in various national and international competitive examinations

Books recommended :

1.Herbert W. Rand. Comparative Anatomy of vertebrates, Harvard University Press
2. M.D.L. Srivastava. Comparative Anatomy of Vertebrates
3. Saurav Singh. Text book of Comparative Anatomy of Vertebrate by. Centrum Press
4. T Mishra, Mishra D & Srivastav S, Comparative Anatomy of Vertebrates, Mahaveer Publications.

Maa Pateswari University, Balrampur

M.Sc. II (SEMESTER - IV)
B051003E(A) (A) Paper III
Elective Paper - FISH BIOLOGY
Paper I APPLIED FISH AND FISHERIES

Course Code: B051003E(A)	**Marks: 25+75** **Credits: 4**	**Elective Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: APPLIED FISH AND FISHERIES**	

Course objectives

About the layout of different types of Ponds, fishing gears and crafts
Marketing and trade, byproducts
Disease related to fish

Unit	Topics	No. of Lectures
I	Marine, Estuarine fisheries of India, Physico-chemical and biological characteristics of pond water and manuring (organic and inorganic) and fertilization in pond fish	15
II	Construction and layout of different types of ponds (nursery, rearing, and stocking); formulation and operation of different types of hatcheries; transport and mortality of fish fry; eradication of predatory and weed fishes	15
III	Method of fishing, fishing gears and crafts with particular reference to Uttar Pradesh; fish preservation and processing (traditional and advanced methods); fishing marketing and trade; fish byproducts	15
IV	Fish pathology, prevention, prophylaxis and treatment of fungal, bacterial, viral and protozoan diseases; larvivorous fishes, fisheries cooperative societies of India	15

Student learning outcomes

The present course will prepare the students to understand types of hatcheries, fishing gears, brood stock and management of fisheries ponds
The students will study about preservation and processing methods, common enemies, symptoms, etiology and treatment of food fishes.

Books recommended

1. Jhingran, V.G. Fish and Fisheries of India.

2 Aggarwal, S.C. Fishery Management.
3. Govından, T.K. Fısh Processing Technology.
4. Beavan, C.R. Handbook of Freshwater Fishes of India.
5. Bal and Rao, Marine Fısheries.
6. William RD and Matthew G. 1984. Multivariate Analysis, Methods and Applications. John Wiley & Sons.
7. Bıradar RS. 2002. Course Manual on Fisheries Statistics. 2nd Ed. CIFE, Mumbai.
8. Welch PS. 2003. Limnological Methods. Narendra Publ House.
9. Nelson JS. 2006. Fishes of the World, John Wiley and Sons, Inc., New Jersey

Maa Pateswari University, Balrampur

M.Sc. II (SEMESTER - IV)
B051003E (B) Paper III
Elective Paper - Endocrinology and Reproductive Physiology
Paper I Reproductive Endocrinology I

Course Code: B051003E(B)	**Marks: 25+75** **Credits: 4**	**Elective Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Endocrinology and Reproductive Physiology**	

Course objectives

The course focuses on helping the students to understand the basics of male reproductive endocrinology and impart knowledge about the testis and spermatogenesis. The male reproductive organs, gametes, physiology and their hormonal regulation.

Unit	**Topics**	**No. of Lectures**
I	• Differentiation of the testes and male genital ducts. • Histology and ultrastructure of testıs. • Spermatogenic function of the testis. • Hormonal regulation of spermatogenesıs • Structure and functional significance of Sertoli cells	15
II	• Endocrine and paracrine function of Sertoli cells. • Structure and functional role of Leydig cells. • Metabolism of testicular androgens	15
III	• Biochemistry of semen and analysis of semen. • Structure and physiology of the male reproductive tract. • Effects of environmental factors on reproduction. • Inhibın and activın	15
IV	• Ultrastructure of mammalian sperm • Metabolıc changes in spermatozoa during maturation • Capacitation of spermatozoa • Testicular disorders and their remedies. • Regulation of fertility in male. • Contraception through male	15

Student learning outcomes

The students will get the idea about

Male Genital tract, histology, hormones Male gamete, Testıcular dısorder, regulation of fertılıty in males
Books recommended 1 Vertebrate Endocrinology: David O. Norris, James A. Carr, 2013, 5th Edition, Academic Press 2. Williams Textbook of Endocrinology: H. M. Kronenberg, S. Melmed, K. S. Polonsky and P R. Larsen, 2008, 11th Edition, Saunders, Elsevier 3. P. J. Bentley. Comparative Vertbrate Endocrinology, 3rd Edition, Cambridge Universıty Press 4 Charles B. Nemeroff Neuroendocrinology, xxxx, CRC, US 5. Rıchard E. Brown. An Introduction to Neuroendocrinology, 2005, Cambridge University Press 6. Mac E. Hadley and Jon E. Levine. Endocrinology, 2009, 6th Edition, Pearson Education

Maa Pateswari University, Balrampur

M.Sc. II (SEMESTER - IV)
B051003E (C) Paper III
Elective Paper - MOLECULAR BIOLOGY
Paper I Regulation of Gene Expression

Course Code: B051003E(C)	**Marks: 25+75** **Credits: 4**	**Elective Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Regulation of Gene Expression**	

Course objectives

The course focuses on helping students to understand the concept of gene regulation in prokaryotes and eukaryotes.

Unit	Topics	No. of Lectures
I	Gene regulation in prokaryotes: Lac Operon and Tryptophan operon, gene regulation in Bacteriophage Lambda (λ)	15
II	Gene Regulatıon in Eukaryotes: Activators and Repressors, DNA Binding Proteins (Homeodomain Proteins, Zinc-Containing DNA Binding Proteins, Leucine Zipper Motif, Helix-loop Helix Proteins), Action at Distance; Loop and Insulators	15
III	Gene Regulation by Regulatory RNA: In Bacteria by Riboswitch, Gene Regulation in eukaryotes by RNA interference, Regulatory RNA (siRNA, Mi RNA) generation, Structure and Mechanism of Action	15
IV	Epigenetic Regulation of Gene Expression; Overview of epigenetic regulation, Chromatin remodeling and gene expression, Histone modifications and gene expression, Small RNA based epigenetic regulation, Propagation of epigenetic regulation (genome imprinting)	15

Student learning outcomes

How are the different types of genes expressed in different types of cells
How the DNA-binding protein binds to the promoter of eukaryotic and prokaryotic genes
How the operon of catabolıc and anabolic genes get regulated

Maa Pateswari University, Balrampur

M.Sc. II (SEMESTER - IV)
B051003E(D)Paper II
Elective Paper – ENTOMOLOGY
Paper I ECONOMIC ENTOMOLOGY

Course Code: B051003E(D)	**Marks: 25+75** **Credits: 4**	**Elective Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Economic Entomology**	

Course objectives

The course focuses on helping students understand the economic importance of insects

Unit	**Topics**	**No. of Lectures**
I	Beneficial Insects: Biology of Beneficial Insects (Apis, Bombyx, and Kerria), Insect Products, Use of Insects in Medicines, Insects in Biological Research, Pollination by Insects, Insects as Consumers, Scavengers, and as Food, Forensic Entomology.	15
II	Harmful insects. life history, damage caused and control measuresof following insects pests: household insects: insect injurious to man (aedes, Anopheles, Culex, Phlebotomus, Cimex, Xenopsylla, Pediculus) and life stock (Simulium, Tabanus, Hypoderma, Cochliomyia, Hippobasca), insects transmitting viral diseases in plants: pests of cotton (Aphis gossypii, Earius spp., Pectinophora Gossypiella, Dysdercuskoenıgı, Myllocerusundecimpustulants, Amrascahigullula), pests of sugarcane(Scırpophagaexcerptali, Chiloinfuscatellus, Emmaloceradepresella,Pyrillaperpusilla, Aleurolobusbor odenis.)	15
III	Life history, damage caused and control measures of the following insect pests, pests of cereal crops (Leptocorsia acma, Scirpophaga incertulus, Chilo suppressalis, Hieroglyphus banian, Dicladispa armigera, Nephotettixspp spp., Sesamiainferens); pests of pulses (Hehcoverpaarmıgera), pests of vegetables (Aulacophora indica, Leucinodesorbanalıs, Bactroceracucurbitae, Henosepilachna spp., Phthorımaeaoperculella, Pierisbrasiccae)	15
IV	Life history, damage caused and control measures of following insects pests pests of oilseeds (Amsactaspp., Lipaphispscudobrassicae, Athalialugensproxima, Bagradahilarıs). Pests of fruits and fruit trees (Quadraspidiotus pernicious. Eriosomalanıgerum. Amrıtodesatkinsoni, Oryctesrhinoceros, Papillodemoleus); pests of stored commodities: Sitophilus oryzae,Trogodermagranarium,Trıbolium spp., Callosobruchuschinensis, Corcyra cephalinica, sitotrongacereaiella).	15

Student learning outcomes

The students will get the idea about
Beneficial insects
Harmful insects
their life cycle

Books recommended

1 Alford, D.V. A text book of Agricultural entomology (1990), Wiley -Blackwell.
2 Atwal, A.S and Dhalwal, G S. Agriculture pests of South Asia and their Management (1997), Kalyanı Publishers, New Delhi.
3. Awasthı, V.B Agricultural pests and their control. (2001), Scientific Publishers, New Delhi
4 Davıd, B V Elements of economic entomology (2000), Popular Book Depot, Chennar

Maa Pateswari University, Balrampur

M.Sc. II (SEMESTER - IV)

MZO514E (A) Paper IV

Paper II AQUACULTURE FISHERIES

Course Code: B051004E (A)	**Marks: 25+75** **Credits: 4**	**Elective Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Aquaculture Fisheries**	

Course objectives

The students will learn about
Induced breeding,
Integrated fish farming,
Fish culture
Problems and perspectives related to fish culture

Unit	**Topics**	**No. of Lectures**
I	Problems and prospects of aquaculture: breeding habits of carps, induced, and bundh breeding of carps (indigenous and exotic)	15
II	Polyculture and monoculture, aquatic weeds and their control, aquarium fish and their maintenance, cage culture, integrated fish farming and their management, nets and boats used for fishing	15
III	Gynogenesis, androgenesis, transgenic fish, advances in fishery science	15
IV	Freshwater reservoirs and cold water fisheries of India: problems and prospects of mariculture, fisheries in India, with particular reference elasmobranchs, crustacean and molluscan fisheries	15

Student learning outcomes

The present course will prepare the students for
To understand the economic importance of different types of fisheries
The self-employment and job related to fish and fisheries

Books recommended

1 Jhingran V. G. 1991. Fish and Fisheries of India, Hindustan Publishıng Corporation
2. Pillay TVR and Dill WMA. 1979. Advances in Aquaculture Fishering New Books, Ltd. England
3. Nikolsky GV. 1963. Ecology of Fishes Academic Press
4. Ojha J.S. 2005. Aquaculture Nutrition and Biochemistry. Daya Publication
5. Rath R. K. 2000. Freshwater Aquaculture, Scientific Publication

Maa Pateswari University, Balrampur

M.Sc. II (SEMESTER - IV)
B051004E(B)Paper IV
Paper II Reproductive Endocrinology II

Course Code: B051004 E (B)	**Marks: 25+75** **Credits: 4**	**Elective Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Reproductive Endocrinology II**	

Course objectives

The course focuses on helping the students to understand

the basics of female reproductive endocrinology and impart knowledge about the ovary and the female genital duct.

the female reproductive organs, gametes, physiology and their neurohormonal regulation.

Unit	Topics	No. of Lectures
I	Differentiation of the ovary and female genital ducts. Histology of the ovary and ultrastructure of the ovum. Estrous and Menstrual cycle in mammals.	15
II	Puberty and its hormonal control. Implantation and its hormonal regulation. Pregnancy and its hormonal regulation. Hormonal regulation of parturition and lactation	15
III	Fine structure and types of plantation and their significance. Placental hormones- secretions and significance. Corpus luteum and its functional significance. Control of fertility in females due to mechanical, chemical and biological means	15
IV	Prostaglandins and their role in reproduction. Endocrine control of ovulation and lutenization. Endocrine control and function of mammalian oviduct.	15

Student learning outcomes

The students will get the idea about

female reproductive system and their hormonal regulation.

Books recommended

1. David O. Norris, James A. Carr Vertebrate Endocrinology, 2013, 5th Edition, Academic Press
2. H. M. Kronenberg, S. Melmed, K. S. Polonsky and P. R. Larsen. Williams Textbook of Endocrinology, 2008, 11th Edition, Saunders, Elsevier
3. P. J. Bentley Comparative Vertrebrate Endocrinology, 3rd Edition, Cambridge University Press
4. Charles B. Nemeroff. Neuroendocrinology, xxxx, CRC, US
5. Richard E. Brown An Introduction to Neuroendocrinology, 2005, Cambridge University Press
6. Mac E. Hadley, Jon E. Levine. Endocrinology, 2009, 6th Edition, Pearson Education

Maa Pateswari University, Balrampur

M.Sc. II (SEMESTER - IV)
B051003E (C) Paper IV
Elective Paper - MOLECULAR BIOLOGY
Paper II: Applied Molecular Biology

Course Code: B051004E (C)	**Marks: 25+75** **Credits: 4**	**Elective Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Applied Molecular Biology**	

Course objectives

The course focuses on helping the students to understand

The course focuses on helping the students to understand the concept of genetic engıneerıng and how genes transfer from one organism to another organism

Unit	**Topics**	**No. of Lectures**
I	Enzymes used in DNA technology: Restriction and modification enzymes, nucleases, Polymerases, Ligase, kınases and phosphatases, Cloning vectors; Plasmids, Cosmids, Artificial chromosomes, Shuttle vectors, Expression vectors, Construction of genomic and cDNA libraries	15
II	Screening and characterisation of clones, Preparation of probes, Principles of hybridızations and hybridisation-based techniques (colony, plaque, Southern, Northern and in situ hybridisations)	15
III	Basic principles and applications of the following techniques: DNA sequencing, Oligonucleotide synthesis, Polymerase Chain Reaction, Microarray, Promoter characterızation: promoter analysis through reporter genes, electrophoretic mobility shift assay, DNA footprinting	15
IV	Mutagenesis: Site-directed mutagenesis, Transposon mutagenesis, and Construction of knock-out mutants, Gene transfer techniques; Electroporation and microinjection, Transfection of cells: Principles andMethods, germ-line transformation in Drosophila and transgenic mice: Strategies and methods, Genome editing using the CRISPR/Cas9 system, Applications of Recombinant DNA Technology: Crop and livestock improvement, Gene therapy, somatic and germ line gene therapy, DNA drugs and vaccines	15

Student learning outcomes

The students will get the idea about

How does the restriction enzyme recognise the cutting site in the gene and the selected part

How the genes are transferred from one organism to another with the help of a suitable vector

How the sequence of a gene will be deciphered by the sequencing technique.

Books recommended

1. Ausubel et al (2002). Short Protocols in Molecular Biology. Wiley
2 Brown (2000) Essential Molecular Biology VI. AP
3 Brown (2000). Essential Molecular Biology VII. AP
4. Brown (2006). Gene Cloning and DNA Analysıs - An Introduction Blackwell
5 Glick and Pasternak (2003). Molecular Biotechnology. ASM Press

Maa Pateswari University, Balrampur

M.Sc. II (SEMESTER - IV)
B051003E (D) Paper IV
Elective Paper - ENTOMOLOGY
Paper II: Applied Entomology

Course Code: B051003E (D)	**Marks: 25+75** **Credits: 4**	**Elective Paper**
Total no. of Lectures (in hours per week) - 4	**Course Title: Applied Entomology**	

Course objectives

The course focuses on helping the students to understand the concept of genetic engineering and How the genes transfer from one organism to another organism.

Unit	**Topics**	**No. of Lectures**
I	Methods of pest managemenrt: physical control measures (temperature, electromagnetic fields and ionizing radiations, temperature); mechanical control measures (handpicking of infested plants and their destruction, netting, bagging and dislodging insect pests, trenching, insect barriers, insect traps, destruction of crops residues, weeds and trash); cultural control measures (selected of quality seeds, clean cultivation, destruction/provision of alternative/trap plants, crop rotations, tillage operations, timing of planting/harvesting, nutrient/water management).	15
II	Chemical control measures insecticides: classification, properties. synergistic, repellants, attractions: feeding deterrents: feeding deterrents, formulations, biopesticides; benefits and risks of chemical control, application; modes of action of insecticides, developments of insect resistance against insecticides	15
III	Biocontrol measures organisms used in biocontrol, inoculation, augmentation and conservation of natural enemies - pathogens, predators and parasitoids; selected criteria of a promising natural enemy). Feasibility of biocontrol: genetic control measures(sterile-male techniques, artificial manipulation of gene composition of pest insects; breeding of insect-resistant host plants); legal control measures (enactment and enforcement of quarantines);	15
IV	Mass production of quality biocontrol agents: Techniques, formulations, economics, field release/application and evaluation, Successful biological control projects, analysis, trends and future possibilities of biological control, Importation of natural enemies: Quarantine regulations, Biotechnology in biological control. Semiochemicals in biological control, Concept of integrated pest management (IPM) in agroecosystem, ticks and Mites of Economic importance.	15

Student learning outcomes

The students will get the idea about

To study the methods of pest management, physical control measures, mechanical control measures and selection of quality seeds. clean cultivation, destruction of alternative/trap plants, crop rotations, tillage operations, and timing of planting/harvesting. nutrient/water management.

Books recommended

1.Abroi, D P. Integrated pest management (2014) Academic press, USA

2 Alford, D V. A textbook of Agricultural entomology (1990), Wiley -Blackwell.
3. Atwal, AS & Dhalwal, G.S. Agriculture pests of South Asia and their Management (1997), Kalyanı Publishers. New Delhi
4 Awasthi, V.B. Agrıcultural pests and their control (2001), Scientific Publishers, New Delhi
5. David, B.V. Elements of economic entomology (2000), Popular Book Depot, Chennai
6. Ananthkrishnana, TN and A Raman. Dynamics of Insect-Plant Interaction (1988) Oxford & IBBH Publishing Co Pvt. Ltd, New Delhı.

M.Sc. II (SEMESTER - IV)

General Practical (B051005P)

Bioinstrumentation

- Study of electron micrograph, basic principles and functioning of absorption spectrophotometry, paper and thin-layer chromatography, centrifugation

Comparative Anatomy of Vertebrates

- To study comparative anatomy of the following systems of vertebrates (slıdes and bones)
- Integumentary system, digestive system, respiratory system, circulatory system, excretory system, nervous system and reproductive system

Elective Paper Practical (MZO515P)

Fish Biology

- Estimation of hydro biological parameters, temperature, pH, conductivity, salinity, dıssolved oxygen, primary productivity, ammonia, nıtrite, nitrate, phosphate, biological oxygen demand, chemical oxygen demand, of nursery rearing, stocking and breeding ponds.
- Demonstration of breeding pools and hatcheries. Induced breeding of Indian major carps and catfishes. Identification of eggs, spawn, fry and fingerlings of cultivable fishes of India.
- Collection and identification of aquatic weeds and aquatic insects: Study of feeding habits of fishes by gut content analysis, isolation and estimation of fish immunoglobulins;
- Molecular techniques in fish health management: Aquarium design and maintenance, formulation and preparation of artificial fish food for Indian major carps and Prawns;
- Analysis of the proximate composition of fish and processed products.

Reproductive Endocrinology

- Dissection of various reproductive glands in vertebrates.
- Operations in male rats: castration, vasectomy
- Confirmation of pregnancy in urine using the antibody method.
- Identification of permanent slides of reproductive organs.
- Identification of chemical structures of steroidal hormones.

- Dissection of the reproductive gland accessory organ with display and diagrams.
- Experiments on living rats (two). Operation in male and female rats: Vaginal smear and sperm Studies

Molecular Biology

- Epigenetic Analysıs - Insilico
- Understanding Human Genome Project
- Serum mıRNA analysis
- In silico study of regulatory RNA
- Isolation of genomic DNA from any bacterial strain* genome.
- PCR amplification of any gene and analysis by agarose gel electrophoresis
- Preparation of plasmid, pET-28a, from E. coli DH5α and gel analysis
- Restriction digestion of the vector (gel analysis) and insertion of the target gene
- Vector and Insert ligation
- Transformation in E.coli.
- Plasmıd isolation and confirming recombinant by PCR and RE digestion.
- Transformation of recombinant plasmid in BL21 (DE3).
- Purification of protein on Ni-NTA column and analysis of purification by SDS-PAGE
- Identification of restriction enzymes for RFLP analysis using NEB cutter software.
- Visit any research lab related to molecular biology and write a project on it

ENTOMOLOGY

- A collection of different kinds of larvae and pupae of insects.
- Collection, preservation and identification of locally available insects.
- Permanent preparation of mouth parts, antennae, wings, legs, Spiracles and external
- genitalia of insects from different groups.
- Identification of various insect pests, their life history and materials damaged by them.
- Study of various groups of insecticides and equipment used for insecticide application.
- To study histology and to demonstrate the presence of lipid and glycogen in microtomy
- sections of suitable material.
- Study of life -history of beneficial insects and their products.

(B051005P)	
Distribution of Marks (Practical)	
• Technique/ Instrumentation	20
• Exercise for Fish Biology/ Endocrınology/ Molecular Biology/ Entomology	15+15
• Spotting(10 Spots)	30
• Viva Voce	10
• Class Record	10
Total Marks:	**100**

M.Sc. II Year (Semester Paper II) Paper VI

Course Code: **(B051006 R)**	**CREDIT: 4**	**PROJECT**
	Course Title: Research Project	
Each Student will do a research project under the guidance of a supervisor. Evaluation of the research project will be done after the fourth semester.		