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 2021-2022 onwards)

Semester-IV				
Part	**Subject Status**	**Subject Title**	**Subject Code**	**Credit**
3	Core	Biostatistics and Bioinformatics		4
3	Core	Immunology		4
3	Core	Entomology		4
3	Elective	Aquaculture/Sericulture		3
3	Practical	Practical		
3	Practical	Practical		
		Project		

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

BIOSTATISTICS AND BIOINFORMATICS

Unit 1: Collection of Data: Primary and Secondary data –Methods of collecting primary data –sources of secondary data. Sampling and Sample Designs: Essentials of sampling – Methods of sampling –Random sampling methods –Non random sampling methods –Merits and Limitations of sampling. Classification and tabulation of data – Diagrammatic and graphic presentation of data.

Unit II: Measures of Central Tendency: Mean- Arithmetic mean –Weighted arithmetic mean – Median – Mode. Measures of Dispersion: Quartile deviation – Mean deviation – Standard deviation – Lorenz curve. Skewness Moments and Kurtosis: Measure of skewness–Absolute measure of skewness -Relative measure of skewness -Karl Pearson's coefficient of skewness- Bowley's coefficient of skewness. Moments. Measures of kurtosis. Correlation analysis: Types of Correlation –Methods of studying correlation Karl Pearson's coefficient of correlation –Regression Analysis –Regression line, Regression equations.

Unit III: Probability and Expected Value: Concepts of probability –Types of events - Theorems of probability - conditional probability –Bayes' Theorem. Theoretical Distribution: Binomial distribution -Poisson distribution - Normal distribution. Statistical Inference: Test of hypothesis -procedure of testing hypothesis. Estimation: Test of significance for large sample - Test of significance for small samples – Student's t- distribution.

Unit IV: Chi square test and a Goodness of fit –Yates correction F-Test and Analysis of Variance – one way classification and two-way classification. Experimental design – Randomized block design –Latin squares – The Sign Test – A rank sum test (The Mann- Whitney U Test).

Unit V: Bioinformatics: Information Technology in Biology - Types of sequences used in bioinformatics – Application of Bioinformatics. Biological Database: Objectives –Properties of Database –database retrieval system –Symbols used in data base –Nomenclature of DNAsequences Nomenclature of protein sequences –NCBI. SWISS-PROT. Data Base Similarity Search Tools: BLAST –FASTA –Application of bioinformatics tools –Homology search tools –Protein functional analysis tools – Sequences analysis tools –Structural analysis tools - Molecular modelling and visualizing tools –Polygenetic analysis tools.

Suggested reading materials:

1. Gupta S.P. 2008 Statistical methods Sultan Chand & Co. New Delhi.
2. Khanum. A& I.A. Khan 2004 Fundamental of Biostatistics, Ukazz Publication. Hyderabad.
3. Ramakrishnan P.1994 Biostatistics SARAS Publication Tamil Nadu
4. C.S.V.Murthy 2008 Bioinformatics Himalaya Publishing House Pvt Ltd . New Delhi.
5. Sundararajan and Balaji 2007 Introduction to Bioinformatics Himalaya Publishing House Pvt Ltd. Mumbai.
6. Gerrold H Zar Fundamentals of Biostatistics 5th edition
7. Banergi,P.K. 2004Introduction to Biostatistics S Chand & company Ltd .New Delhi.
8. Gurumani,N. 2004Introduction to Biostatistics .MJP Publishers Chennai
9. Misra ,B.N.and Misra ,B.K.1998 Introductory Practical Biostatistics. Naya Prakash, Calcutta.
10. Pillai, RSN.and Bhavathi ,V.1989 Statistics S Chand & company Ltd .New Delhi
11. Schefler W.C.1980. Statistics for biological sciences Addison –Wesley Publishing Company, NewYork.
12. Sokal,R.R.and Rohif ,F.J. 1987 Introduction to Biostatistics .W.H.Freeman and Company New York.
13. Sundar Rao,P.S.S and Righard ,J.2002 An Introduction to Biostatistics .III edn Prentice Hall of India
14. N.J.Chikhale and V.S. Gomare 2007 Bioinformatics Theory and Practice Himalya Publishing House Pvt Ltd .Hyderabad.
15. Attwood T.K. Parry smith D.J. 2006 Introduction to biostatistics, Dorling Kindersley (India) Pvt Ltd South Asia.

IMMUNOLOGY

Unit: I

Innate and Acquired Immunity: Phylogeny and Ontogeny of immune system - Organization and structure of lymphoid organs Cells of the immune system and their differentiation - Lymphocyte traffic - Nature of immune response

Unit: II

Nature of antigens: Antigenicity and immunogenicity - Factors influencing immunogenicity - Epitopes and haptens - Superantigens - Structure and Functions of

Antibodies - Classes and subclasses - Gross and fine structure - Antibody mediated effector functions - Antigen- Ab interactions in vitro and in vivo.

Unit: III

Complement system: Components, control proteins and activation pathways Major Histocompatibility Complex in mouse and HLA system in human MHC haplotypes - Class I and class II molecules - Cellular distribution - Peptide binding - Expression and diversity - Disease susceptibility and MHC/HLA Organization and expression of Ig genes- Models for Ig gene structure - Multigene organization of Ig genes - DNA rearrangements and mechanisms - Generation of antibody diversity - Differential expression of Ig genes.

Unit: IV

T-cell generation, activation and differentiation

Isolation, molecular components and structure of T-cell receptor complex - T-cell maturation and thymus - TH- cell activation mechanism - T- cell differentiation - Cell death and T- cell population - B- cell generation, activation and differentiation - B-cell receptors - Selection of immature self-reactive B-cells - B-cell activation and proliferation - TH- B- Cell interactions

Unit: V

Cytokines - Definition and salient functional features - Cytokine receptors - Cytokines and immune response - Cell-mediated effector functions - Cell adhesion molecules - Effectors cells and molecules - CTL and NK cells- mechanism of action - Immunological tolerance and Anti-immunity - Delayed type hypersensitivity - Hypersensitivity:

Types and immunological reactions and immune response to infection agents especially intracellular parasites

Suggested Reading Materials:

1. W. Paul. Fundamentals of Immunology.
2. I.M. Roitt, Essential Immunology, ELBS Edition
3. C.V.Rao, An Introduction to Immunology Narosa Puplishing House, 35, Greams Road, Thousand light, Chennai -600006.
4. Immunology, 2007. I.Kannan. MJP Publishers, Chennai.
5. Janis Kuby, Immunology W.H.Freeman and Company, New York.
6. Klans.D. Elgert, Immunology Wiley –Liss Pub. Co. U.S.A.
7. R.M.Coleman, M.F.Lomb and R.E.S.Cord Fundamental Immunology 2nd Edn. W.C.Brown Publishers U.S.A.

8. Donald M.Weir and John Shewart Immunology Churchill Livingston 9th Edn.
9. Geroge Pinchuk 2004.Schum's Outlines Immunology Tata McGraw –Hill.
10. Aruna Bhatia Manual of Practical Immunity Vikas Pub. House Ltd., New Delhi.
11. Talwar.G.P. A hand book practical immunology - Third edition, Backwell scientific publication-ISBN 0-632-01491-1

ENTOMOLOGY

Unit I

Introduction – principles of classification – Taxonomist A. D. Imms' classification down to orders with their diagnostic characters of any ten significant orders– methods of collection, killing and preservation of insects.

Unit II

External morphology of insects – types of mouthparts, antennae, wings, legs, thorax and abdomen. Life cycle of insects- types of metamorphosis.

Unit III

Structure, morphology and functions of integument. Alimentary canal and associated glands. Organization, structure and types of tracheal system. Hemolymph- composition and function. Hemocytes – types and function. Reproductive system – male and female

Unit IV

Any four important pests of Paddy, Sugarcane and Coconut. Pests of stored products – internal feeders and external feeders. Insects associated with human beings- vectors - mosquitoes and house fly – beneficial insects.

Unit V

Methods of pest control - natural, cultural, mechanical, legal, biological and chemical (organic and inorganic compounds – synthetic pyrethroids).Recent trends in pest control- Biointensive integrated pest management, hormones, pheromones, anti-feedants. Sterile insect technique – insect virus. Modern trends in pest control - integrated pest management.

Suggested reading materials:

1. David BV and TN. Ananthakrishnan.2004. General and Applied Entomology, McGraw Hill Education, Bangalore.
2. R.F. Chapman, 1998 The Insects: Structure and Function. Cambridge University Press.
3. Saxena R. C. and R.C. Srivastava 2007. Entomology, Agrotech Publishing Academy, Udaipur
4. Tembhare. D.B. 2017. Modern Entomology, Himalaya Publishing House, New Delhi,
5. Sandhya Agrawal 2009, Applied Entomology Oxford Book Company, Jaipur, India.
6. Ravindran K.R. 2013. A Text Book of Economic Zoology, Wisdom Press, New Delhi
7. Nalina Sundari, M.S. and R. Shanthi 2006. Entomology MJP Publishers, Chennai
8. Vasanthraj David B. and V.V. Ramamurthy. 2016. Elements of Economic Entomology. Brillion Publication, New Delhi.
9. Sanjay Mardal A. 2004 Handbook of Insect Neuro Endocrinology, Emkay Publication, Delhi- 51
10. Kumar A, and Nigam P.M. 2004. Economic and Applied Entomology, Emkey Publication, Delhi – 51

Lab on Entomology

1. Identification and classification of common local insects.
2. Mounting– Honey bee (Mouth parts, Sting and pollen basket),
3. Mounting of mouth parts of mosquito
4. Museum specimens: Any three insect pests and their damages – paddy, coconut, sugarcane.
5. Museum specimens: Life history of House fly
6. Museum specimens: Life history of Mosquito
7. Submission of insect box with minimum 10 insects.

AQUACULTURE

Unit I: Aquaculture: history, definition, scope & importance, fishery resources of India in general & Tamil Nadu in particular, a biotic and biotic factor of water necessary for fish life, ecological characteristics of lakes & rivers, general ecological characteristics of reservoirs of India.

Unit II: Fish culture: mono, poly, mixed & composite fish culture, fresh water and marine prawn culture and its prospects in India, culture of mussels, clams, oysters and pearl culture, sewage fed fish culture, paddy cum fish culture, frog culture, sea weed culture.

Unit III: Fish breeding in natural conditions, bundh breeding, hypophysation & stripping, transport of live fish and seed, different types of crafts and gears used for fish catching, plankton – its definition, culture & identification, common weeds of fish ponds& methods of their eradication, production of mono sex and sterile fishes, transgenic fishes, hybridization, polyploidy, role of bio technology in conservation of fishes.

Unit IV: Fresh water fish farm: selection of site, construction of fish farm and soil chemistry, designing layout and construction of different types of fish ponds, setting and management of fresh water aquarium, preservation and processing of fish, fish by products industry and their utility.

Unit V: Water pollution, its effects on fisheries and methods of its abatement, common fish diseases (bacterial, viral, fungal and nutritional deficiency diseases), biochemical composition and nutritional value of fish, fisheries economics and marketing, fisheries managements and extension.

Suggested reading materials:

1. Pillay T.V.R. & Dill, W. A. 1979. Advances in Aquaculture. Fishing News Books Ltd.
2. Agarwal, S.C. 2008. A Handbook of Fish Farming. Narendra Publishing House.
3. Rath, R. K. 2011. Fresh water Aquaculture. 3rd edition. Scientific Publishers, CIFA.
4. Hall, C. B. 2000. Ponds & Fish Culture. Agro-Botanica Publishers.
5. Chhapgar, B. F. 2008. Fishes of India. 2nd edition. Oxford University press.
6. Jhingaran, V. G. 1997. Fish and Fisheries of India. Hindustan Publishing Corporation.
7. Khanna, S.S. 2019. An Introduction to Fishes. Surjeet Publications.
8. Kumar, H.D. 2005. Sustainability and Management of Aquaculture & Fisheries, Daya Publishing House.
9. Sanatam, R. Sukumaran, N. and Natarajan, P. 1987. India Book House Pvt Ltd.
10. Gupta, S. K. and Gupta, P. C. 2006. General and applied ichthyology. Fish and Fisheries. S. Chand & Co.

SERICULTURE

UNIT - 1 Sericulture - India and World Scenario

Introduction, History, Scope & Importance – Silk production in the world – Sericulture in India –CSB, Central Silk Board and Research Institutes – CSR & TI, NSSP (National Silkworms seed project). Silk producing organisms, Non-mulberry silkworms: Eri, Tasar & Muga - food plants and life history

UNIT – II Moriculture

Taxonomy and Mulberry varieties and diversity of mulberry, Package of practices for mulberry cultivation and propagation –Plantation system – Methods of propagation, manuring, irrigation and pruning - Harvesting of leaves. Genetics of mulberry: Spontaneous and induced mutation, Diseases of mulberry: Factors, symptoms and control measures – Fungal, Bacterial, Viral, Nematode and deficiency diseases. Pest of Mulberry: Life cycle, nature of damage and control – Bihar hairy caterpillar, mealy bugs, thrips and stem borer.

UNIT – III Biology of Bombyx mori

Biology of B. mori – races and voltinism. Structure of egg, larva, pupa and adult. Sexual dimorphism- larva, pupa and adult. Anatomy: Digestive system, circulatory, respiratory, Excretory, male and female reproductive system. Silk gland – Structure and significance-Silk protein. Neuroendocrine system, neuro secretary cells, Corpora allata, Corpora cardiaca, ecydysial gland. Hormonal control of moulting and metamorphosis. Exocrine glands and pheromones.

UNIT – IV Grainage and Rearing operation

Grainage technology: Breeding Stations - methods of industrial egg production, mother moth examination, diapausing and non-diapausing eggs. Incubation and transport of eggs. Silk worm - Rearing: Rearing House (CSB- model) and Rearing appliances. Rearing operation- Disinfection, brushing, maintenance of optimum conditions, feeding, bed cleaning, spacing, care during moulting, mounting, and Harvesting. Rearing methods: Chawki rearing and rearing of late age and mature larvae- Mounting practices.

UNIT – V Silk reeling operation and disease management

Cocoon marketing- physical characters for commercial purposes- shell ratio – defective and malformed cocoons -Stifling, Storage- Sorting– deflossing- riddling- blending - cooking, brushing. Reeling operation: reeling appliances- types - raw silk – raw silk testing – silk wastes, preparation of compost using sericultural wastes and by products of sericulture. Diseases of Silkworm: Fungal, Viral, Bacterial

diseases; Pest of silkworm – Uzi fly and Dermestid beetles - causative agent, symptoms, prevention and control measures.

Suggested Reading materials:

1. Damdrin, S.B. Jayant Jayaswal K., Giridhar 2000. Hand book of sericulture technologies. Central Silk board, Bangalore, India
2. Ganga,G and I. Sulochana Chetty 2008;Second Edition. An Introduction to Sericulture. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. G.Rangaswamy et al., Mulberry cultivation – Central Sericultural Research and Training Institute . Mysore (1972).
4. Ullal, S.R. and Narasimhanna, M.N. (1987), Handbook of Practical Sericulture, Central Silk Board Publication, Bangalore.
5. Hisao Aruga. Principles of Sericulture. Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
6. Madan Mohan Rao, M. 1998. A book of sericulture B.S. Publications, 4-3-309. 2nd floor, Sultan Bazar, Hyderabad.
7. Choudhary, S.N. 1982. Muga Silk Industry. Directorate of Sericulture, Government of Assam, Assam.
8. Nanavaty, M.N., 1990. Silk Production, Processing and Marketing. South Asia Books.
9. M.S. Jolly, (1982) Economics of Sericulture under Irrigated and Rainfed Conditions CSR & TI Mysore.
10. Sarkar, D.D. (1998), Silkworm Biology, Genetics and Breeding: Vikas Publication, New Delhi.
11. Silkworm Diseases (1988): FAO Pub. by Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
12. Joly, M.S., Sen, S.K. and Absan, M.M. (1974), Tasar Culture, CSTRI, Ranchi.

Biostatistics and Bioinformatics

1. Calculation of mean, median, mode, standard deviation, standard error, variance and coefficient of variation - individual observation.
2. Calculation of mean, median, mode, standard deviation, standard error, variance and coefficient of variation – continuous series.
3. Calculation of correlation coefficient – length and width of leaves.
4. Calculation of correlation coefficient – height and weight of students in the class.
5. Calculation of regression co-efficient using length and width of leaves.
6. Probability experiment with coin tossing (one coin, two coins). using chi square test
7. Test of significance for small samples – student's t test.
8. PubMed, NCBI, EMBL, SWISS-PROT – printout.

Immunology

1. ABO blood grouping by haemagglutination technique.
2. Immuno-diffusion technique.
3. Counting of white blood corpuscles and red blood corpuscles.
4. Primary and secondary lymphoid organs in man (chart).
5. Lymphoid organs in rat (chart).
6. Cells of immune system – (slides).
7. Immunoglobulin G (chart).
8. Monoclonal antibody preparation (chart).
9. Histology of lymphoid organs: Primary organs – Thymus, Bone marrow. Secondary organs – Lymph node, Spleen. (slides).

Aquaculture

1. Morphometry of a pond
2. Estimation of fish population using mark and recapture method
3. Estimation of primary productivity of macrophyte
4. Analysis of dissolved oxygen, salinity and alkalinity of any two water samples
5. Study of fish pathology
6. Taxonomic description of cultivable fishes (Indian major carps, 3 exotic carps)
7. Morphological feature of penaeid and non-penaeid prawn
8. Determination of age of fishes.

Sericulture

1. Any three local varieties of mulberry (MR2, K2, V1).
2. Pests of mulberry.
3. Dissections: Digestive system, silk gland, nervous system – larva,
4. Mounting of mouth parts of larva.
5. Life cycle of Bombyx mori
6. Sexing of Larva, pupa and adults
7. Characteristics of defective cocoons.
8. Physical characters of commercial cocoons.
9. Spotters: Rearing tray, rearing stand, chandrika, cocoon, raw silk, Open Pan cooking unit. Three pan cooking unit, Jettebout, country charkha, Netrika.
10. Diseases of Silkworm – (bacterial, and fungal).
11. Diseases of mulberry (fungal and nematode)
12. Field visit to sericulture station.

MAJOR PROJECT