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 2023-2024 onwards)

Semester-IV				
Part	**Subject Status**	**Subject Title**	**Subject Code**	**Credit**
3	Core	IMMUNOLOGY	WZOM41	5
3	Core	ECOLOGY	WZOM42	5
3	Core	LAB COURSE IN IMMUNOLOGY & ECOLOGY	WZOL41	3
3	Elective	AQUACULTURE/ APPLIED BIOTECHNOLOGY & NANOTECHNOLOGY	WZOE41/ WZOE42	3
3	SEC - 3	ANIMAL BEHAVIOUR/ FORENSIC SCIENCE	WZOSE41/ WZOSE42	2
3		PROJECT	WZOP41	4
3		EXTENSION ACTIVITY	WEXA41	1

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

IMMUNOLOGY

Course Objectives:

The main objectives of this course are:

- To impart conceptual understanding of functional organization of immune system and its responsiveness in health and disease.
- To enable a successful performance in Immunology component of CSIR-UGC NET.

Unit I

Introduction to Immunology: An overview; Historical perspective, Concepts of external and internal defense systems; External (first line / innate) defense system: components, distribution; Internal (second line / acquired) immune system: cellular and humoral immune components- distribution, salient functions-primary and secondary immune responses; Immune tissues / organs: types, anatomical location, structure and development; lymphocyte traffic during development; Types of immunity: innate and acquired - types, functional features.

Unit II

Antigens: Definition, characteristic features and classification; Antigenicity versus immunogenicity; Adjuvants: definition, types and applications. Vaccines: Types, Preparations, efficacies and recent developments: Complement System – Components, three major activation pathways and immune functions including Graphylaxis and inflammation.

Unit III

Major effector components of cellular immune system: Lymphocytes - types, morphology, clones; sub-populations, distribution, T cell activation, maturation and differentiation. Steps in B cell – activation, differentiation - T cell receptors, B and T cell epitopes, Toll-like receptors; Antigen presenting cells: antigen processing and presentation, MHC molecules and their immunologic significance

Unit IV

Major effector components of humoral immune system: Antibodies – Primary structure, classification, variants and antigen-antibody interactions; Structural and functional characteristics of various antibody classes; Generation of diversity; Monoclonal antibodies: Hybridoma Technology. Cytokines -Definition and salient functional features; Interleukins: definition, types (lymphokines and monokines), and functions. Interferons - Origin, types and functions

Unit V

Diseases and immune responses: Hypersensitivity: definition, Types I to IV and immune manifestations; Auto-immune diseases: onset, spectrum of diseases, and major immune responses; Immunodeficiency diseases: types including SCID and consequences; Viral (HIV), bacterial (tuberculosis) and parasitic (malaria) diseases: etiology, host immune responses and evasion by pathogens; Tumour immunology, transplantation immunology.

Reading list

1. Kuby, J. 1997. Immunology. W. H. Freeman & Co., New York, pp-670.
2. Male, D. J. Brostoff, D. B. Roth and I. Roitt. 2006. Immunology (7th edition), Mosby / Elsevier, Philadelphia, pp-472
3. Abbas, A. K and A. H. Lichtman. 2007. Cellular and Molecular Immunology (6^{th} edition), W. B. Saunders, Philadelphia, pp-564
4. Coica, R. Sunshine, G. 2015. Immunology (Seventh Edition), Wiley Blackwell, UK, pp-406.

Recommended texts

1. Weir, D. M and J. Stewart. 1997. Immunology, Churchill Livingstone, London, pp-362
2. Janeway, C. A and P. Travers. 1997. Immunology, Garland Publ. Inc., London, pp-904
3. Peakman, M and D. Vergani. 1997. Basic and Clinical Immunology, Churchill Livingstone, London, pp 366
4. Parham, P. 2009. The Immune System (Third Edition), Garland Science, USA, pp-506
5. Weissman, I. Hood, L. Wood, W. 1978. Essential Concepts in Immunology, the Benjamin/Cummings, California, pp-165.
6. Hood, L. Weissman, I. Wood, W. Wilson, J. 1984. Immunology (Second Edition), the Benjamin/Cummings, California, pp-558.
7. Coica, R and Sunshine, G. 2009. Immunology A Short Course (Sixth Edition), John Wiley & Sons, USA, pp-391.
8. Doan, T. Melvold, R. Viselli, S. et al., 2013. Immunology (Second Edition), Lippincott Williams & Wilkins, Maryland, pp-376.
9. Owen, J. A. Punt, J. Stanford, S. A. 2013. Kuby Immunology (7th Edition), Macmillan, England, pp692.

ECOLOGY

Course Objectives:

The main objectives of this course are:

- Knowing the ecology and climatic changes at world level and its impact on natural resources.
- Understanding the contributing factors for pollution in the environment and the ways in controlling and restoring to natural conditions

Unit I

The Environment: Physical environment; biotic environment; biotic and abiotic interactions. Habitat and niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Unit II

Population ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation-demes and dispersal, interdemic extinctions, age structured populations -action taken to control population explosion.

Unit III

Species interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis. Community ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones. Ecological succession: Types; mechanisms; changes involved in succession; concept of climax

Unit IV

Ecosystem: Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine). Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

Unit V

Applied ecology: Environmental pollution; global environmental change; biodiversity-status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches - Waste management. Conservation biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

Reading list

1. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publication, India, pp-616.
2. Calabrese, E.J. 1978. Pollutants and High-Risk Groups, John Wiley, pp-286.
3. Raven, P.H. and L.R. Berg, G.B. Johnson, 1993. Environment, Saunders College Publishing, pp-579.
4. Cunningham, W. P. and B. W. Saigo, 1999. Environmental Science, McGraw Hill Boston, 5th Edition.
5. Online courses.nptel.ac.in / noc 19 - g e 23/preview
6. Class central.com/course/swayam -ecology - and environment – 14021.

Recommended texts

1. Odum, E.P. 1893. Basic Ecology, Saunders & Co., Philadelphia, pp-383.
2. Barthwl, R.R. 2002. Environmental Impact Assessment, New Age International Publishers, New Delhi, India, pp-425.
3. United Nations Environment Programme (UNEP). 1995. Global Biodiversity Assessment, Cambridge University Press, pp-1140.

LAB COURSE IN IMMUNOLOGY & ECOLOGY

Course Objectives:

The main objectives of this course are:

- To provide hands on training to perform specific lab courses in immunology and ecology.

IMMUNOLOGY

1. Identification of Lymphoid organs in rat / chick – dissections.
2. Identification of various types of immune cells in peripheral blood smear.
3. Observation of WBCs.
4. Single radial immuno diffusion technique
5. Double immune diffusion
6. Agglutination titer – Determination of agglutination titer

Spotters / Charts / Models

1. ELISA
2. Western Blot, Southern Blot
3. HIV, Malaria, TB
4. IgG, IGM, IgA – Immuno globulin – Types
5. Lymphocytes – T & B Cells

ECOLOGY

1. Measurement of primary productivity in relation to biomass.
2. Estimation of dissolved O2 and Carbondioxide in the given water samples.
3. Estimation of salinity and total alkalinity
4. Identification of fresh water / Marine planktons
5. Estimation of pH in different water samples
6. Visit and field study report on a pond/ forest / marine ecosystem (any one).

Spotters / Charts / Models

- Commensalism, Mutualism, Parasitism, food web, Inter specific and Intra specific competitions, Ecological Pyramid of number, Biomass and energy.

AQUACULTURE

Course Objectives:

The main objectives of this course are:

- Students should know basic concepts in Aquaculture.

Unit I

Importance of aquaculture- Present status, prospects and scope in India. Freshwater aquaculture- Brackishwater aquaculture- Mariculture - Metahaline culture in India. Types of fish culture -Types of fish ponds for culture practice. Topography, site selection - soil condition and quality –pond design and layout -. Water quality management – Temperature, Salinity, Nutrients, O2, pH). Control of parasites, predators and weeds in culture ponds. Fish farm implements - Secchi disc - aerator - pH meter - feeding trays – Fishing gears used in aqua farming.

Unit II

Procurement of seed from natural resources- collection methods and segregation. Hatchery technology for major carps and freshwater prawn. Artificial breeding under controlled conditions, induced breeding techniques, hypophysation, larval rearing, packing and transportation Commercial substitute for pituitary extracts. Classification of fish feed –Types of ArtificialFeed - formulation - feeding methods. Live feed- Culture of Microalgae, Spirulina, Nostoc, Rotifer, Artemia.

Unit III

Shrimp hatchery technology - Hatchery design, brood stock management, spawning, larval rearing, Shrimp developmental stages, packaging and transportation. Culture technology - extensive culture methods semi- intensive - intensive culture methods - Bio floc technology - Culture operations (water quality, feed and health management) - harvesting, processing and marketing. Brackish water fish culture. Edible and Pearl oyster culture - pearl production. Crab culture. Economic importance of Lobster, Sea urchin and Sea cucumber - their by-products. Types of Seaweeds - species and methods of culture – by-products

Unit IV

Fish and Shrimp diseases and health management – infectious diseases – Bacterial: Dropsy, Erythroderma – Fungal: Branchiomycosis (Gill rot), Aspergillomycosis – Viral: Epizoatic Ulcerative Syndrome, Viral Hemorrhagic Septicaemia (VHS) – Protozoan: Ichthyopthiriasis (White Spot Disease), Myxozoans (Whirling Disease); Non-infectious - environmental and nutritional diseases. Diseases diagnosis, prevention and control measures.

Unit V

Types of ornamental fishes (freshwater and marine), their breeding behavior and biology. Oviparous, Ovo-viviparous and Viviparous fishes. Setting and maintenance of freshwater Aquarium tanks. Central aquaculture research organizations- CMFRI, CIBA, CIFT, CIFA, CIFE, ICAR-NBFGR, RGCA, MPEDA and its activities.

Reading list

1. Pillay, T. V. R. (1990). Aquaculture: Principles and Practices. Blackwell Scientific Publications Ltd.
2. Santhanam, R. (1990). Fisheries Science. Daya Publishing House.
3. Sinha, V.R. P. and Srinivastava, H. C. (1991). Aquaculture Productivity. Oxford and IBH Publications CO., Ltd., New Delhi.
4. Yadav, B. N. (1997). Fish and fisheries.Daya Publishing house, New Delhi.

Recommended texts

1. Das M. C. and Patnaik, P. N. (1994) Brackish water culture. Palani paramount Publications, Palani, T. N.
2. Day, F (1958). Fishes of India, VoL I and Vol. II. William Sawson and Sons Ltd., London.
3. Jhingran, V. G. (1991). Fish and Fisheries of India. Hindustan Publishing Co., India
4. Maheswari. K. (1983) Common fish disease and their control. Institute of Fisheries Education, Powarkads (M.P).

APPLIED BIOTECHNOLOGY AND NANOTECHNOLOGY

Course Objectives:

The main objectives of this course are:

- Enable the students to understand the basic concepts of Biotechnology
- Familiarize the significance of Biotechnology in enriching human life

Unit I

Introduction to Biotechnology: Tools of Genetic Engineering - Vectors - Cloning and Expression Vectors - Plasmids, Bacteriophage, Cosmids, Shuttle Vectors, Yeast Vectors. Enzymes - Restriction Endonucleases, Ligases, Reverse Transcriptases, Polymerases, Terminal Transferases and Isozymes. Nucleic acid Probes and Molecular markers - RFLP, RAPD.

Unit II

Techniques in Genetic Engineering - selection and isolation of desired genes, gene splicing, introduction of rDNA into host, selection of clone containing DNA insert, PCR, DNA finger printing, blotting techniques, DNA sequencing, genomic library, cDNA library.

Unit III

Biotechnology and Human Welfare: Tissue Plasminogen Activator, Erythropoitein, Interferons, Recombinant Vaccines, Monoclonal Antibodies Production. Genetically modified organisms (GEMO's) - Transgenic Mice and Cattle - Gene Pharming. Bioterrorism. Bioprocess Technology: Overview of Upstream & Downstream processing. Production of industrially important antibiotics, Single Cell Production. Role of GMOs in Biodegradation. Biotechnological Applications in Environmental Management, Biodiesel production and Bioplastics.

Animal Biotechnology: Artificial Insemination in Cattle, Embryo Transfer, Cryopreservation, Stem Cell Therapy, Targeted Gene Transfer - Gene knockouts.

Unit IV

Introduction to Nanobiotechnology: History and Scope of Nanotechnology. Nano materials - definition, types and properties. Development of nanomedicines - nanotechnology in diagnostic applications. Biochips Analytical devices. Biosensors - natural nanocomposite systems as spider silk, bones, shells.

Unit V

Application of Nanobiotechnology: Application in green energy, environmental remediation - pollution in industrial and waste water treatment. Application of Nanotechnology in the treatment of infectious diseases, nanomaterials in cancer diagnosis and therapy.

Reading List

1. U.Sathyanarayana, Biotechnology, Books and allied P. Ltd., Kolkata, 2005
2. V.Kumaresan.A Text Book of Biotechnology, Saras Publication., 2009.
3. Sree Krishna V (2007) Bioethics and Biosafety in Biotechnology, New age International publishers.

Recommended texts

1. V.A Saunders, Microbial Genetics Applied to Biotechnology: Principles and Techniques of Gene Transfer and Manipulation. Springer Science & Business Media. 2012.
2. Mathews and Mickee. An introduction to genetic engineering in plants, Blackwell Scientific Publishers. London. 2015.
3. Ramadass. P., Animal Biotechnology: Recent Concepts and Developments. Publishers, India. (2008).
4. Sateesh MK (2010) Bioethics and Biosafety, I. K. International Pvt Ltd.

ANIMAL BEHAVIOUR

Course Objectives:

The main objectives of this course are:

- Students should understand basic concepts in Animal behaviour.

Unit I

Genetic material, Genes and chromosomes, Genetic variation, Single and Polygenic inheritance of behaviour, Heritability of behaviour, Natural selection and behaviour, Frequency distribution of phenotypes, Darwinian fitness, Evolution of adaptive strategies.

Unit II

Sexual selection, Altruism, Sexual strategy and social organization, Animal perception, Neural control of behaviour, Sensory processes and perception, Visual adaptations to unfavourable environments.

Unit III

Coordination and Orientation, Homeostasis and Behaviour, Physiology and Behaviour in changing environments, Animal Learning, Conditioning and Learning, Biological aspects of learning, Cognitive aspects of learning.

Unit IV

Instinct and learning, Displacement activities, Ritualization and Communication, Decision making behaviour in Animals, Complex behaviour of honey bees, Evolutionary optimality, Mechanism of Decision making. The mentality of Animals: Languages and mental representation, non-verbal communication in human, mental images, Intelligence, tool use and culture, Animal awareness and Emotion.

Unit V

Organization of circadian system in multicellular animals; Concept of central and peripheral clock system; Circadian pacemaker system in invertebrates with particular reference to Drosophila; Photoreception and photo- transduction; Molecular bases of seasonality; The relevance of biological clocks for human welfare - Clock function (dysfunction); Human health and diseases – Chrono pharmacology, chrono medicine, chronotherapy.

Reading list

1. David McFarland, 1985.Animal Behaviour, Longman Scientific & Technical, UK.576pp.
2. HarjindraSingh, 1990. A TextBook of Animal Behaviour, AnomolPublication, 293pp.
3. Hoshang S.Gundevia and Hare Goving Singh, 1996. Animal Behaviour,

S.Chand & Co, 280pp.
4. Shukla, J. P 2010, Fundamentals of Animal Behaviour, Atlantic, 587pp.
5. Vinod Kumar, 2002. Biological Rhythms. Narosa Publishing House, Delhi.

Recommended texts

1. Michael D. Breed and Janice Moore, 2012. Animal Behaviour, Academic Press, USA, 359pp.
2. Aubrey Manning and Martin Stamp Dawkins, 2012. An Introduction to Animal Behaviour, 6th Edition, Cambridge University Press, UK. 458pp.
3. Davis E.Davis, 1970. Integral Animal Behaviour, Mac Millan Company,London, 118pp.
4. Jay, C. Dunlap, Jennifer, J. Loros, Patricia J. De Coursey (ed). 2004. Chronobiology Biological time Keeping, Sinauer Associates Inc, Publishers, Sunderland, MA.

FORENSIC SCIENCE

Course Objectives:

The main objectives of this course are:

- To understand the different aspects of Forensic Biology and some very specific areas such as DNA forensics, Wild Life Forensics and Forensic Entomology.
- To learn in details, the Forensic Examination of body fluids, and Hair and its significance
- Use tools and techniques required for detection of deception.

Unit I

Introduction to Forensic Science

Forensic Science-definition, history, development and scope. Concepts, functions and need of forensic science. Principles and Methods of Forensic Science. State and Central Forensic Science Laboratories. Mobile Forensic Science Laboratory. Locard's Exchange Principle.

Unit II

Forensic Importance of Body fluids and evidence

Common body fluids. Collection and preservation of blood evidence. Distinction between human and non-human blood. Forensic characterization of bloodstains. Typing of dried stains. Semen. Forensic significance of semen. Collection, evaluation and tests for identification of semen. Composition, functions and forensic significance of saliva, sweat, milk and urine. Tests for their identifications. Nature and importance of biological evidence. Significance of hair evidence. Transfer, persistence and recovery of hair evidence. Comparison of human and animal hair.

Unit III

DNA Forensics and Finger printing:

DNA Forensics: DNA as biological blueprint of life. DNA testing in disputed

paternity, Application and Forensic Significance of DNA Profiling.
Finger printing: Biological basis of fingerprints. Formation of ridges. Fundamental principles of fingerprinting. Types of fingerprints. Fingerprint patterns. Fingerprint characters. Plain and rolled fingerprints. Classification method for fingerprint record keeping. Automated Fingerprint Identification System.

Unit IV

Fundamentals of Forensic Medicine and Toxicology

Forensic Medicine- Definition, nature and scope. Inquests. Medico Legal documents. Evidences- Dying declarations- Identification of dead and living persons. Medico legal autopsy and its importance.
Toxicology: Significance of toxicological findings. Techniques used in toxicology. Toxicological analysis and chemical intoxication tests. Postmortem Toxicology. Human performance toxicology

Unit V

Wildlife Forensics and Forensic Entomology

Wildlife Forensics: Fundamentals of wildlife forensic. Significance of wildlife forensic, Identification of physical evidence pertaining to wildlife forensics.
Forensic Entomology: Basics of forensic entomology. Insects of forensic importance. Collection of entomological evidence during death investigations.

Reading list

1. Houck, M. M & Siegel, J. A 2006. Fundamentals of Forensic Science Acadamic Press, London.
2. James, S. H and Nordby, J. J. 2003. Forensic Science- An Introduction to Scientific and Investigative
3. Techniques. CRC Press, USA.
4. Saferstein 2007. An Introduction of Forensic Science Prentice HallInc, USA.
5. Basu R. 2019. Fundamentals of forensic medicine and toxicology. Books & allied (P) LTD.-Kolkata.

Recommended texts

1. Narayana Reddy (1981). Introduction to Forensic Medicine and Toxicology. Calcutta.
2. William G. Eckert., (1997) Introduction to Forensic Sciences, CRC press New York.