

BOARD OF STUDIES IN ZOOLOGY

1. Chairperson: Dr Hemachandra, Associate Professor
2. Members from the department: Mr. Hariprasad Shetty, Assistant Professor.
Mr. Kiran Vati K, Assistant Professor
Mr. Glavin Thomas Rodrigues, Assistant Professor
Ms. Savia Dsouza, Assistant Professor
Ms. Michelle Sonali Rodrigues, Assistant Professor
3. External Members:

| Sl No | Name | Address | CellPhone | E-Mail |
|---|----------------------------|---|--------------------------|--|
| Subject Experts | | | | |
| 1 | Dr Siby Philip | Head of Zoology, Nirmalagiri College Kuthuparamba, Kannur, Kerala, 670701. | 9567655327 | philips@nirmalagiricollege.ac.in |
| 2 | Dr Shamprasad Varija Raghu | Ramalingaswami Fellow/Associate Professor, Dept. of Applied Zoology, Mangalore University. | 7899496251. | shamprasadvrijaraghu@gmail.com |
| Vice-Chancellor Nominee | | | | |
| | Dr Nagarathna K A | Department of Zoology, Mangalore University College, Mangaluru | 9449073120 | Nagarathnasathish96@gmail.com |
| 5. Representative from Industry / Corporate Sector/Allied Area | | | | |
| | Conrad Charles I P | Atlantis Aquaria, #16-7-448, Muthu's Compound Balmatta, Mangaluru-575002 | 9481440479 | charlpaul@gmail.com |
| 6. Meritorious Alumnus | | | | |
| | Dr Sudeep Ghate | Scientist, centre for Bioinformatics and Biostatistics, NITTE (Deemed to be University), Paneer Deralakatte. | 9742352321 8217669438 | Sudeep1129@gmail.com |
| 7. Student | | | | |
| | Ian Castelino | Student, St. Aloysius College. | 8861779980 | Ian.castelino2002@gmail.com |

Scheme of credit based semester system for B.Sc.

Optional subject: Zoology

III Semester

| Paper | Instructions hours/week | | Duration of exam hours | Marks | | Total Marks | Credits |
|---|-------------------------|-----------|------------------------|-------|----|-------------|---------|
| | Theory | Practical | | Exam | IA | | |
| G508DC2.3 (Theory) Molecular Biology, Bioinstrumentation and Techniques in Biology | 4 | - | 2 | 60 | 40 | 100 | 2 |
| G 508.DC 2.3P (Practical) Molecular Biology, Bioinstrumentation and Techniques in Biology | - | 4 | 4 | 40 | 10 | 50 | 1 |
| G508OE 2.3E (Open Elective) Endocrinology | 3 | - | 2 | 40 | 10 | 50 | 1 |

IV Semester

| Paper | Instructions hours/week | | Duration of exam hour | Marks | | Total Marks | Credits |
|--|-------------------------|-----------|-----------------------|-------|----|-------------|---------|
| | Theory | Practical | | Exam | IA | | |
| G508.DC2.4 (Theory) Gene Technology , Immunology and Computational Biology | 4 | - | 2 | 60 | 40 | 100 | 2 |
| G508.DC2.4P (Practical) Gene Technology , Immunology and Computational Biology | - | 4 | 4 | 40 | 10 | 50 | 1 |
| G508OE 2.4E (Open Elective) Animal Behavior | 3 | - | 2 | 40 | 10 | 50 | 1 |

**Proposed Course content under New Education Policy Year 2022-23 for III
Semester B.Sc. Zoology**

Core Course Content

Course Title/Code: Molecular Biology, Bioinstrumentation and Techniques in Biology

Semester III - Zoology Core Course III Content:

| Content | Hours |
|--|-----------|
| Unit I | 14 |
| Chapter 1: Process of Transcription <ul style="list-style-type: none"> • Fine structure of gene • RNA polymerases • Transcription factors and machinery • Formation of initiation complex • Initiation, elongation and termination of transcription in prokaryotes and eukaryotes | 07 |
| Chapter 2: Process of Translation <ul style="list-style-type: none"> • The genetic code • Ribosome • Factors involved in translation • Aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase • Initiation, elongation and termination of translation in prokaryotes and eukaryotes | 07 |
| Unit II | 14 |
| Chapter 3: Regulation of Gene Expression I <ul style="list-style-type: none"> • Regulation of gene expression in prokaryotes: Lac and trp operons in <i>E. coli</i> • Regulation of gene expression in eukaryotes: Role of chromatin in gene expression • Regulation at transcriptional level, Post-transcriptional modifications: Capping, splicing, polyadenylation • RNA editing | 07 |
| Chapter 4: Regulation of Gene Expression II <ul style="list-style-type: none"> • Regulation of gene expression in eukaryotes • Regulation at translational level, Post-translational modifications: protein folding etc. • Intracellular protein degradation • Gene silencing, RNA interference (RNAi) | 07 |

| | |
|--|-----------|
| Unit III | 14 |
| Chapter 5: Principle and Types of Microscope <ul style="list-style-type: none"> • Principle of microscopy and applications • Types of microscopes: light microscopy, dark field microscopy, phase-contrast microscopy. • Fluorescence microscopy, confocal microscopy, electron microscopy | 06 |
| Chapter 6: Centrifugation and Chromatography <ul style="list-style-type: none"> • Principle of centrifugation • Types of Centrifuges: high speed and ultracentrifuge • Types of rotors: Vertical, swing-out, fixed-angle etc. • Principle and Types of Chromatography: paper, thin layer, column-ion-exchange, gel filtration, GLC, HPLC, affinity chromatography | 08 |
| Unit IV | 14 |
| Chapter 7: Spectrophotometry and Biochemical Techniques <ul style="list-style-type: none"> • Colorimetry and spectrophotometry: Beer-Lambert law, absorption spectrum • Biochemical techniques: Measurement of pH, • Preparation of buffers and solutions • Measurement, applications and safety measures of radio-tracer techniques | 06 |
| Chapter 8: Molecular Techniques <ul style="list-style-type: none"> • Nucleic acid fractionation, detection by electrophoresis, Polymerase Chain Reaction (PCR), primer designing, site directed Mutagenesis, DNA sequencing. • Molecular cloning, genomic libraries. • Detection of proteins, PAGE, ELISA, Western blotting. | 08 |

Suggested Readings:

- Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004).
- Alberts et al: Molecular Biology of the Cell: Garland (200Z).
- Cooper: Cell: A Molecular Approach: ASM Press (2000).
- Karp: Cell and Molecular Biology: Wiley (2002).
- Watson et at. Molecular Biology of the Gene. Pearson (2004).
- Lewin. Genes VIII. Pearson (2004).
- Pierce B. Genetics. Freeman (2004),
- B. Sambrook et al. Molecular Cloning Vols. I, II, III. CSH L T 2

Zoology Core Lab Course Content

Course Title: Molecular Biology, Bioinstrumentation and Techniques in Biology

Lab Course Content

| List of labs to be conducted | 56hrs. |
|--|---------------|
| <ol style="list-style-type: none">1. To study the working principle of simple, compound and binocular microscopes.2. To study the working principle of various lab equipments such as pH meter, electronic balance, vortex mixer, use of glass and micropipettes, laminar air flow, incubators, shaker, water bath, centrifuge, chromatography apparatus, etc.3. To prepare solutions and buffers.4. To learn the working of colorimeter and spectrophotometer.5. Demonstration of differential centrifugation.6. To prepare dilutions and verify the principle of spectrophotometry.7. To identify different amino acids in a mixture using paper chromatography.8. Demonstration of DNA extraction from blood or tissue samples.9. To estimate amount of DNA using spectrophotometer. <p>10. Virtual Labs</p> <p>IIT Bombay Virtual Labs</p> <p>www.labinapp.com</p> <p>www.uwlax.edu</p> <p>www.labster.com</p> <p>www.onlinelabs.in</p> <p>www.powershow.in</p> <p>https://vlab.amrita.edu/?sub=3&brch=77</p> | |

Suggested Readings:

1. Primrose & Twyman Principles of Genome Analysis and Genomics. Blackwell (2003).
2. Hartl & Jones. Genetics: Principles & Analysis of Genes & Genomes. Jones & Scartlett (1998).
3. Sambrook et al. Molecular Cloning Vols. I, II, III. CSHL (2001).
4. Primrose. Molecular Biotechnology. Panima (2001).
5. Clark & Swifter. Experimental Biochemistry. Freeman (2000)
6. Sudbery. Human Molecular Genetics. Prentice-Hall (2002).
7. Wilson. Clinical Genetics-A Short Course, Wiley (2000).
8. Pasternak. An Introduction to Molecular Human Genetics. Fritzgerald (2000).
9. Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc. Delhi.
10. Statistical Methods (Eighth Edition) by G.W. Snecdecor and W.G. Cochran, Willey
Blackwell IG. Biostatistics (Tenth Edition) by W.W. Daniel and C.L. Cross, Wiley
12. Introductory Biological Statistics (Fourth Edition) by John E. Havel.

Open Elective Course Content

Course Title: Endocrinology

Course Content

| Content | Hrs |
|---|-----------|
| Unit I | 08 |
| Chapter 1: Introduction to Endocrinology <ul style="list-style-type: none">• History of endocrinology• Classification, characteristic and transport of hormones• Neurosecretions and neurohormones | |
| Unit II | 33 |
| Chapter 2: Epiphysis, Hypothalamohypophysial Axis <ul style="list-style-type: none">• Structure of pineal gland, secretions and their functions in biological rhythms and reproduction.• Structure of hypothalamus, hypothalamic nuclei and their functions,• Regulation of neuroendocrine glands, feedback mechanisms• Structure of pituitary gland• Hormones and their functions, hypothalamohypophysial portal system,• Disorders of pituitary gland | 18 |
| Chapter 3: Peripheral Endocrine Glands <ul style="list-style-type: none">• Structure, hormones, functions and regulation of thyroid gland, parathyroid, adrenal, pancreas, ovary and testis hormones in homeostasis• Disorders of endocrine glands | 15 |
| Unit III | 15 |
| Chapter 4: Regulation of Hormone Action <ul style="list-style-type: none">• Hormone action at cellular level: Hormone receptors, transduction and regulation• Hormone action at molecular level: Molecular mediators• Genetic control of hormone action | |

Suggested Readings:

Text Books

1. Zubay et al: Principles of Biochemistry: WCB (1995)
2. Nelson & Cox: Leininger's Principles of Biochemistry: McMillan (2000)
3. Voet & Voet: Biochemistry Vols. 1 & 2: Wiley (2004)
4. Murray et al: Harper's Illustrated Biochemistry: McGraw Hill (2003)
5. Elliott and Elliott: Biochemistry and Molecular Biology: Oxford University Press
6. Chatterjee C C Human Physiology Volume 1 & 2, 11th edition, CBS Publishers (2016).

**Proposed Course content under New Education Policy–Year 2022-23
For IV Semester B.Sc. Zoology Core Course Content**

Course Title: Gene Technology, Immunology and Computational Biology

Core Course content:

| Content | Hours |
|---|-----------|
| Unit I | 14 |
| Chapter 1: Principles of Gene Manipulation <ul style="list-style-type: none"> • Recombinant DNA technology • Restriction enzymes, DNA modifying enzymes, cloning vectors, ligation • Gene transfer techniques, gene therapy • Selection and identification of recombinant cells • CRISPR- Cas | 07 |
| Chapter 2: Applications of Genetic Engineering <ul style="list-style-type: none"> • Single cell proteins • Biosensors, Biochips • Crop and livestock improvement, development of transgenes • Development of DNA drugs and vaccines | 07 |
| Unit II | 14 |
| Chapter 3: Enzyme Technology <ul style="list-style-type: none"> • Microbial culture • Methods of enzyme production • Immobilization of enzymes • Applications of antibiotics | 07 |

| | |
|--|-----------|
| <p>Chapter 4 : DNA Diagnostics</p> <ul style="list-style-type: none"> • Genetic analysis of human diseases, detection of known and unknown mutations • DNA fingerprinting • Concept of pharmacogenomics and pharmacogenetics • Personalized medicine optimizing drug therapy | 07 |
| Unit III | 14 |
| <p>Chapter 5: Biostatistics</p> <ul style="list-style-type: none"> • Calculations of mean, median, mode, variance, standard deviation • Concepts of coefficient of variation, Skewness, Kurtosis • Elementary idea of probability and application • Data summarizing: frequency distribution, graphical presentation—bar, pie diagram, histogram • Tests of significance: one and two sample tests, t-test and Chi-square test | 06 |
| <p>Chapter 6: Basics of Computers</p> <ul style="list-style-type: none"> • Basics (CPU, GPU, RAM, threads, parallel computing), operating systems (Windows, Linux) and languages (R and python) • Work stations, servers and networking | 02 |
| <p>Chapter 7: Bioinformatics</p> <ul style="list-style-type: none"> • Databases and search engines: nucleicacids, genomes, protein sequences and structures. • Sequence analysis (homology): pairwise and multiple sequence alignments - BLAST, CLUSTAL W • Tools for phylogenetic analysis | 6 |
| Unit IV | 14 |
| Chapter 8. Immunology | |

Immune system

- Immunity: innate and acquired immunity, passive and active immunity.
- Organs of immune system - Primary lymphoid organs (thymus, bone marrow, Bursa of fabricius). Secondary lymphoid organs (spleen, lymph nodes, Peyers patches).
- Cells of immune system (B cells, T cells, natural killer cells, macrophages). Antigens and antigenecity.
- Immunoglobulins - structure of IgG, functions of immunoglobulins. Immunological memory.
- Antibody diversity.
- Major histocompatibility complex
- Complement system

Immunodeficiency diseases

- AIDS - causative agent, mode of transmission, effects and preventive measures
- Vaccines- bacterial- viral- toxoid- III generation vaccines
- Autoimmunity

Suggested Readings:

1. N. Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
2. Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998).
3. Sambrook et al Molecular Cloning vols. I, II, III. CSHL (2001).
4. Primrose. Molecular Biotechnology. Panima (2001)
5. N. Gurumani (2004) An introduction to Biostatistics, MJP publishers, Chennai
6. Ivan M. Roin - Essential Immunology, Low Price Edn. VI.ELBS Publisher, 1988.
7. K.R. Joshi, N.O. Osama - immunology, 4th Edition, Agro Botanica IV E 176,
J.N.Vyas Nagar, Bikaner, 1998
8. Nandini Shetty - Immunology - Introductory T.B. - Wiley Estern Ltd., New Delhi, 1993

Zoology Semester IV Core Course Lab Content

Course Title/Code: Gene Technology, Immunology and Computational Biology

Course Content

| List of labs to be conducted | Hours |
|---|--------------|
| <ul style="list-style-type: none"> • Measure the pre and post clitellar lengths of earthworms and calculate mean, median, mode, standard deviation etc. • Measure the height and weight of all students in the class and apply statistical measures. | 08 |
| <ul style="list-style-type: none"> • To perform bacterial culture and calculate generation time of bacteria. • To study restriction enzyme digestion using teaching kits. • To study Polymerase Chain Reaction (PCR) using teaching kits. • Demonstration of agarose gel electrophoresis for detection of DNA. • Demonstration of polyacrylamide gel electrophoresis (PAGE) for detection of proteins. • To calculate molecular weight of unknown DNA and protein fragments from gel pictures | 16 |
| <ul style="list-style-type: none"> • To learn the basics of computer applications • To learn sequence analysis using BLAST • To learn Multiple sequence alignment using CLUSTALW • To learn about Phylogenetic analysis using any suitable program. • Identification of cells and organs of immune system | 16 |
| <p>Virtual Labs</p> <ol style="list-style-type: none"> 1. To learn how to perform Primer designing for PCR 2. Gel documentation system 3. PCR – www.youtube.com 4. DNA isolation 5. Spectrophotometer <p>Suggestive sites https://vlab.amrita.edu/?sub=3&brch=77</p> | 16 |

Suggested Readings:

1. N Primrose & Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).
2. Hartl & Jones. Genetics: principles & Analysis of Genes & Genomes. Jones & Bartlett (1998).
3. Sambrook et al Molecular Cloning vols. I, II, III. CSHL (2001).
4. Primrose. Molecular Biotechnology. Panima (2001)
5. N. Gurumani (2004) An introduction to Biostatistics, MJP publishers, Chennai
6. Ivan M. Roin - Essential Immunology, Low Price Edn. VI.ELBS Publisher, 1988.
7. K.R. Joshi, N.O. Osama - immunology, 4th Edition, Agro Botanica IV E 176,
J.N. Vyas Nagar, Bikaner, 1998
8. Nandini Shetty - Immunology - Introductory T.B. - Wiley Estern Ltd., New Delhi, 1993

Open Elective Course Content

Semester: **IV Zoology**

Course Title: **Animal Behaviour**

Course Content

| Content | 42Hrs |
|--|-----------|
| Unit I | 14 |
| <p>Chapter 1: Animal behaviour</p> <ul style="list-style-type: none"> • Definition and types of animal behaviour: • Innate behaviour- taxes, reflexes, instincts and motivation; • Learnt behaviour - habituation, imprinting, conditioned reflexes and insight learning. Biological clock- circadian rhythm | 05 |
| <p>Chapter 2: Communication in Animals</p> <ul style="list-style-type: none"> • Significance of communication • Components of communication • Types: Tactile, visual, acoustic, chemical | 05 |
| <p>Chapter3. Social organisation in animals</p> <ul style="list-style-type: none"> • Social behaviour • society /colony in ants, termites and monkey troops. | 04 |
| Unit II | 14 |
| <p>Chapter 4: Behaviour in solving ecological obstacles</p> <ul style="list-style-type: none"> • Foraging behavior • territorial behavior • antipredatory behavior • aggressive behavior • play behaviour | 06 |
| <p>Chapter 5 : Animal Migration</p> <ul style="list-style-type: none"> • Migration in fishes. Catadromous and anadromous. • Migration in birds - causes, types of migration, origin of migration, preparation for migration, orientation and navigation. • Advantages of migration - methods of studying bird migration (suitable examples are to be cited.) | 08 |
| Unit-3 | 14 |

| | |
|--|------------------|
| <p>Chapter 6: Reproductive behaviours</p> <ul style="list-style-type: none"> ▪ Sexual selection ▪ Reproductive strategies ▪ Diversity in mating system monogamy, polygamy- types, polyandry types. ▪ Courtship in spiders, frogs and birds. | <p>07</p> |
| <p>Chapter 7: Nesting behavior and Parental Care</p> <ul style="list-style-type: none"> • Nesting and parental care in birds (suitable examples are to be cited). • Nesting behaviour in wasps. • Parental care in fishes (<i>Hippocampus, Ophiocephalus, Tilapia, Arius</i>) • Parental care in Amphibians (<i>Racchophorus, Salamander, Hyla, Pipa, and Ichthyophis</i>). | <p>07</p> |

Suggested Readings:

- Norman T. J. Bailey (1994) Statistical methods in biology, 3rd edition, Cambridge University Press.
- Ron Freethy – Secrets of Bird Life (A guide to Bird Biology), Blandford, London, 1982, 1990.
- .T. M. Caro – Behavioural Ecology & Conservation Biology, Oxford University Press, 1998.
- Drickamer et al – Animal Behaviour, W.C. Brown Publisher, London, 1996.
- Kejoshi Aoki, Susuma et al., - Animal Behaviour, Springer Verlag, Newyork, 1984

Question Paper Pattern

Time: 2.5 hours

Max. Marks: 60

Note:

1. Answer any **TEN** questions from Part-A - Assorted questions from all four units
 2. Answer any **EIGHT** questions from Part-B - Assorted questions from all four units
 3. Answer any **FOUR** questions from Part-C - Assorted questions from all four units
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Part-A

I. Answer any TEN OUT OF TWELVE questions of the following 2x10=20

- a.
- b.
- c.
- d.
- e.
- f.
- g.
- h.
- i.
- j.
- k.
- l.

Part-B

II. Answer any FOUR OUT OF SIX questions-Assorted questions from all four units 5x4=20

- a.
- b.
- c.
- d.
- e.
- f.

Part-C

III. Answer any TWO OUT OF FOUR questions-Assorted questions from all four units 10x 2=20

- a.
- b.
- c.
- d.
