MANONMANIAM SUNDARANAR UNIVERISTY,
TIRUNELVELI-12

SYLLABUS

PG - COURSES – AFFILIATED COLLEGES

Course Structure for M. Sc. Zoology
(Choice Based Credit System)
(with effect from the academic year 2024-2025 onwards)

Semester-II				
Part	**Subject Status**	**Subject Title**	**Subject Code**	**Credit**
3	Core	CELLULAR AND MOLECULAR BIOLOGY		5
3	Core	DEVELOPMENTAL BIOLOGY		5
3	Core	LAB COURSE IN CELL BIOLOGY & LAB COURSE IN DEVELOPMENTAL BIOLOGY		4
3	Elective III	BIOSTATISTICS/ BIOINFORMATICS		3
3	Elective IV	RESEARCH METHODOLOGY		3
3	SEC I	POULTRY FARMING		2

Total Marks: 100 Internal Exam: 25 marks + External Exam: 75 marks

A. **Scheme for internal Assessment**:
Maximum marks for written test: **15 marks**
3 internal tests, each of **I hour** duration shall be conducted every semester.
To the average of the **best two** written examinations must be added the marks scored in. The **assignment** for 5 marks and Seminar for 5 marks

The break up for internal assessment shall be:
Written test- 15 marks; Assignment -5 marks; Seminar-5 Marks Total - 25 marks

B. Scheme of External Examination
3 hrs. examination at the end of the semester
A – Part : 1 mark question two - from each unit
B – Part : 5 marks question one - from each unit
C – Part : 8 marks question one - from each unit

➢ Conversion of Marks into Grade Points and Letter Grades

S.No.	Percentage of Marks	Letter Grade	Grade Point	Performance
1	90 - 100	O+	10	Outstanding
2	80 - 89	O	9	Excellent
3	70 - 79	A+	8	Very Good
4	60 - 69	A	7	Good
5	55 - 59	B+	6	Above Average
6	50 - 54	B	5	Pass
7	0 - 49	RA	-	ReAppear
8	Absent	AA	-	Absent

➢ Cumulative Grade Point Average (CGPA)

$$\mathbf{CGPA} = \frac{\mathbf{\Sigma\,(GP \times C)}}{\mathbf{\Sigma C}}$$

- **GP** = Grade point, **C** = Credit
- CGPA is calculated only for Part-III courses
- CGPA for a semester is awarded on cumulative basis

➢ Classification

a) First Class with Distinction : CGPA $\geq$ 7.5*****
b) First Class : CGPA $\geq$ 6.0
c) Second Class : CGPA $\geq$ 5.0 and $<$ 6.0
d) Third Class : CGPA$<$ 5.0

CELLULAR AND MOLECULAR BIOLOGY

Course Objectives:

The main objectives of this course are:

- To understand the ultra-structures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.
- To realize involvement of various cellular components in accomplishing cell division.
- To enable a successful performance in cell biology component of CSIRUGC NET.
- To understand the ultra-structures and functions of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes and organelles.

UNIT I

General features of the cell: Basic structure of prokaryotic and eukaryotic cells - Protoplasm - cell organelles; cell theory; Diversity of cell size and shapes.

UNIT II

Cellular organization: Membrane structure and functions - Structure of model membrane, lipid bilayer and membrane proteins diffusion, osmosis, ion channels, active transport, ion pumps, mechanism and regulation of intracellular transport, electrical properties of membranes. Structure and functions of Intracellular organelles: Nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles and chloroplasts.

UNIT III

Cell division and Cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle. Molecular biology of cell: Structure of DNA and RNA; Process of DNA replication, transcription, and translation in pro and eukaryotic cells; Genetic maps.

UNIT IV

Cell communication and cell signaling: Membrane- associated receptors for peptide and steroid hormones - signaling through G-protein coupled receptors, signal transduction pathways. General principles of cell communication: extracellular space and matrix, interaction of cells with other cells and noncellular structures.

UNIT V

Cancer cells: Characteristic features of normal and cancer cells; Carcinogens: types and cancer induction; Metastasis; Oncogenes and tumor suppressor genes, apoptosis; therapeutic interventions of uncontrolled cell growth.

Reading list

1. Plopper, G., D. Sharp, and E. Sikorski. 2015. Lewin's Cells (Third Edition), Jones & Bartlett, New Delhi, pp-1056
2. Plopper, G. 2013. Principles of Cell Biology, Jones & Bartlett, Maryland, pp-510

Recommended texts

1. Karp, G. 2010. Cell Biology (Sixth Edition), John Wiley & Sons, Singapore, pp-765.
2. Lodish, H., C. A. Kaiser, A. Bretscher, et al., 2013. Molecular Cell Biology (Seventh Edition), Macmillan, England, pp-1154
3. De Robertis, E.D.P. and E. M. F. De Robertis Jr, 1987. Cell and Molecular Biology. Info-Med, Hong Kong, pp-734
4. Abbas, A. K., A. H. Lichtman and S. Pillai, 2007, Cell and Molecular Immunology (Sixth Edition), Saunders, Philadelphia, pp-566
5. Loewy, A.G., P. Siekevitz and J. R. Menninger, et al., 1991, Cell Structure and Function (Third Edition), Saunders, Philadelphia, pp-947
6. Watson, J. D., N.H. Hopkins, J.W. Roberts, et al., 1987, Molecular Biology of the Gene (Fourth Edition), Benjamin/Cummings, California, pp-1163
7. Han, S. S. and J. Holmstedt. 1979, Cell Biology, McGraw Hill, pp-319
8. Alberts, B., A. Johnson, J. Lewis, et al., 2015, Molecular Biology of the Cell (Sixth Edition), Garland Science, New York, pp-1342
9. Clark, D.P., 2005. Molecular Biology, Elsevier, China, pp-784
10. Tropp, B. 2008. Molecular Biology Genes to Proteins (Third Edition), Jones & Bartlett, US, pp-1000

DEVELOPMENTAL BIOLOGY

Course Objectives:

The main objectives of this course are:

- Understand the process of gametogenesis, cleavage and gastrulation, embryonic development, extra embryonic membrane and placenta in various animals and human.
- Learn the principles, methods and applications of cryo-preservation of gametes and embryo.

UNIT I

Pattern of animal development: Chief events in animal development; History of thoughts and conceptual developments. Gametogenesis: Origin of germ cells, spermatogenesis - Sperm morphology in relation to the type of fertilization, Oogenesis - Oogenesis in insects and amphibians; Composition and synthesis of yolk in invertebrates (insects and crustaceans) and vertebrates; Genetic control of vitellogenin synthesis in amphibians

UNIT II

Fertilization: Sperm aggregation, Sperm activation, Chemotaxis, Sperm maturation and capacitaion in mammals, Acrosome reaction. Sperm – egg interaction. Sperm entry into the egg - Egg activation - Intracellular calcium release - Cortical reaction - Physiological polyspermy - Fusion of male and female pronuclei - Post fertilization metabolic activation - Parthenogenesis

UNIT III

Cleavage and gastrulation: Pattern of embryonic cleavage, mechanisms of cleavage, mid blastula transition - Determinate and regulatory embryos, Factors affecting gastrulation, mechanisms and types of gastrulation in respective animal embryos (Sea urchin, Amphibians, Aves, Mammals); Fate maps - (Amphibian and Chick), Epigenesis and preformation – Formation of primary germ layers

UNIT IV

Embryonic Development; Embryonic development of fish and birds, formationof extra embryonic membranes in mammalian – Organogenesis - Development of endodermal, mesodermal and ectodermal derivatives. Embryonic Induction and neurulation; Formation and migration of neural crest cells - types of neural crest cells and their patterning - primary and secondary neurulation. Genetic control of segmentation – Gap genes; pair rule genes; Homeotic genes

UNIT V

Post embryonic development metamorphosis: Endocrine control of metamorphosis in insect and amphibian - Endocrine control of moulting and growth in crustaceans and insects - Neoteny and pedogenesis. Regeneration: Formation of ectodermal cap and regeneration blastoma – Types of regeneration in planaria, Factors stimulating regeneration – Biochemical changes associated with regeneration. Experimental Embryology: Mammalian reproduction: Mammalian reproductive cycle, Hormonal regulation, Cryopreservation of gametes/embryos - Ethical issues in cryopreservation

Reading list

1. Balinsky, B. I. 1981. Introduction to Embryology (5th Edition), CBS College Publishers, New York, pp-782.
2. Gilbert. S. F. 2006. Developmental Biology, 8th Edition, INC Publishers, USA, pp 785.
3. Berrill, N.J. 1974. Developmental Biology, Tata Mc-Graw Hill Publications, New Delhi, pp-535.
4. Tyler, M.S. 2000. Developmental Biology - A Guide for Experimental Study, Sunderland, MA, pp-208.
5. Subramoniam, T. 2011. Molecular Developmental Biology (2nd Edition),

Narosa Publishers, India, pp-364.
6. www.easybiologyclass.com › developmental-biology-e
7. www.studocu.com › document › lecture-notes › view
8. ocw.mit.edu › courses › 7-22-developmental-biology-f.

Recommended texts

1. Wilt, F.H. and N.K. Wessel. 1967. Methods in Developmental Biology, Thomas Y Crowell, New York.
2. Slack J.M.W. 2012. Essential Developmental Biology (3rd Edition), Wily-Blackwell Publications, USA, pp-496.
3. Mari-Beffa, M. and J. Knight. 2005. Key Experiments in Practical Developmental Biology, Cambridge University Press, UK, pp-404.

LAB COURSE IN CELL BIOLOGY AND DEVELOPMENTAL BIOLOGY

Course Objectives:

The main objectives of this course are:

- Practical course aims at demonstrating significant cellular and molecular biological principles, quantitative and analytical approaches that enable the students to translate the theoretical foundation in cell biology, and developmental biology into practical understanding.

Cell and Molecular Biology

1. Determination of cell size using micrometer
2. Mitosis in root meristematic cells of plants
3. Identification of various stages of meiosis in the testes of grasshopper
4. Detection of polytene chromosome in salivary gland cells of the larvae of the Chironomus
5. Detection of sex chromatin
6. Identification of blood cells in the haemolymph of the of the cockroach
7. Isolation of genomic DNA from eukaryotic tissue
8. Isolation of total RNA from bacterial cells/tissues
9. Agarose gel electrophoresis of DNA
10. SDS-Polyacrylamide gel electrophoresis

Developmental Biology

Gametogenesis - Observation of gametes from gonadal tissue sections

i. Oogenesis:

Section through ovary of shrimp, fish, frog and mammals

ii. Spermatogenesis:

Section through testis of shrimp, fish, calotes and mammals Fertilization

iii Induced spawning in polycheate worm Hydroids elegans

iv In vitro fertilization and development in a polycheate worm Hydroids elegans

v Observation of egg developmental stages in Emerita emeritus Embryogenesis

vi Observation and whole mount preparation of the chick blastoderm - 18 hours of development

vii Chick embryonic stage - 24 hours of development

viii Chick embryonic stage - 48 hours of development

ix Chick embryonic stage - 72 hours of development

x Chick embryonic stage - 96 hours of development

Histological observation: Section through various developmental stages in chick embryo

Experimental Embryology: Regeneration in Frog Tadpoles

xi Blastema formation

xii Demonstration of regenerative process in tadpole Metamorphosis

xiii Demonstration of metamorphosis in Frog Tadpole using exogenous Iodine Cryopreservation

xiv Demonstration of cryopreservation of gametes of fin fish/ shell fish

BIOSTATISTICS

Course Objectives:

The main objectives of this course are:

- Students should know basic concepts in Biostatistics.

UNIT I

Definition, scope, and application of statistics; Primary and secondary data: Source and implications; Classification and tabulation of biological data: Types and applications. Variables: Definition and types. Frequency distribution: Construction of frequency, distribution table for grouped data; Graphic methods: Frequency polygon and ogive curve; Diagrammatic representation: Histogram, bar diagram, pictogram, and pie chart.

UNIT II

Measures of central tendency: Mean, median and mode for continuous and discontinuous variables. Measures of dispersion: Range, variation, standard deviation, standard error, and coefficient of variation.

UNIT III

Probability: Theories and rules; Probability - Addition and multiplication theorem; Probability distribution: Properties and application of Normal, Binomial and Poisson distributions.

UNIT IV

Hypothesis testing: Student 't' test - paired sample and mean difference 't' tests. Correlation: Types - Karl Pearsons Co-efficient, Rank correlation, Significance test for correlation coefficients. Regression analysis: Computation of biological data, calculation of regression co-efficient, graphical representation and prediction.

UNIT V

Analysis of variance: one way and two-way classification. Data analysis with comprehensive statistical software using Statistical Package for the Social Sciences (SPSS).

Reading list

1. Arora, P. N. and P. K. Malhan. 1996. Biostatistics, Himalaya Publishing House, Mumbai, pp-447.
2. Gurumani, N. 2005. Introduction to Biostatistics, M.J.P. Publishers, Delhi, pp-407.
3. Das, D. and A. Das. 2004. Academic Statistics in Biology and Psychology, Academic Publisher, Kolkata, pp-363.
4. Palanichamy, S. and Manoharan, M. 1990. Statistical Methods for Biologists, Palani Paramount Publications, Tamil Nadu, pp-264.

Recommended texts

1. Bailey, N. T. J. 1959. Statistical in Biology, English Universities Press, London, pp 48.
2. Sokal, R. R. and F. J. Rohlf, 1973. Introduction to Biostatistics, W.H. Freeman, London, pp-467.
3. Sokal, R.R. and F.J. Rohlf. 1981. Biometry: The principles and practice of statistics in biological research, San Francisco: W.H. Freeman, London, pp-859.
4. Zar, J.H. 1998. Biostatistical Analysis, Pearson Education (Singapore) Pvt. Ltd., Delhi, India, pp-660.
5. Bailey, N. T. J. 1994. Statistical Methods in Biology (Third Edition), Cambridge University Press, Cambridge, pp-255.
6. Wayne W. Daniel. Biostatistics: A Foundation for Analysis in the Health Sciences, John Wiley & Sons Inc, USA, pp-443.
7. Snedecor, G. W. and W. G. Cochran. 1967. Statistical Methods (Sixth Edition), Oxford & IBH Publishing Co., New Delhi, pp-593.
8. Pagano, M. and K. Gauvreau. 2008. Principles of Biostatistics (Second Edition), Cengage Learning, New Delhi, pp-525.

BIOINFORMATICS

Course Objectives:

The main objectives of this course are:

- To utilize bioinformatics tools and databases for retrieving, analyzing, understanding and managing biological data.
- To learn, understand and apply the basic concepts of Bioinformatics and its significance in biological data analysis

Units I

Internet concepts, Bioinformatics a multidisciplinary approach, Scope and applications of Bioinformatics. Biological databases- Nucleic acid databases (Genbank, DDBJ and EMBL)Protein databases - primary, composite, secondary Specialized databases-SGD, TIGR, Structural databases -PDB, CATH Mod BASE.

Unit II

Sequence similarity search (FASTA and BLAST). Significance of E-value. Introduction to ORF and primer designing. Secondary structure prediction: Hidden Markov method

Unit III

Multiple sequence alignment (CLUSTAL W), conserved domain search (Motif). Phylogenetic analysis- phylogenetic tree construction (Neighbor Joining method and Maximum parsimony).

Unit IV

Homology modeling - SPDB viewer. Ramachandran plot for evaluation of predicted structure. Data mining for drug designing and docking analysis. Structure visualization tool- RASMOL

Unit V

Genomics-scope and applications of structural and functional genomics, microarray technology Proteomics scope and applications of structural and functional-2D gel electrophoresis, Mass spectroscopy and MALDI-TOF

Reading List

1. Baxevanis, A.D. and Quellette, B.F.F. 2009. Bioinformatics. A practical guide to the analysis of genes and proteins. II edn. Wiley-Intern Science Publication, NewYork.
2. Mount, W. 2005. Bioinformatics sequence and genome analysis. Cold Spring harbor Laboratory Press, NewYork.
3. Pevsner, 2009. Bioinformatics and Functional Genomics. Wiley Dream tech, India.

4. Lesk, M.A. 2008. Introduction to Bioinformatics. Oxford Univ Publishers

Recommended texts

1. Mount, D.W. 2004. Bioinformatics: Sequence and Genome analysis, 2nd Edition, CBS Publishers, New Delhi.
2. Attwood, T.K, Parry Smith, D.J. Phukan, S. 2007. Introduction to Bioinformatics, Pearson Education, UK.
3. Gromiha, M.M. 2010. Protein Bioinformatics - From Sequence to Function, Elsevier India Pvt. Ltd, New Delhi.

RESEARCH METHODOLOGY

Course Objectives:

The main objectives of this course are:

- Students understand the basic principles, methodology and applications of widely used instruments in biological sciences.

UNIT I

Microscopy: Compound (Dark and Light field), Phase Contrast, Fluorescent, Polarized, Electron (Transmission and Scanning), AFM and Confocal Microscope - Micrometry.

UNIT II

Histology- Sectioning, fixation and staining of tissues. Centrifuge Clinical, Density gradient and Ultra - sedimentation coefficient. GM counter, Liquid Scintillation counter, Lyophilizer, Spectrophotometer (visible, ultraviolet), ELISA Reader. FTIR, NMR, XRD, Atomic Absorption and Mass Spectrophotometer.

UNIT III

Chromatography: Paper, Thin layer, Column, gel filtration, ion exchange, Gas and HPLC, PAGE, Agarose Gel Electrophoresis, 2D Gel Electrophoresis, Western blotting, and PCR.

UNIT IV

Identification of research problems - Steps in formulating a research problem. Thesis writing - Introduction, Review of literature, Methodology, Results - illustrations and tables, Discussion, Bibliography.

UNIT V

Publication of research and review articles – choosing the right journal; refereed journals, open access journals, Journal metrics, citation, impact factor, SCI, H index,

i10 index, software for paper formatting MS Office, Software for detection of Plagiarism.

Reading list

1. Pearse, A.G. 1968. Histochemistry: Theoretical and Applied, Vol. I, Third Edition, J & A Churchill Ltd, pp-758.
2. Lillie, R.D. 1954. Histopathologic Technic and Practical Histochemistry, Second Edition, Blakiston, New York, pp-715.
3. Hoppert, M. 2003. Microscopic Techniques in Biotechnology, Wiley-VCH GmbH, Weinheim, Germany, pp-330.

Recommended texts

1. Chandler, D.E. and Roberson R.W. 2009. Bioimaging: Current Concepts in Light and Electron Microscopy, Jones and Bartlet Publishers, Sudbury, MA, USA, pp440.
2. Engelbert, B. 1960. Radioactive Isotopes in Biochemistry, Elsevier Applied Science, pp-376.
3. Wolf, G. 1964. Isotopes in Biology, Academic Press, pp-173.
4. Srivastava, B. B. 2005. Fundamentals of Nuclear Physics, Rastogi Publications, pp- 500.
5. Pantin, C. F. A. 1948. Microscopical Techniques, Cambridge University Press, London.

WILDLIFE BIOLOGY

Course Objectives:

The main objectives of this course are:

- To make the students equipped with the knowledge of wildlife resources of India
- To strengthen the students to learn the principles and applications of various wildlife management techniques

Units I

Wildlife and Forestry of India - Definition of Wildlife: Economic importance of wildlife; need for wildlife conservation, Causes of wildlife depletion; Rare, endangered, threatened and endemic species in India- India as a mega wildlife diversity country. Types of Forests in India - Deforestation & Impacts; Natural and artificial regeneration of forests.

Unit II

Wildlife Census Methods - Basic concepts and applications - census – total counts - sample counts –- Direct count (block count, transect methods, point counts, visual encounter survey, waterhole survey); Indirect count (Call count, track and signs, pellet count, pugmark, camera trap, DNA finger printing and aerial photography) - Identifying animals based on indirect signs.

Unit III

Wildlife Management Techniques -Habitat manipulation: food, water, shade improvement; impact and removal of invasive alien species. Planning wildlife management Investigations and projects; Wildlife Photography: Field Equipment: binoculars, altimeter, pedometer, field compass; radio collaring; GPS; GIS; Remote sensing: Satellite images, Drones and their applications in wildlife management.

Unit IV

Human Wildlife Conflicts - Basic concepts, reason for conflicts, Identification of damages caused by wild animals and control measures; Chemical restraints: Advantage & Disadvantage – Basic considerations– Chemical restraints of Elephant, rhino, Gaur, Sambar, Panthera, small herbivores – post capture medical care & treatment; Translocation of Wild animals – Principles, Methods and application.

Unit V

Wildlife Conservation - Conservation Genetics: Scope and Genetic approaches to wildlife conservation; Evolutionary genetics of natural populations- Loss of genetic diversity in small populations – Resolving taxonomic uncertainties – Genetic management of threatened species; Molecular phylogenetics of wildlife; Wildlife Crimes detection and prevention. Eco-Development, Eco- Restoration and Ecotourism programmes; Anti-poaching operations –Village Forest Council (VFC).

Reading List

1. J.M. Fryxell, R.E. Anthony Sinclair, and G. Caughley, 2014, Wildlife Ecology, Conservation, and Management, Wiley-Blackwell Publication, U.S.A.
2. A.P. Dwivedi, 2008, Wildlife Ecology and Conservation, Biotech Books.
3. R.F. Dasmann, 1964. Wildlife Biology, John Wiley & Sons in New York.
4. R.Gopal, 1992, Fundamentals of Wildlife Management, Natraj Publishers.

Recommended texts

1. B.B. Hosetti, 2002. Glimpses of Biodiversity, Daya Publishing House, Delhi-35, India
2. W.L. Robinson and E.G Bolen, 2002.WildlifeEcologyand Management, Maxmillan Publishing Company, NewYork.
3. S.K. Singh, 2009. Text book of Wildlife Management, 2nd edition, International book distributing Co., Lucknow.
4. S.S. Negi, 2002. Hand book of National Parks, Wildlife Sanctuaries and Biosphere reserves in India. Indus Publ., New Delhi.
5. W.A. Rodgers, 1991. Techniques for Wildlife Census in India - A Field Manual: 5.Technical Manual-T M-2. WII

POULTRY FARMING

Course Objectives:

The main objectives of this course are:

- Students should know basic concepts in Poultry Farming.

UNIT I

General introduction to poultry farming - Definition of Poultry - Past and present scenario of poultry industry in India - Principles of poultry housing - Poultry houses - Systems of poultry farming

UNIT II

Management of chicks - growers and layers - Management of Broilers. - Preparation of project report for banking and insurance.

UNIT III

Poultry feed management-Principles of feeding, Nutrient requirements for different stages of layers and broilers - Feed formulation and Methods of feeding.

UNIT IV

Poultry diseases-viral, bacterial, fungal and parasitic (two each); symptoms, control and management; Vaccination programme.

UNIT V

Selection, care and handling of hatching eggs - Egg testing. Methods of hatching. Brooding and rearing -. Sexing of chicks. - Farm and Water Hygiene - Recycling of poultry waste.

Reading list

1. Sreenivasaiah., P. V., 2015. Textbook of Poultry Science. 1st Edition. Write & Print Publications, New Delhi 2.
2. Jull A. Morley, 2007. Successful Poultry Management. 2nd Edition. Biotech Books, New Delhi"
3. Hurd M. Louis, 2003. Modern Poultry Farming. 1st Edition. International Book Distributing Company, Lucknow."
4. Life and General Insurance Management"

Recommended texts

1. http://www.asci-india.com/BooksPDF/Small%20Poultry%20Farmer.pdf
2. https://nsdcindia.org/sites/default/files/MC_AGR-Q4306_Small-poultry-farmer-.pdf
3. http://ecoursesonline.iasri.res.in/course/view.php?id=335
4. https://swayam.gov.in/nd2_nou19_ag09/preview