

ADIKAVI NANNAYA UNIVERSITY

RAJAMAHENDRAVARAM



School of Life and Health Sciences

M.Sc. Zoology & Aquaculture

Course Structure and Syllabus

**M.Sc. Zoology
2016-17 Onwards**

I and II Semester syllabus is common for both M.Sc Zoology and M.Sc Aquaculture.

ADIKAVI NANNAYA UNIVERSITY



M.Sc. DEGREE EXAMINATION IN ZOOLOGY & AQUACULTURE - SYLLABUS

(Effective from 2016-2017 Batch)

Synoptic note

- 1) Welcome PG courses affiliating college from this AY 2016-17
- 2) Syllabi last revised in 2012-13, three years ago
- 3) There about 25 different courses and BoS
- 4) Therefore there is need to revised syllabi to incorporate emerging concepts / aspects in relevant subject to be in sync with emerging national and global higher education trends

Proposed Guidelines:

- 5) All PG arts and commerce courses will have 5 subjects in each semester x 4 semester 20 subjects consisting total of 2000 marks. For science course there will be four theory each carries 100 marks and 200 marks for practical and total marks for each semester 600 x 4 semester 2400 marks. 100 marks for project works and presentation in all PG courses. Except MBA/MCA/MA(SW) and M.Tech.
- 6) Out of 100 marks for each subject, 75 marks (75%) marks in each paper are assigned for semester end examination and 25 marks (25%) for internal / continuous assessment for all PG courses.
- 7) Every subject of 100 marks will have 5 – 6 periods class load per week, 5 credits
- 8) Every subject will have four units of syllabus in PG courses except MBA, which will have five units of syllabus for each subject
- 9) Semester end examination question paper structure consists of two sections, viz. section A consist of four easy questions, one question from each unit of syllabus with internal choice a) or b). section B short answer questions 8 questions two from unit of syllabus, with choice to attempt any five out of 8 short answer questions given.

For MBA question paper consist of 3 sections; viz. section 'A' short answer questions 8 covering wholes syllabus, out which any five can be attempted and each question carry 4 marks $5 \times 4 = 20$ marks. Section 'B' consist of 5 long answer question for each question carries 8 marks, one question {with internal choice a) or b) } from each unit of syllabus, $8 \times 5 = 40$ marks and section 'C' is case study compulsory for 15 marks.

- 10) For all PG courses including MBA, the brake up 25 marks (25 %)for internal examination / continuous assessment will be;
- a) 15 marks for written examination, two written examinations are to be conducted average of both examinations is considered for awarding final score
 - b) 5 marks for attendance
 - c) 5 marks assignment preparation and presentation
(The proportionate may be followed for 50 marks paper / practical)
- 11) There will be project work for all PG courses except MBA, MCA, M.Tech and MA (Social work) for 100 marks (50 marks for dissertation and 50 marks for presentation and viva-voce. The project fieldwork is to be done during summer vacation i.e. after II semester and before III semester. Dissertation should be submitted by the student to the respective department during 2nd year study and presentation and viva-voce examination is to be held after IV semester examination. The project presentation and vive-voce examination is conducted by external examiner, for affiliating colleges University teachers will be external examiner for University Department external examiner from other university is to be invited. MCA / MBA /M.Tech/ MA (SW) will continue the extant system. The external examiner TA / DA and remuneration will be borne by the respective College / Department strictly as per the approved norms to be notified from time to time.
- 12) There may be comprehensive viva-voce at end of every semester being conducted by all subject teacher together assigning suitable credit from internal marks to be taken. This is intending to prepare and boost the student interview facing skills and comprehension of subject. This is proposed for PG courses.

M.Sc. ZOOLOGY
Scheme of Examination

Code	Title of the paper	Total Marks	Credits
I SEMESTER			
Z101	Biosystematics and Taxonomy	100	4
Z102	Tools and Techniques for Biology	100	4
Z103	General and Comparative Physiology	100	4
Z104	Molecular Cell Biology	100	4
	Lab Course		
Z105	Biosystematics and Taxonomy lab	50	2
Z106	Tools and Techniques for Biology lab	50	2
Z107	General and Comparative Physiology lab	50	2
Z108	Molecular Cell Biology lab	50	2
II SEMESTER			
Z201	Genetics and Evolution	100	4
Z202	Developmental Biology	100	4
Z203	Quantitative Biology	100	4
Z204	Immunology	100	4
	Lab Course		
Z205	Genetics and Evolution lab	50	2
Z206	Developmental Biology lab	50	2
Z207	Quantitative Biology lab	50	2
Z208	Immunology lab	50	2
III SEMESTER			
Z301	Population Ecology	100	4
Z302	General and Comparative Endocrinology	100	4
Z303	Biodiversity and animal conservation	100	4
Z304	Molecular Biology	100	4
	Lab Course		
Z305	Population Ecology Lab	50	2
Z306	General and Comparative Endocrinology Lab	50	2
Z307	Biodiversity and animal conservation Lab	50	2
Z308	Molecular Biology Lab	50	2
IV SEMESTER			
Z401	Metabolic cell function and regulation	100	4
Z402	Principles of Biotechnology	100	4
Z403	Aquaculture	100	4
Z404	Neurobiology and animal behaviour	100	4
	Lab Course		
Z405	Metabolic cell function and regulation lab	50	2
Z406	Principles of Biotechnology lab	50	2
Z407	Aquaculture lab	50	2
Z408	Neurobiology and animal behaviour Lab	50	2
Z409	Project Work*	100	4
	Total	2500	100

***2 months project work at the end of II Semester during summer and evaluation at the end of IV Semester.**

ADIKAVI NANNAYA UNIVERSITY: RAJAHMUNDRY
BOARD OF ZOOLOGY/ AQUACULTURE

Date: 08-07-2016

AGENDA:

1. Revision of the Syllabus
2. Syllabus for practicals
3. Number of teaching hours / Periods theory / Practical
4. Credits / Evaluation
5. Eligibility and Entrance Examinations
6. Scheme of Valuation
7. List of Examiners for papers setting and Model Question Papers
8. List of Practical Examiners

Members present:

Dr. P Vijaya Nirmala

Prof. Pala Indira

Dr. A. Matta Reddy

Dr. K. Ramaneswari

Dr. D Kalyani

Dr. J. Lalitha Bharathi

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Minutes of the meeting of the Board of Studies held on 8-7-2016
at 11:00AM at the Department of Zoology, Adikavi Nannaya University
Rajahmundry, Rajamahendravaram.

Members present

1. Dr. P. Vijaya Nirmala, Assistant Professor, ANUR.
Convenor — P. Vijaya Nirmala, 8/7/16
2. Prof. Pala Indira; Sri Krishna Devaraya University,
Ananthapur; Member —
3. Dr. A. Matta Reddy; Associate Professor; ANUR — A. Matta Reddy 8/7/16
4. Dr. K. Rameswari; Assistant Professor, ANUR - O.D.
5. Dr. D. Kalyani, Assistant Professor, ANUR — D. Kalyani 8/7/16
6. Dr. J. Lalitha Bharathi; SKR college for Women;
Rajamahendravaram; Member — J. Lalitha Bharathi
8-7-16
7. Officer from Avanti Seeds, Bhimavaram —

RESOLUTION:

The common Board consisting of the above members have met in the Department of Zoology, Adikavi Nannaya University, Rajamahendravaram and considered the enclosed agenda. After thorough deliberations and discussions, the Board members have resolved as follows.

1. The members formulated the syllabus for M.Sc Zoology and M.Sc Aquaculture 2 years course on par with other Universities in the Country to be implemented from 2016-17 academic year.
2. The syllabus for practical for the above courses formulated on par with UGC model curriculum.
3. There shall be 4 to 5 hours per week for each theory paper & 3 hrs for each practical.
4. A B.Sc Graduate with Zoology as one of the subjects is eligible to apply for admission into M.Sc Zoology & Aquaculture.
5. Ist & IInd Semesters are common for M.Sc Zoology & Aquaculture IIIrd & IVth Semesters have separate syllabus for M.Sc Zoology & Aquaculture.
6. Marks and credits are allotted to theory & practical papers in each semester. There will be 100 marks for each theory, and 200 marks for 4 practicals each 50 marks and total marks for each semester 600 x 4 semester 2400 marks. 100 marks for Project work.
7. **Examination pattern will be as follows.**
 - a) 75% of marks for Semester end Examination while the remaining 25 marks for continuous Internal assessment which includes 5 marks for attendance (5 marks 95 % above, 4 marks 85-94%, 3 marks 75 – 84%, 2 marks 65-74%, 1 mark 55-64%), 5 marks for Assignment and Presentation and 15 marks for Mid-Examination, with one (10 marks) & one short question (5 marks) with internal choice.
 - b) The Semester end Examination question paper comprise of two section –Section A & B ,
Section A consist of 4 questions one question from each unit, of syllabus with internal choice ‘a’ or ‘b’

Section-B consist of 8 short questions two from each unit of the syllabus, with internal choice to attempt only 5 out of 8 questions.
 - c) In practical 75% of marks for semester end Examination (38 Marks) and Internal Semester Examination 25% (12 Marks) for continuous assessment for Practical paper (9 + Record-3)
8. There will be Project work for Aquaculture & Zoology for 100 marks. (50 marks for Dissertation & 50 marks for Presentation & Viva-voce). The Project work is to be done during summer vacation i. e after II Semester & before III Semester. Dissertation should be submitted by the students, during 2nd year of study, Presentation and Viva-voce is to be conducted by External Examiner. For Affiliating Colleges University teachers of the concerned Department (or) External Examiner to other University will be invited. The External Examiner TA/DA & Remuneration will be borne by the respective College/Department as per the approved norms.
9. A comprehensive Viva-voce to be conducted for students at the end of every semester in the presence of all subject teachers with 20 marks in order to prepare & boost the students face the interview in future. Marks adjusted from the internal presentation marks (5 marks in each subject i.e 4x5=20 marks).

ADIKAVI NANNAYA UNIVERSITY
M.Sc. ZOOLOGY & AQUACULTURE

Examination pattern:

Theory: 75% is End Semester Examination

25% is Internal Assessment

Practical: 75% is End Semester Examination

25% is Internal Assessment – Continuous Assessment

ADIKAVI NANNAYA UNIVERSITY
M.Sc. ZOOLOGY & AQUACULTURE
END SEMESTER EXAMINATION

Model question paper

Time: 3 hrs

Max. Marks: 75

Answer all the questions. Each question carries 15 marks.

Section-A

4x15=60

Q1. Unit-1

a or b

Q2. Unit-2

a or b

Q3. Unit-3

a or b

Q4. Unit-4

a or b

Section-B

5x3=15

Q5. It contains 8 short questions with at least two from each unit, carrying 3 marks.

5 questions are to be answered at least one from each unit.

ADIKAVI NANNAYA UNIVERSITY
M.Sc ZOOLOGY & AQUACULTURE
I SEMESTER
Z101. BIOSYSTEMATICS & TAXONOMY

UNIT-I

- 1.0. Definition and basic concepts of biosystematics and taxonomy
 - 1.1. Historical resume of systematics
 - 1.2. Importance and applications of biosystematics in biology
 - 1.3. Material basis of biosystematics – different attributes

UNIT-II

- 2.0. Trends in biosystematics – concepts of different conventional and aspects
 - 2.1. Chemotaxonomy
 - 2.2. Cytotaxonomy
 - 2.3. Molecular taxonomy
- 3.0. Molecular perspective on the conservation of diversity
 - 3.1. Diversity and ecosystem process: Theory, achievements and future directions

UNIT-III

- 4.0. Dimensions of speciation and taxonomy characters
 - 4.1. Dimensions of speciation- types of lineage changes, production of additional lineage
 - 4.2. Species concepts – species category, different species concepts: sub-species and other infra specific categories
 - 4.4. Theories of biological classification, hierarchy of categories
 - 4.5. Taxonomic characters – different kinds.

UNIT-IV

- 5.0. Procedure keys in taxonomy
 - 5.1. Taxonomic procedures – taxonomic collections, preservation, curation process of identification
 - 5.2. Taxonomic keys – different kinds of taxonomic keys, their merits and demerits
 - 5.3. Systematic publications – different kinds of publications
 - 5.4. International Code of Zoological Nomenclature (ICZN) – its operative principles, interpretation and application of important rules, Zoological nomenclature.

Suggested Reading Material:

1. M. Kato. The Biology of Biodiversity, Springer.
2. J.C. Avise. Molecular Markers. Natural History and Evolution, Chapman & Hall, New York.
3. E.O. Wilson. Biodiversity, Academic Press, Washington.
4. G.G. Simpson. Principles of Animal Taxonomy. Oxford IBH Pub. Co.
5. E. Mayer. Elements of Taxonomy.
6. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northern & Co.
7. B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta.

Z102. TOOLS AND TECHNIQUES FOR BIOLOGY

UNIT-I

- 1.0. Assay
 - 1.1. Definition
 - 1.2. Chemical assay
 - 1.3. Biological assay
- 2.0. Principles and uses of analytical instruments
 - 2.1. pH meter
 - 2.2. Spectrophotometer
 - 2.3. Ultra-centrifuge
 - 2.4. Radio activity counter
 - 2.5. NMR Spectrophotometer

UNIT-II

- 3.0. Microscopy
 - 3.1. Principles of light, dark field, phase contrast, fluorescence, transmission electron, scanning electron microscope
- 4.0. Micro-biological Techniques
 - 4.1. Media preparation & sterilization
 - 4.2. Inoculation & Growth monitoring
 - 4.3. Use of fermentors
 - 4.4. Biochemical Mutants & their uses
 - 4.5. Microbial assays

UNIT-III

- 5.0. Cell culture techniques
 - 5.1. Laboratory facilities
 - 5.2. Substrates on which cells grow
 - 5.3. Treatment of substrate surfaces
 - 5.4. Feeder layers
 - 5.5. Culture Media

UNIT-IV

- 6.0. Separation Techniques in biology
 - 6.1. Molecular separation by chromatography and electrophoresis
 - 6.2. Organelle separation by centrifugation, density gradient separation
- 7.0. Radio Isotopes
 - 7.1. Sample preparation for radioactive counting
 - 7.2. G M Counter
- 7.3. Auto-radiography

Suggested Reading Material:

1. Animal cell culture – A practical approach, Ed. John R.W. Masters, IRI Press
2. Introduction to Instrumental Analysis. Robert Braun. McGraw Hill International Editions
3. A Biologist Guide to Principles and Techniques of Practical Biochemistry. K. Wilson & K.H. Goulding, ELBS Edn.

Z103. GENERAL AND COMPARATIVE PHYSIOLOGY

UNIT-I

- 1.1. Aims and scope of Comparative Physiology
- 1.2. Muscle structure and properties, Molecular basis of muscle contraction, sliding filament theory
- 1.3. Twitch Summation, Tetanus and Fatigue.
- 1.4. Nerve structure, nerve impulse, ionic basis of resting and action potentials
- 1.5. Synaptic transmission, Neurotransmitters
- 1.6. Blood coagulation - Factors affecting coagulation

UNIT-II

- 2.1. Osmoregulation in aquatic and terrestrial environments mechanism of ionic regulation
- 2.2. Thermoregulation
- 2.3. Homoeothermic animals
- 2.4. Poikilotherms
- 2.5. Hibernation and Aestivation

UNIT-III

- 3.1. Respiratory organs and respiratory pigments through different phylogenetic groups. Mechanisms of uptake of O₂ and CO₂
- 3.2. Circulation of fluids and their regulation.
- 3.3. Comparative physiology of digestion and absorption of carbohydrates
- 3.4. Patterns of excretion among different animal groups
- 3.5. Receptor physiology – Comparative study
- 3.6. Mechanoreceptors
- 3.7. Chemoreceptor

UNIT-IV

- 4.1. Physiological adaptations of animals to different environments
- 4.2. Marine environment
- 4.3. Shores and Estuaries
- 4.4. Fresh water environment
- 4.5. Terrestrial environment
- 4.6. Yoga, meditation and their effects

Suggested Reading Material:

1. Eckert, R. Animal Physiology: Mechanisms and adaptation, W.H. Freeman and Company, New York.
2. Hochachka, P.W. and Somero, G.N. Biochemical adaptation, Princeton, N.J.
3. Hoar, W.S. General and comparative Animal Physiology, Prentice Hall of India.
4. Schiemdt Neisen, Animal Physiology, Adaptation and Environment, Cambridge
5. Stamd, F.L. Physiology: A regulatory systems approach, Macmillan Publishing Co., New York.
6. Punmer, L. Practical Biochemistry, Tata McGraw-Hill
7. Prosser, C.L. and Brown. Comparative Animal Physiology
8. Wilson, K. and Walker, J. Practical Biochemistry
9. Willmer, *PIG* Sone and 1. Johnson, Environmental Physiology, Blackwell Science, Oxford, U.K. 944p.
10. Newell, R.C. (ed.) 1976. Adaptation to environment, Essays on the physiology of marine animals. Butterworths, London, UK 539 pp.
11. Townsend, C.R. and P. Callow, Physiological Ecology An evolutionary approach to resource use, Blackwell Sci. Publication, Oxford, UK.

Z104. MOLECULAR CELL BIOLOGY

UNIT-I

- 1.0. Introduction: Experimental system in Cell Biology
- 2.0. Biomembranes
 - 2.1. Molecular composition and arrangement, functional consequences
 - 2.2. Transport across cell membrane: diffusion, active transport, pumps, uniports, symports and antiports
 - 2.3. Membrane potential
 - 2.4. Co-transport by symporters or antiporters
 - 2.5. Transport across epithelia: Transport of macromolecules

UNIT-II

- 3.0. Cytoskeleton
 - 3.1. Microfilaments and microtubules – structure and dynamics
 - 3.2. Microtubules and mitosis
 - 3.3. Cilia and flagella
 - 3.4. Cell movements – intracellular transport, role and kinesin and dynein, signal transduction mechanisms

UNIT-III

- 5.0. Cell-Cell Signaling
 - 5.1. Cell surface receptors
 - 5.2. Second messenger system
 - 5.3. MAP kinase pathways
 - 5.4. Apoptosis: Definition, mechanism and significance
- 6.0. Cell-Cell adhesion and communication
 - 6.1. Ca^{++} dependent homophilic cell-cell adhesion
 - 6.2. Ca^{++} independent homophilic adhesion
 - 6.3. Gap junctions and connections
 - 6.4. Integrins
 - 6.5. Collagen

UNIT-IV

- 7.0. Cell cycle
 - 7.1. Cyclins and cyclin dependent kinases
 - 7.2. Regulation of CDK-cyclin activity
- 8.0. Genome organization
 - 8.1. Hierarchy in organization
 - 8.2. Chromosomal organization of genes and non-coding DNA
 - 8.3. Mobile DNA
 - 8.4. Morphological and functional elements of eukaryotic chromosomes
- 9.0. Intracellular protein traffic
 - 9.1. Protein synthesis on free and bound polysomes
 - 9.2. Uptake into ER
 - 9.3. Membrane proteins, Golgi sorting, post-translational modifications
 - 9.4. Biogenesis of mitochondria and nuclei
 - 9.5. Trafficking mechanisms

Suggested Reading Material:

1. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore, Scientific American Book INC, USA.
2. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson Garland Publishing INC, New York.

I SEMESTER PRACTICALS

Z105-Biosystematics and Taxonomy lab:

1. A practical approach towards Biosystematics and taxonomy
2. Examples representing the different taxa in the order of evolution
3. Molecular perspective of diversity – Identification of species by molecular separation of proteins by examples
4. Diversity and similarity index.
5. Methods of collection, preservation and identification of plankton and representative forms of terrestrial and aquatic fauna

Z 106-Tools and Techniques for Biology lab:

1. Spectrophotometer – Estimation of biomolecules
2. Centrifugation – Demonstration and working
3. Separation Techniques - Paper chromatography
4. Electrophoresis – Demonstration and usage
5. Demonstration and working of:
 - a) Atomic Absorption Spectrophotometer
 - b) High Pressure Liquid Chromatography
 - c) ELISA Reader
 - d) Liquid Scintillation counter
6. PH Meter – Preparation of Phosphate buffer
7. Microscope –
 - a) Demonstration of oil immersion – WBC & RBC
 - b) Preparation of tissue for SEM & TEM procedure
8. Cell culture -
 - a) Preparation of media
 - b) Inoculation

Z107-General and Comparative Physiology lab:

1. Metabolic rate of fish
2. Digestive enzymes
3. Oxygen consumption vs temperature
4. Oxygen consumption vs body weight
5. Osmotic regulation
6. Ion concentration measurements
7. Spotters

Z108-Molecular Cell Biology lab:

1. Light microscopic examination of tissues
2. Preparation of different cell – types Hepatic parenchymal cells, adipocytes, macrophages, neuronal cells, epithelial cells
3. Stages of Mitosis and Meiosis
4. Squash preparation
5. Sub-cellular fractionation – separation of macromolecules

ADIKAVI NANNAYA UNIVERSITY
M.Sc ZOOLOGY & AQUACULTURE
II SEMESTER

Z201. GENETICS AND EVOLUTION

UNIT-I

Mendelian principles Multiple Alleles; Lethality and interaction of genes; Linkage and crossing over; Sex determination, Sex linkage, Extra chromosomal inheritance Molecular Evolution, Gene and gene families, Molecular drive

UNIT-II

Concepts of evolution and theories of organic evolution with emphasis on Darwinism. Neo Darwinism, Hardy Weinberg law of genetic equilibrium, A detailed account of destabilizing forces (i) natural selection (ii) Mutation, (iii) Migration

UNIT-III

Quantifying genetic variability, Genetic structure of natural population, phenotypic variation, Models explaining changes in genetic structure of population, Genetic of quantitative traits in population. Analysis of quantitative traits, Quantitative traits and natural selection, Estimation of heritability, Genotype-environmental interactions.

UNIT-IV

Genetics of speciation, phylogenetics and biological concept of species. Models of speciation (Allopatric, Sympatric, Parapatric). Patterns and mechanisms of reproductive-isolation. Phylogenetic gradualism and punctuated equilibrium, Micro and macro evolution, Origin of higher categories.

Suggested Reading Material:

1. Dobzhansky, Th. Genetics and origin of species, Surjeet Publication, Delhi
2. Dobzhansky, Th., F.J. Ayala, G.L., Stebbens and J.M. Valentine Evolution, Surjeet Publication, Delhi
3. Futuyama, D.J. Evolutionary Biology, Suinuer Associates, INC, Publishers, Dunderland
4. Hartl. D.L.A. Primer of population Genetics, Sinauer Associates, INC Massachusetts.
5. Jha, A.P. Genes and Evolution, John Publication, New Delhi
6. King, M. Species Evolution - the role of chromosomal change. The Cambridge University Press, Cambridge.
7. Meerrer, D.J. Evolution and genetics. Oxford University Press, New York.
Strikberger, M.W. Evolution, Jones and Bartett Publishers, Boston London

Z202. DEVELOPMENTAL BIOLOGY

UNIT-I

Gametogenesis, Fertilization and Cleavage:

Introduction to animal development, pattern of embryonic development, Fertilization (species specific recognition of egg and sperm, acrosome reactions, fast and slow block to polyspermy); oogenesis & gameto genesis. Cleavage (patterns, molecular mechanism of cleavage)

UNIT-II

Early embryonic Development:

Gastrulation, Neurulation (Establishment of neural tube, Tissue architecture of CNS, cerebral organization, differentiation of neural tube, neurons and neural crest cells); Specification of cell fate and cellular basis of morphogenesis, Autonomous development, Regulative development, Syncytial development.

UNIT-III

Organogenesis:

Mechanism of cellular differentiation – Ectoderm (CNS and Epidermis), Mesoderm (Chorda Mesoderm, paraxial, intermediate and lateral plate mesoderm) and Endoderm (digestive tube and its derivatives), Cell-cell communication, Development during organ formation: introduction and competence, paracrine and other factors (the inducer molecules), Signal transduction cascades.

UNIT-IV

Gene expression during development:

Establishment of body axes. Anterior-posterior polarity-role of maternal effector, segmentation and homeotic selector genes, Dorso-Ventral polarity. Differential gene expression during animal development, Differential gene transcription, Selective nuclear RNA processing and mRNA translation. Differential protein modification. Regeneration of organs.

Suggested Reading Material:

1. Scott F. Gilbert (2006). Developmental Biology, 8th Edition, Sinauer Associates, Inc., Publishers Sunderland, Massachusetts, USA
2. L. Wolpert Rosa Beddington Thomas M. Jessell Peter Lawrence Elliot M. Meyerowitz and Jim Smith (2002) Principles of Development Second Edition Oxford University Press.
3. JMW Slack (2005) Essential Developmental Biology Second Edition Blackwell Publishing Australia.
4. Mac E. Hadley Endocrinology Sixth Edition Prentice hall International, Inc. Arizona (For Section 9).

Z203. QUANTITATIVE BIOLOGY

UNIT-I

1. Introduction – Scope and application of statistics in Biology
2. Sampling – Essentials, advantages and methods of sampling and sampling errors
3. Frequency distribution: Preparation of ordered, discrete and continuous tables
4. Diagrammatic presentation of data: Data presentation by diagrams, graphs and curves
5. Skewness and Kurtosis

UNIT-II

1. Measures of central tendency: Mean, median and mode
2. Measures of dispersion: Standard deviation, variance and coefficient of variance
3. Correlation and regression

UNIT-III

1. Laws of Probability: Measurement, terminology
2. Probability distributions: Binomial, Poisson and normal distributions
3. Tests of significance: Chi-square test, t-test
4. Analysis of variance

UNIT-IV

1. Fundamentals of computers – Hardware and Software
2. Computer-aided techniques for data presentation, data analysis and statistical techniques – Excel
3. Mathematical modeling – Types of models, building of a model
4. Examples of models from Biology: Growth of snail shell, morphogenesis

Suggested Reading Material:

1. Batschelet, E., Introduction to Mathematics for Life Scientists. Springer-Verlag, Berlin.
2. Jorgensen, S.E., Fundamentals of Ecological Modelling, Elsevier, New York.
3. Swartzman, G.L. and S.P.O. Kaluzny. Ecological Simulation Primer. Macmillan, New York.
4. Lendren, D. Modeling in Behavioural Ecology. Chapman & Hal. London, UK
5. Sokal, R.R. & F.J. Rohlf. Biometry. Freeman, San Francisco.
6. Snedecor, G.W. and W.G. Cochran, Statistical methods for environmental biologists. John Wiley & Sons, New York.
7. Murray, J.D. Mathematical Biology. Springer – Verlag, Berlin.
8. Pielou, E.C. The Interpretation of Ecological Data. A Primer on Classification and Ordination.

Z204. IMMUNOLOGY

UNIT-I

Immunity-innate and acquired, innate immune mechanisms, acute phase reactants, properties of acquired immunity

Immunogens and antigens- Properties, factors governing immunogenicity, haptens, epitopes size and identification. Adjuvants- properties and mechanism of action.

Immunoglobulins- structure, isotypes, allotypes and idiotypes. Functions of antibody in relation to structure

UNIT-II

Antigen-antibody interactions- affinity of antibody, avidity, bonus effect, classical precipitin reaction, antigen-binding site of antibody, forces involved in antigen - antibody complex formation.

Lymphoid tissue- primary and secondary lymphoid organs, structure and cellular organization. Lymphocyte traffic.

Cells involved in the immune response- T cells, B cells, CD antigens, neutrophils, eosinophils and natural killer cells.

Antigen presentation - pathways of antigen processing and presentation of intracellular and extracellular antigens.

UNIT-III

Antibody response - Primary and secondary antibody response, antibody response to haptens, enumeration of antibody-forming cells, T- dependent and T- independent antigens.

Macrophage- role in immune response and activation.

Cell mediated immunity- helper, cytotoxic, suppressor T cells. *In vivo* and *in vitro* assays for assessment of cell mediated immunity

Complement- classical and alternative pathways of activation. Regulation of complement activation and functions.

Antigen receptors -On T and B cells. Generation of receptor diversity.

UNIT-IV

Development of immune system- T cell ontogeny in thymus, thymic hormones, cell development. **Immunological tolerance**- pathways of tolerance and mechanisms of tolerance in T and B cells. **Immunological tests**- Immunodiffusion, immunoelectrophoresis, immunofluorescence, radioimmunoassay and enzyme-linked immunosorbent assay.

Suggested Reading Material:

1. Immunology and Immunopathology by Stewart.
2. Cellular and Molecular Immunology by Abul K. Abbas *et. al.*
3. Textbook of Immunology by Barret.
4. Essential Immunology by Roitt, Brostoff, Male, Harcourt Brace & Company (5th Ed), Mosby (6th Ed).
5. Immunology by Kuby, Richard A. Goldsby, Thomas, J. Kindl, Barbara A. Osbome, Freeman & Company, Mosby publishers.
6. Immunobiology – The immune system in Health disease by Janeway and Travers.
7. Immunology – An introduction by Tizard.
8. Text book of Immunology by Unani and Benacerraf.
9. Fundamentals of Immunology by Paul.
10. Immunology – A short course by Benjaini, Sunshine and Lesrowitz.

II SEMESTER PRACTICALS

Z205-Genetics and Evolution lab:

Population Genetics:

1. Calculating gene frequencies and genotype frequencies for Autosomal dominant traits, Autosomal recessive traits using Binomial distribution.
2. Quantitative Genetics: Mean, Median, Standard Deviation, Chi-Square & Variance.
3. Problems on related topics.
4. Multifactor of inheritance.

Ecology:

1. Ecosystems and observation of biodiversity – field visit
2. Population identification – rocky shore, estuarine interstitial
3. Estimation of primary productivity on land and water ecosystem.
4. Growth patterns under laboratory conditions.

Z206-Developmental Biology lab:

1. Estimation of shell calcium during the development of chick and its role
2. Estimation of phosphorus during the development of chick
3. Observation of spermatozoa in vertebrates

Z207-Quantitative Biology lab:

1. Vectors and Matrices - Problems
2. Sampling – Lottery method and Random digits
3. Frequency distribution
4. Graphical presentation of the data
5. Measures of Central Tendency – Mean, median and mode
6. Measures of Dispersion – Standard deviation and Coefficient of variation
7. Probability
8. Coefficient of Correlation
9. Circuit diagram – Examples of models
10. Ecological modeling – Case study

Z208-Immunology lab:

1. Western Blotting
2. SRID
3. DID
4. Immunoelectrophoresis
5. RIA
6. ELISA

ADIKAVI NANNAYA UNIVERSITY
M.Sc ZOOLOGY
III SEMESTER
Z301. POPULATION ECOLOGY

UNIT-I

Ecology: Nature and scope of ecology; ecosystem structure and function.

Composition: Abiotic and biotic components; classification of ecosystem with examples; feedback loop.

Tropic dynamics of ecosystem: Energy flow; food chain; food web; trophic levels; ecological pyramids. Major terrestrial biomes. Concept of productivity.

UNIT-II

Population growth – Natality and Mortality, Biotic Potential and Environmental resistance – Form of population growth – Logistic Curve – Stochastic and time log models of population growth – Optimal yield.

Population Regulation – Effects of increased numbers – Harmful Effects – Beneficial Effects – Protection – Influence on reproduction – Division of labour

Population – Inter-specific relationships – Positive interactions – Commensalism – Mutualism – Negative interactions – Predation – Parasitism – Antibiosis

UNIT-III

Community concept – Community dominance – Ecotone – Community composition – Stratification of community

Habitat and Ecological Niche – Ecological Equivalents – Sympatry and Allopatry – Spatial relations of populations – Space requirements – Home range and Territory – Homing and return migration – Emigration

UNIT-IV

Demography – Life Tables – Net Reproductive rate – Longevity and theories of ageing – Reproductive strategies

Fish population – Population density – Population structure : Year classes – Estimation of population – Population dynamics – Abundance in population and fishery – Population dynamics and fishery catches.

Suggested Reading Material:

1. Begon, M., J.L. Harper and C.R. Townsend. Ecology, Individuals, Populations and Communities. Blackwell Science, Oxford, UK.
2. Koromondy, E.J. Concepts of ecology. Prentice Hall, New Delhi.
3. Clarke, G.L. Elements of Ecology, John Wiley & Sons, New York.
4. Odum, E.P. Fundamentals of Ecology. W.B. Saunders, Philadelphia.
5. Krebs, C.J. Ecology. Harper & Row, New York.
6. Jorgensen, S.E. Fundamentals of Ecological modeling. Elsevier, New York.
7. Chapman JL and Reiss MJ. 1995. *Ecology Principles and Application*. Cambridge University Press.
8. TrivedyRK, Goel and Trisa. 1997. *Practical methods in Ecology & Environmental Science*.

Z302. GENERAL AND COMPARATIVE ENDOCRINOLOGY

UNIT-I

- 1.0 Aims and scope of endocrinology.
 - 1.1 Discovery of hormones.
 - 1.2 Classification of hormones.
 - 1.3 Hormones as messengers.
 - 1.4 Experimental methods of hormone research.
 - 1.5 Phylogeny and ontogeny of endocrine glands.
 - 1.6 Neuroendocrine system and neurosecretion.

UNIT-II

- 2.0 General principles of hormone action;
 - 2.1 Hormone structure and evolution,
 - 2.2 Chemical nature and nature of hormone action,
 - 2.3 Hormone receptors,
 - 2.4 Signal transduction mechanisms,
 - 2.5 Hormones and homeostasis.
 - 2.6 Hormonal regulation of carbohydrate, nitrogen and lipid metabolism.

UNIT-III

- 3.0 Biosynthesis and secretion of hormones;
 - 3.1 Biosynthesis of steroid hormones-de novo,
 - 3.2 Biosynthesis and amino acid derived small sized hormones (T₄, Epinephrine),
 - 3.3 Biosynthesis of simple peptide hormones – Pre and pro hormones,
 - 3.4 Co-translational and post-translational modification of hormone structure,
 - 3.5 Metabolism of hormones.

UNIT-IV

- 4.0 Hormones growth and development;
 - 4.1 Invertebrates (insects, crustacean),
 - 4.2 Vertebrates (amphibian, reptiles, mammals),
 - 4.3 Hormones and reproduction,
 - 4.4 Seasonal breeders and continuous breeders.

Suggested Reading Material:

1. Turner, Endocrinology
2. E.J.W. Barrington. General and Comparative Endocrinology, Oxford, Clarendon Press
3. P. J. Bently. Comparative Vertebrate Endocrinology. Cambridge University Press.
4. R. H. Williams. Text Books of Endocrinology, W. B. Saunders.
5. C. R. Martin. Endocrine Physiology. Oxford University Press.
6. A. Gorbman et al. Comparative Endocrinology, John Wiley & Sons.

Z303. BIODIVERSITY AND ANIMAL CONSERVATION

UNIT – I

1. Biodiversity: Definition and significance; biodiversity at global, national and local levels; magnitude and distribution of biodiversity.
2. Patterns of biodiversity: Latitudinal and altitudinal gradients; species area relationship.
3. Biogeographic realms of the world.
4. Biogeographic zones of India and faunal diversity; Hotspots in the world and in India.

UNIT – II

1. **Hierarchical components** of biodiversity: Species diversity, genetic diversity and ecosystem diversity.
2. Biodiversity values: Direct values and indirect values.
3. Biodiversity in peril: Causes of biodiversity losses and extinction; anthropogenic impact on biodiversity.
4. Biodiversity and biotechnology: DNA based wildlife forensics; genetically modified organisms and Bioremediation.

UNIT – III

Biodiversity management and conservation

1. Conservation Biology- introduction. Threats to Biological diversity, habitat degradation, fragmentation and destruction, extinction, overexploitation, global warming. Protected areas-Parks, nature reserves, wildlife and wild life corridors. Restoration Ecology.
2. IUCN classification of wildlife.
3. Biodiversity threats; *In-situ* conservation and *Ex-situ* conservation.

UNIT – IV

1. Gene banks; conservation of genetic resource; cryopreservation, Biological databases.
2. Wildlife protection acts; organizations involved in protection of Biodiversity.
3. Satellite Remote Sensing and GIS programmes; Environmental Impact Assessment (EIA).

REFERENCE BOOKS

1. Agarwal KC. 1998. *Biodiversity*. India.
2. Peggy I. Fieldler and Perer M. Kareiva. 1997. *Conservation Biology*.
3. Prabodh K. Maiti and Paulami Maiti. 2011. *Biodiversity: Perception, Peril and Preservation*.
4. Saharia VV. 1982. *Wildlife in India*. Natraco Publishers, Dehradun.
5. Tandon RK. 1999. *Biodiversity, Taxonomy & Ecology*. Prithipal singh Scientific Publishers, Jodhpur.
6. T.K. Attwood & D.J. Parry-Smith 1999. *Introduction to Bioinformatics*. Pearson Education Asia.
7. Stephen Misener & S.A. Krawez 2000. *Bioinformatics: Methods and Protocol*.

Z304. MOLECULAR BIOLOGY

UNIT-I

- 1.0 History and scope of Molecular Biology
- 2.0 DNA Structure and Replication
 - 2.1. Prokaryotic and Eukaryotic DNA Replication
 - 2.2. Mechanics of DNA Replication
 - 2.3. Enzymes and accessory proteins involved in DNA Replication

UNIT-II

- 3.0 Transcription
 - 3.1. Prokaryotic Transcription
 - 3.2. Eukaryotic Transcription
 - 3.3. RNA Polymerases
- 4.0 Post-transcriptional modifications in RNA
 - 4.1. Cap formation
 - 4.2. Transcription
 - 4.3. Nuclear Export of m-RNA

UNIT-III

- 5.0 Translation
 - 5.1. Genetic Code
 - 5.2. Prokaryotic and eukaryotic Translation
 - 5.3. Mechanisms of initiation, elongation and termination
 - 5.4. Regulation of translation
- 6.0 Antisense and Ribozyme technology
 - 6.1. Molecular mechanisms of antisense molecules
 - 6.2. Inhibition of splicing, polyadenylation and translation

UNIT-IV

- 7.0 Recombination and Repair
 - 7.1. Holiday junction, gene targeting and gene disruption
 - 7.2. RecA and other Recombinases
 - 7.3. DNA repair mechanisms
- 8.0 Molecular mapping of genome
 - 8.1. Genetic and physical maps
 - 8.2. Physical mapping and map-based cloning
 - 8.3. Southern fluorescence insitu hybridization (FISH) for genome analysis

Suggested Reading Material:

1. J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. Molecular biology of Gene. The Benjamin/Cummings Pub. Co. Inc., California.
2. Alberts, B., D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson. Molecular Biology of the Cell. Garland Publishing Inc., New York.
3. Benjamin Lewin, Gene IV, Oxford University Press, U.K.
4. Meyers, R.A. (Eds.) Molecular Biology and Biotechnology : A comprehensive desk reference. VCH Publishers Inc., New York.
5. Sambrook, J., E.F. Fritch and T. Maniatis. Molecular cloning : A Laboratory Manual. Cold Spring Harbor Laboratory Press, New York.
6. Daber, P.D. Introduction to practical Molecular Biology. John Wiley & Sons Ltd., New York.
7. Brown, T.a. (Eds.). Molecular Biology LabFax. Bios Scientific Publishers Ltd., Oxford.

III SEMESTER PRACTICALS

Z305-Population Ecology Lab:

1. Enumeration of Zooplankton
2. Enumeration of phytoplankton
3. Enumeration of Rocky shore fauna
4. Enumeration of macrobenthos
5. Enumeration of meiobenthos
6. Creation of Life Table
7. Calculation of net reproductive rate (R_0), Generation time (T), Rate of intrinsic growth and optimal age for sexual maturity
8. Calculation of logistic and exponential growth of a given population
9. Zooplankton – Identification (10 examples)
10. Identification of Rocky shore fauna (10 examples)

Z306-General and Comparative Endocrinology lab:

1. Dissection of endocrinology fish
2. Pituitary gland dissection
3. Role of iodine in metamorphosis of frog tadpole
4. Insulin level in blood sample
5. Identification of human gonadotropic hormone
6. Prawn – Nervous system.

Z307-Biodiversity and animal conservation Lab

Biodiversity

1. List of local fauna (invertebrates and vertebrates).
2. Faunal diversity of man-made ecosystem.
3. Endangered species of Indian sub-continent (invertebrates and vertebrates).
4. Conservation methods
5. Examples of biological databases

Z308-Molecular Biology lab:

1. Estimation of DNA (Colorimetric method)
2. Estimation of RNA in tissue (Colorimetric method)
3. Fluorescence reaction method for DNA localization
4. Localization of RNA by methyl green pyronin – ‘Y’
5. Polymerase chain reaction (Demonstration)
6. RFLP Analysis (Demonstration)

ADIKAVI NANNAYA UNIVERSITY
M.Sc ZOOLOGY
IV SEMESTER
Z401. METABOLIC CELL FUNCTION AND REGULATION

UNIT-I

- 1.0. Thermodynamic principles and steady-state conditions of living organisms
 - 1.1. Organization and methods to study metabolism
- 2.0. Degradation of glucose, palmitic acid, phenylalanine

UNIT-II

- 3.0. Energy metabolism and high energy compounds
 - 3.1. Redox potentials
 - 3.2. Mitochondrial electron transport chain
 - 3.3. Oxidative phosphorylation
- 4.0. Storage and utilization of biological energy
 - 4.1. Biosynthesis of Urea, Glucose, Glycogen, Oleic acid and prostaglandins

UNIT-III

- 5.0. Nature of Enzymes
 - 5.1. Classification and nomenclature of enzymes
 - 5.2. Kinetic analysis of enzyme catalysed reactions
- 6.0. Metabolic profile of adipose, neural, hepatic, and muscle tissues

UNIT-IV

- 7.0. Metabolic Engineering
- 8.0. Immobilized enzymes and their applications

Suggested Reading Material:

1. Voet, D. and J.G. Voet. Biochemistry. J. Wiley & Sons
2. Foster, R.L. Nature of Enzymology
3. Lodish et. al. Molecular Cell Biology
4. Annual Reviews of Biochemistry
5. Garrett and Grisham. Biochemistry.

Z402. PRINCIPLES OF BIOTECHNOLOGY

UNIT-I

1. Concepts of Biotechnology: Scope and importance. Biotechnology in India
2. Recombinant DNA Technology
3. Gene cloning: Cloning and expression vectors Chimeric DNA.
4. Gene Libraries, genomic libraries.

UNIT-II

1. Polymerase chain reaction (PCR)
2. Gene amplification: Basic PCR and its modifications.
3. Applications of PCR in Biotechnology and genetic engineering

UNIT-III

1. Animal cell and tissue culture: Laboratory facilities, culture media
2. Procedures, primary culture, cell lines, cloning tissue and organ culture
3. Biotechnology in Medicine: animal and human health care.
4. Genetic counseling, forensic medicine

UNIT-IV

1. Biotechnology and Environment: Pollution control environment and energy
2. Biodiversity and conservation
3. Biotechnology and intellectual property:
Intellectual Property Rights (IPR)
Intellectual Property Protection (IPP)

Suggested Reading Material:

1. Gupta, P.K. Elements of Biotechnology
2. Singh, B.D. Biotechnology
3. Balasubramanian. Concepts in Biotechnology

Z403. AQUACULTURE

UNIT-I

- 1.0. History, General principles and economics of different kinds of aquaculture and productivity of culture ponds
- 2.0. Freshwater Aquaculture:
 - 2.1. Construction of fish farm and reclamation of swamps
 - 2.2. Selection of species for culture – Biological principles
 - 2.3. Preparation and management of nursery ponds, rearing ponds and stocking ponds along with control of weeds, pests and predators

UNIT-II

- 3.0. Fish seed resources:
 - 3.1. Procurement and transportation of seed from natural resources
 - 3.2. Transportation of brood stock and induced breeding
 - 3.3. Construction of hatcheries and their management
- 4.0. Freshwater fish culture:
 - 4.1. Common carp; Indian Major carps; Air breathing fishes; Composite Fish Culture; Freshwater prawn culture
 - 4.2. Integrated Fish Farming – Paddy cum Fish Culture and Fish cum Livestock Culture

UNIT-III

- 5.0. Fish nutrition:

Nutritional requirements, energy metabolism, formulation and preparation of fish feeds
- 6.0. Brackish water aquaculture:
 - 6.1. Selection of site, principles of pond design; traditional, extensive, modified extensive, semi-intensive, intensive and super intensive culture of shrimps and their management and economics
 - 6.2. Crab culture – Pond design, management of crab farm, fattening process of crab, economics – cage culture and pen culture
 - 6.3. Finfish culture – Mulletts (Mugil), Milk fish (Chanos) and sea bass (Lates)

UNIT-IV

- 7.0. Hatchery management:
 - 7.1. Principles of shrimp hatchery establishment: Site selection, water source, water management, maturation section, larval and post larval sections, feed management
 - 7.2. Principles of establishment of crab and lobster hatcheries; site selection, water source and management, larval and post larval sections, feed management
- 8.0. Brackish water farm management:
 - 8.1. Water quality management – pH, turbidity, dissolved oxygen, BOD, COD, Nitrates, Phosphates, Ammonia etc.
 - 8.2. Feed management: Feed schedules, protein requirements at different ages of finfish and shellfish, feed formulations, wet and dry feeds
- 9.0. Mariculture:
 - 9.1. Lobster culture
 - 9.2. Mussel culture
 - 9.3. Pearl oyster culture
 - 9.4. Edible oyster culture
 - 9.5. Sea weed culture

Suggested Reading Material:

1. Pillay, T.V.R. 1990. Aquaculture – Principles and Practices. Fishing News Books Survey, U.K.
2. Jhingran, V.G. 1993. Fish and fisheries of India. Hindustan Publishing Corporation (India), New Delhi.
3. Ravishankar Piska, 1999. Fisheries and Aquaculture. Lahari Publications, Hyderabad.
4. Santanam, R., Ramanathan, N. and Jegatheesan, G. 1990. Coastal Aquaculture in India. CBS Publishers & Distributors, Delhi.
5. Bardach, J.E., Ryther, J.H. and McLarney, W.O. 1972. Aquaculture. John Wiley & Sons Inc., USA.
6. Ghosh, S., Palanisamy, K. and Pathak, S.C. 1994. Shrimp and Freshwater Hatchery Public Relations Division, National Bank for Agriculture and Rural Development, Bombay.

Z404. NEUROBIOLOGY AND ANIMAL BEHAVIOUR

UNIT-I

Introduction to Neurobiology: Neuron: Passive and membrane properties, information flow in neurons, compartments, spike initiation zone.

Neurons, astrocytes, oligodendroglia, Schwann cells, microglia, ependymal cells, neuroglial cell interaction.

Animal electricity, electrochemical potential, The Nernst equation and Goldman equation.

UNIT-II

Channels and Membrane Potential: Neuron – Excitability, conductivity, Resting Membrane potential, Nerve Impulse, Refractory period, Action potential and its propagation. Signaling and Channels, Ion Channels and Voltage-gated Channels. Sodium Channel, Potassium Channel, Calcium channel – morphological and physiological characters.

Neural Communication: Synapses- Electrical and Chemical synapses, Nerve-muscle synapse and signaling, Synaptic Integration, Synaptic Plasticity. Neurotransmitters-synthesis, storage, release and uptake, inactivation, post-synaptic action of neurotransmitters, neurotransmitter gated ionic channels; Dale's principle drugs affecting their activities, ionotropic and metabotropic receptors.

UNIT-III

Organization of the Brain: Functional Anatomy of the brain. Systems neurobiology – Visual systems, hearing systems.

UNIT-IV

Cognitive Neuroscience; Nerve cells and their network, Cognitive skills, Learning and memory-Conditioning, habituation, insight learning, associative learning, Reasoning, Genetic aspects of cognition. Neurogenetics and behaviour in insects. Imprinting-case studies of animal models.

Suggested Reading Material:

1. **Fundamental Neuroscience** by Haines, Duane E., Churchill Livingstone, New York.
2. **Principles of Neural Science** by Kandel Eric, James H. Schwartz, and Thomas Jessel; 4th ed. Mc Graw-Hill.
3. **Basic Neurochemistry: Molecular, Cellular and Medical Aspects**, by George M.D. Siegel, R. Wayne Albers, Scott Brady, Donald M. D. Price; Seventh Edition; Elsevier Academic Press.
4. **Foundations of Neurobiology** by Fred Delcomyn, N.Y. Freeman
5. **The Neuron: Cell and Molecular Biology** 3ed by Irwin B. Levitan, Leonard K. Kaczmarek, (2002), Oxford University Press
6. **Neuroscience (Book with CD-ROM)** 3ed by Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Lawrence C. Katz, Anthony-Samuel LaMantia, James O. McNamara, S. Mark Williams (2004) Sinauer Assoc.,
7. **Fundamental Neuroscience**, 2ed by Larry R. Squire, Floyd E. Bloom, Susan K. McConnell, James L. Roberts (Editor), Nicholas C. Spitzer, Michael J. Zigmond (2002) Academic Press.

IV SEMESTER PRACTICALS

Z405-Metabolic cell function and regulations lab:

1. Enzyme kinetics
2. Dehydrogenase
3. Lactic acid estimation
4. Proteins, glucose and Lipid estimations
5. DNA, RNA estimation
6. Transaminases

Z406-Principles of Biotechnology lab:

1. Determination of DNA, RNA, Glucose, Proteins and Lipids. Polyacrylamide gel electrophoresis (PAGE), Southern Blotting and Northern Blotting. PCR demonstration.

Z407-Aquaculture lab:

1. Analysis of water: Turbidity, pH, Dissolved oxygen, Alkalinity etc.
2. Primary productivity, Estimation by Light and Dark bottle method
3. Spotters: cultivable species of finfish and shellfish based on the theory
4. Dissecting out the pituitary gland and preparing the extract
5. Visits to aquaculture farms, finfish and shellfish hatcheries

Z408-Neurobiology and Animal Behaviour Lab

1. An introduction to animal behaviour – Animal Psychology – Classification of behavioural patterns
2. Perception of the environment – Examples
3. communication – Examples from invertebrates and vertebrates (Terrestrial, Aerial, Aquatic habitats)
4. Ecological aspects – Food selection, optimal foraging, prey and predator, Host-Parasite relations
5. Social behaviour – Aggregations – Examples from fishes, birds and mammals, social organization - insects
6. Reproductive behaviour – mating systems, sexual selection, parental care
7. Biological rhythms – examples – migration of fish, turtle and bird.

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY

M.Sc Zoology-I Semester

Model Question Paper: Paper-I

Z101-Biosystematics and taxonomy

Time: 3hours

Max. Marks: 75

**Answer ALL questions.
All questions carry equal marks**

Section-A

1. a) Define Biosystematics. Explain the importance and applications of biosystematics.
(OR)
b) What is the material basis for biosystematics?
2. a) Explain the various new aspects adopted in biosystematics
(OR)
b) Explain the diversity and ecosystem processes involved in conservation of biodiversity
3. a) What is speciation? Explain the mechanism of speciation.
(OR)
b) What is species? Discuss the various concepts of species
4. a) What are the different taxonomic procedures and explain the different taxonomic keys.
(OR)
b) Discuss ICZN

Section-B

5. Answer any **FIVE** of the following:
 - a) Reproductive isolation
 - b) Systema Natura
 - c) Holotypes
 - d) Panmictic species
 - e) Lineage
 - f) Publication
 - g) Darwin.
 - h) Subspecies.

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-I Semester
Model Question Paper: Paper-II
Z102-Tools and Techniques for Biology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Describe the principle and applications of spectrophotometer.
(OR)
b) What is an assay? Explain different types of assays
2. a) Write the principle and types of microscopy and elaborate dark field microscopy.
(OR)
b) Describe the process of inoculation and growth monitoring.
3. a) Write an essay on laboratory facilities required for cell cultures.
(OR)
b) Give an account on various culture media required for the growth of animal cells.
4. a) Describe various types of chromatographic techniques to separate molecules.
(OR)
b) What is autoradiography? Give an account on its biological applications.

Section-B

5. Answer any **FIVE** of the following:
 - a) pH meter.
 - b) Biochemical mutants and their uses.
 - c) Feeder layers.
 - d) GM counter.
 - e) Density gradient centrifugation.
 - f) Treatment of substrate surfaces.
 - g) Use of fermenters.
 - h) Radio active counter.

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-I Semester
Model Question Paper: Paper-III
Z103-General and comparative physiology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Write about the molecular basis of muscle contraction and sliding filament theory.
(OR)
b) Explain the nerve impulse transmission and add note on neurotransmitters.
2. a) Write briefly about osmoregulation in aquatic and terrestrial animals.
(OR)
b) Explain thermoregulation with suitable examples.
3. a) Write an essay on comparative physiology of digestion and absorption of carbohydrates.
(OR)
b) Write an essay on mechanisms of uptake of O_2 and CO_2 .
4. a) Write briefly the physiological adaptation of Marine and sandy shore environment.
(OR)
b) Write briefly the fresh water and terrestrial environment adaptations

Section-B

5. Answer any **FIVE** of the following:
 - a) Muscle twitch
 - b) Tetanus and fatigue
 - c) Poikilotherms
 - d) Homoeotherms
 - e) Mechanoreceptors
 - f) Bioluminescence
 - g) Parasitic habits
 - h) Yoga

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-I Semester
Model Question Paper: Paper-IV
Z104-Molecular Cell Biology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Describe in detail about the transport across the cell membrane.
(OR)
b) Explain the transport of macromolecules across the epithelial layer.

2. a) Explain the role of cytoskeletal elements in defining the structure of a cell.
(OR)
b) Enumerate the role of cytoskeletal elements in mitosis.

3. a) Write in detail about cell adhesion and communication mechanisms.
(OR)
b) Elaborate on the second messenger system in cell signaling.

4. a) Cyclins and cyclin dependent kinases regulate cell cycle, Justify.
(OR)
b) Describe various post-translational mechanisms in protein synthesis.

Section-B

5. Answer any **FIVE** of the following
 - a) Membrane potential
 - b) Cilia and flagella
 - c) Integrins and collagen
 - d) Chromosomal organization of genes
 - e) Mobile DNA
 - f) Symporters and antiports
 - g) Microtubules.
 - h) Apoptosis

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-II Semester
Model Question Paper: Paper-I
Z201- Genetics and Evolution

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Write in detail genetic mapping of chromosomes and sex determination.
(OR)
b) Write the fine structure of the gene. Add a note on multiple alleles

2. a) Write in detail about Hardy-Weinberg law of genetic equilibrium.
(OR)
b) Write the concept of evolution and theories of organic evolution with emphasis on Darwinism.

3. a) Write the genotype and environmental interaction. Add a note on factors effecting human disease frequency.
(OR)
b) Write in detail the genetic structure of natural population and models explaining changes in genetic structure if population

4. a) What is speciation? Write about phylogenetic and biological concepts of species
(OR)
b) Explain macro and micro evolution.

Section-B

5. Answer any **FIVE** of the following:
 - a) A genetic imprinting.
 - b) Karyotyping
 - c) Mutation.
 - d) Migration.
 - e) Phenotypic Variation.
 - f) Analysis Of Quantitative Traits.
 - g) Sympatric speciation.
 - h) Allopatric Speciation.

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-II Semester
Model Question Paper: Paper-II
Z202- Developmental Biology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Describe in detail about the process of fertilization.
(OR)
b) Write an account on molecular mechanism of cleavage and cleavage patterns.
2. a) Give a detailed account on chick gastrulation.
(OR)
b) What is neurulation .Explain the process of neurulation with an example,
3. a) Explain the mechanism of cellular differentiation of ectoderm into CNS & Epidermis.
(OR)
b) How does cell to cell communication help in organ formation during development?
4. a) How does differential gene expression occurs during animal development.
(OR)
b) Write about selective nuclear RNA processing and mRNA translation.

Section-B

5. Answer any **FIVE** of the following:
 - a) Blocking of polyspermy.
 - b) Regulative development.
 - c) Endoderm derivatives.
 - d) Homeotic selector genes.
 - e) Structure of sperm.
 - f) Autonomous development.
 - g) Signal transduction cascades.
 - h) Regeneration of organs.

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-II Semester
Model Question Paper: Paper-III
Z203-Quantitative Biology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) What is Sampling? Write the different methods of sampling.
(OR)
b) What is frequency distribution? Explain the process of formation of frequency distribution in different series.
2. a) What are Measures of Central tendency? Explain
(OR)
b) Write about correlation
3. a) Write about Probability distributions
(OR)
b) What is test of significance? Write about 't' test
4. a) What are the computers aided techniques used for data analysis?
(OR)
b) Write about mathematical modeling giving an example.

Section-B

5. Answer any **FIVE** of the following:
 - a) Skewness
 - b) Graphs
 - c) Standard deviation
 - d) Chi-square test
 - e) Software
 - f) Standard error
 - g) Design of experiment
 - h) Regression

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-II Semester
Model Question Paper: Paper-IV
Z204- Immunology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) What is innate immunity? Describe various innate immune mechanisms.
(OR)
b) Describe the structure and functions of various types of immunoglobulins.
2. a) Write an essay on antigen-antibody interactions.
(OR)
b) What are the cells involved in immune response? Describe their role.
3. a) Elucidate the mechanisms of antibody response to antigens.
(OR)
b) Write about Classical and alternative activation of complement.
4. a) What is immune tolerance? Elucidate the mechanisms of tolerance in T and B cells.
(OR)
b) Write an essay on immunological tests used in molecular and diagnostic laboratories.

Section-B

5. Answer any **FIVE** of the following:
 - a) Acquired immunity
 - b) Haptens
 - c) Lymphocyte traffic
 - d) Antigen presenting cells
 - e) Cytotoxic T-cells
 - f) Antigen receptors
 - g) ELISA
 - h) Thymic hormones

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-III Semester
Model Question Paper: Paper-I
Z301-Population Ecology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) What are the components of the ecosystem. Discuss. Add a note on its structure and function

(OR)

- b) Explain the trophic dynamics of the ecosystem

2. a) Give a detailed account on population growth.

(OR)

- b) Describe various kinds of inter-specific relationships.

3. a) What is a community? Elucidate the community composition and stratification.

(OR)

- b) Write an essay on spatial relations of populations.

4. a) Discuss about longevity and theories of ageing.

(OR)

- b) Describe the structure and dynamics of fish population.

Section-B

5. Answer any **FIVE** of the following:

a) Primary productivity

b) Ecological pyramids

c) Logistic curve

d) Antibiosis

e) Ecotone

f) Allopatry

g) Life tables

h) Population density

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-III Semester
Model Question Paper: Paper-II
Z302- General and Comparative Endocrinology

Time: 3 hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Explain ontogeny and phylogeny of any four endocrine glands.
(OR)
b) Describe in detail about neuro-endocrine system and neurosecretion.
2. a) Write the role of hormone and homeostasis
(OR)
b) Describe the role of hormones in the regulation of carbohydrates and lipid metabolism
3. a) Give a detailed account of biosynthesis of steroid hormones
(OR)
b) Explain the co-translational and post-translational modification of hormone structure
4. a) Elaborate on the role of hormones in the growth and development of invertebrates
(OR)
b) Explain the importance of hormones in reproduction with an example in vertebrates

Section-B

5. Answer any **FIVE** of the following:
 - a) Experimental methods involved in hormonal research
 - b) Hormones as messengers
 - c) Classification of hormones
 - d) Hormone action
 - e) Peptide Hormone
 - f) Classification of hormones
 - g) Seasonal and continuous breeders
 - h) Hormonal role in menstrual cycle

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-III Semester
Model Question Paper: Paper-III
Z303- Biodiversity and Animal Conservation

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) What is Biodiversity. Discuss about the levels of biodiversity and its significance.
(OR)
b) Explain the different biogeographic realms of the world.
2. a) What are the levels of Biodiversity. Discuss.
(OR)
b) What are the factors that cause loss to biodiversity.
3. a) Discuss in detail the threats faced by animals in nature.
(OR)
b) Explain the measures take up for the conservation of biodiversity.
4. a) Write about the different wild protection acts and organizations involved in protection of biodiversity.
(OR)
b) What is Environmental impact assessment. Discuss

Section-B

5. Answer any **FIVE** of the following:
 - a) Hotspots
 - b) Bioremediation
 - c) Faunal diversity
 - d) Biodiversity services
 - e) Natural parks.
 - f) Biological databases
 - g) GIS in Biodiversity conservation
 - h) CBD

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-III Semester
Model Question Paper: Paper-IV
Z304- Molecular Biology

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Explain the prokaryotic and eukaryotic DNA replication
(OR)
b) Explain the mechanics of DNA replication
2. a) Explain the post transcription in prokaryote and eukaryotic transcription
(OR)
b) Explain the post transcriptional modifications in RNA.
3. a) Explain the mechanisms of prokaryotic and eukaryotic translation
(OR)
b) Explain the molecular mechanism of the antisense molecules and add a note on inhibition of splicing.
4. a) Write about gene targeting and DNA repair
(OR)
b) Explain the types of mapping and molecular mapping of genome

Section-B

5. Answer any **FIVE** of the following:
 - a) Enzymes involved in DNA replication.
 - b) RNA polymerases.
 - c) Genetic code.
 - d) FISH.
 - e) Necessary proteins involved in DNA replication.
 - f) Genetic map.
 - g) Cap formation in post-translational modifications.
 - h) Structure of DNA.

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-IV Semester
Model Question Paper: Paper-I
Z401-Metabolic Cell Function and Regulation

Time: 3 hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Describe the thermodynamic principles suitable for living organisms.

(OR)

- b) Write notes on degradation of glucose.

2. a) Explain the electron transport chain in mitochondria.

(OR)

- b) Explain the biosynthesis of prostaglandins.

3. a) Write an account on classification and nomenclature of enzymes.

(OR)

- b) Discuss on the metabolic profile of neural tissue.

4. a) Explain the process of immobilization of enzymes..

(OR)

- b) What is metabolic engineering? Elaborate.

Section-B

5. Answer any **FIVE** of the following:

- a) Methods to study metabolism.

- b) Oxidative phosphorylation.

- c) Kinetic analysis of enzymes.

- d) Metabolic profile of adipose

- e) Degradation of palmitic acid

- f) Storage of biological energy

- g) Metabolic profile of tissue

- h) Applications of immobilized enzymes.

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-IV Semester
Model Question Paper: Paper-II
Z402- Principles of Biotechnology

Time: 3 hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Discuss the Scope and Importance of biotechnology
(OR)
b) Explain Recombinant DNA and gene cloning technology
2. a) Write about polymerase chain reaction
(OR)
b) Discuss the application of PCR in biotechnology and genetic engineering.
3. a) Explain the laboratory facilities of culture media in animal cell and tissue culture.
(OR)
b) Discuss biotechnology in Medicine.
4. a) Explain pollution control of environment and energy conservation.
(OR)
b) Explain in detail IPR and IPP.

Section-B

5. Answer any **FIVE** of the following:
 - a) Gene libraries
 - b) Basic PCR and its modifications
 - c) Cell lines
 - d) Organ culture
 - e) Biotechnology and biodiversity
 - f) Genetic counseling
 - g) Vectors.
 - h) Expression vectors.

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-IV Semester
Model Question Paper: Paper-III
Z403-Aquaculture

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Explain the criteria involved for the construction of fish farms
(OR)
b) Write about the preparation and management of different types of ponds in fish farms
2. a) What are the different fish seed resources? Add a note on their transportation
(OR)
b) Discuss about carp culture.
3. a) Discuss about fish nutrition
(OR)
b) Explain crab culture
4. a) Discuss about the shrimp hatchery construction and its management
(OR)
b) Explain the water quality management in brackish water farms

Section-B

5. Answer any **FIVE** of the following:
 - a) Biological criteria for selection of aquaculture species
 - b) Integrated fish farming
 - c) Milk fish culture
 - d) Feed management
 - e) Pearl oyster culture
 - f) Preparation and management of nursery ponds
 - g) Composite Fish Culture
 - h) Cage culture and pen culture

ADIKAVI NANNAYA UNIVERSITY, RAJAHMUNDRY
M.Sc Zoology-IV Semester
Model Question Paper: Paper-IV
Z404- Neurobiology and Animal Behaviour

Time: 3hours

Max. Marks: 75

Answer ALL questions.
All questions carry equal marks

Section-A

1. a) Describe in detail the flow of information in neurons.
(OR)
b) Derive Nernst equation.
2. a) What is Action potential. Explain the propagation of action potential across the neuron.
(OR)
b) Discuss the types of channels involved in signaling.
3. a) Write an account on Catecholamine synthesis, release and uptake.
(OR)
b) Write an account on organization of the brain.
4. a) Discuss the behavior in insects with examples.
(OR)
b) What are cognitive skills. Explain different types of learning with examples.

Section-B

5. Answer any **FIVE** of the following:
 - a) Neuroglial cell interaction
 - b) Metabotropic receptors
 - c) Cerebellum
 - d) Imprinting
 - e) Structure of neuron
 - f) Sodium channel.
 - g) Temporal lobe
 - h) Memory