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	ZZOM41	4
3	Core	Immunology	ZZOM42	4
3	Core	Entomology	ZZOM43	4
3	Elective	Aquaculture/Sericulture	ZZOM41/ ZZOM42	3
3	Practical	Practical VII	ZZOL41	2
3	Practical	Practical VIII	ZZOL42	2
3	Project	Project	ZZOP41	8

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

LEARNING OBJECTIVES (LOs)

The objectives of the course are to

- Impart knowledge on data collection, classification tabulation and graphic presentation.
- Learn important statistical methods such as measure of central tendency, correlation and regression.
- Gain knowledge on concept of probability, distributions and tests of significance.
- Comprehend the chi-square test – goodness of fit and one-way two-way analysis of variance
- Understand the role of information technology in Biology and application of Bioinformatics.

COURSE OUTCOMES (COs):

On successful completion of the course the student will be able to

CO1: Assess the methods of collection data, sampling, classification, tabulation and presentation of data.

CO2: Analyse the measure of central tendency, dispersion, skewness and kurtosis.

CO3: Evaluate the types of correlation, correlation coefficient, regression analysis and regression equation.

CO4: Examine the theoretical Distribution, Binomial distribution, Poisson distribution and Normal distribution in Biological sciences.

CO5: Apply the conceptsof Bioinformatics, bioinformatics tools and Polygenetic analysis tools.

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 DNA sequences 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 modeling 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. C.S.V. Murthy 2008 Bioinformatics Himalaya Publishing House Pvt Ltd . New Delhi.
4. Sundararajan and Balaji 2007 Introduction to Bioinformatics Himalaya Publishing House Pvt Ltd. Mumbai.
5. Banergi,P.K. 2004Introduction to Biostatistics S Chand & company Ltd .NewDelhi.
6. Gurumani,N. 2004Introduction to Biostatistics .MJP Publishers Chennai
7. Misra ,B.N.and Misra ,B.K.1998 Introductory Practical Biostatistics. Naya Prakash, Calcutta.
8. Pillai, RSN.and Bhavathi ,V.1989 Statistics S Chand & company Ltd .New

Delhi

9. Schefler W.C.1980. Statistics for biological sciences Addison –Wesley Publishing Company, NewYork.
10. Sokal,R.R.and Rohif ,F.J. 1987 Introduction to Biostatistics .W.H.Freeman and Company New York.
11. Sundar Rao,P.S.S and Righard ,J.2002 An Introduction to Biostatistics .III edn Prentice Hall of India
12. N.J.Chikhale and V.S. Gomare 2007 Bioinformatics Theory and Practice Himalya Publishing House Pvt Ltd .Hyderabad.
13. Attwood T.K. Parry smith D.J. 2006 Introduction to biostatistics, Dorling Kindersley (India) Pvt Ltd South Asia.

LAB ON BIOSTATISTICS AND BIOINFORMATICS

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

Cos cognitive level and mapping with POs and PSOs:

SEMESTER IV CORE XIII: 4.1 BIOSTATISTICS AND BIOINFORMATICS																
CO	CONGNITIVE LEVEL	PO							PSO							
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	K-1 Remember	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	K-2 Understand	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	K-3 Apply	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	K-4 Analyse	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO5	K-5 Evaluate	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO6	K-6 Create	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1)

IMMUNOLOGY

LEARNING OBJECTIVES (Los):

The objectives of the course are enabling the student to

- Understand the concepts and molecular events underlying Immunology.
- Identify the cells and organs of immune system and antigen-antibody interactions.
- Appreciate the MHC, immune-regulation, immune-tolerance and complement system.
- Know the Immunological tolerance, hypersensitivity, immunological reactions and immune response.

COURSE OUTCOMES (COs):

Upon the successful completion of the course, the student will be able to

COs 1: Explain the oorganization and structure of lymphoid organs Cells of the immune system and their differentiation.

COs 2: Analyse antigens, Antigenicity, immunogenicity, factors influencing immunogenicity andstructure and functions of Antibodies

COs 3: Analyse the Complement system, Major Histocompatibility Complex and HLA system in man

COs 4: Evaluate generation, activation and differentiation of T-cellsand B-Cells.

COs 5: Assess the immunological reactions and immune response to tumor evasion of the immune system – cancer immunotherapy

UNIT –I: OVERVIEW OF THE IMMUNE SYSTEM

Historical perspective – innate (nonspecific) immunity – acquired (specific) immunity.-EXPERIMENTAL SYSTEMS -Experimental animal models – cell-culture systems – recombinant DNA technology – analysis of DNA regulatory sequences – gene transfer into mammalian cells-CELLS AND ORGANS OF THE IMMUNE SYSTEM-Cells of the immune system – organs of the immune system – leukocyte recirculation –ANTIGENS-Immunologic properties of antigens - factors that influence immunogenicity - epitopes -IMMUNOGLOBULINS: STRUCTURE AND FUNCTION-Basic structure of immunoglobulin's-Immunoglobulin sequencing studies – immunoglobulin fine structure – immunoglobulin receptor complex – antigenic determinants on immunoglobulins – immunoglobulin isotypes – the immunoglobulin super family-HISTOCHEMICAL AND IMMUNOTECHNIQUES :- Antibody generation, Detection of molecules using ELISA, RIA, western blot, immune precipitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.

UNIT –II: ANTIGEN-ANTIBODY INTERATIONS

Strength of antigen-antibody interactions – cross-reactivity – agglutination reactions – radioimmunoassay – enzyme-linked immunosorbent assay – western blotting – immunofluorescence – immune electron microscopy-HYBRIDOMAS AND MONOCLONAL ANTIBODY=Formation and selection of hybrid cells – production of monoclonal antibodies – uses for monoclonal antibodies – engineered monoclonal antibodies – t-cell hybridoma-ORGANIZATION AND EXPRESSION OF IMMUNOGLOBULIN GENES-Genetic model compatible with immunoglobulin structure – multigene organization of immunoglobulin genes – variable-region gene rearrangements – regulation of immunoglobulin-gene transcription – generation of antibody diversity – class switching among constant region genes – expression of immunoglobulin genes – b-cell developmental stages-MAJOR HISTOCOMPATIBILITY COMPLEX-General organization and inheritance of the MHC – class IMHC molecules and genes – class II MHC molecules and genes – polymorphism of class I and class II MHC molecules – class III MHC molecules – mapping of the MHC – expression of MHC molecules – probing MHC structure and function – MHC and immune responsiveness – MHC and susceptibility to infectious diseases- ANTIGEN PROCESSING AND PRESENTATION-Self-MHC restriction of T cells – role of antigen-presenting cells – antigen processing – antigen presentation – clinical applications

UNIT –III:T-CELL RECEPTOR

T-cell receptors 0 organization and rearrangement of TCR genes – T-cell receptor complex: TCR-CD3 -- T-cell accessory membrane molecules -- TCR- antigen-MHC interaction alloreactivity of T cells-T-CELL ACTIVATION, MATURATION, AND DIFFERENTIATION-t-cell maturation – Th-cell activation – mature peripheral t-cell populations-CYTOKINES-General properties of cytokines – discovery and purification of cytokines – structure of cytokines – function of cytokines – cytokine receptors – cytokine antagonists – cytokine secretion and biological activity of Th1 and Th2 subsets – role of cytokines in the inflammatory response – cytokines and disease-GENERATION OF THE HUMORAL IMMUNE RESPONSE-Kinetics of the humoral response – experimental systems – identification of cells required for induction of humoral immunity – use of hapten-carrier conjugates study cellular interactions – steps in B-cell activation, propern, and differentiation – induction of the humoral response in vivo.

UNIT –IV:CELL – MEDIATED IMMUNITY

Direct cytotoxic response – delayed-type hyper sensitivity response –IMMUNE REGULATION AND TOLERANCE-Regulation of immune responsiveness – tolerance-THE COMPLEMENT SYSTEM-The complement components – initial

steps in complement activation – formation of membrane-attack complex- regulation of the complement system – complement-binding receptors – biological consequences of complement activation – complement deficiencies-HYPERSENSITIVWE REACTIONS-Cell and coombs classification – IGE-mediated (type I) – hypersensitivity – antibody-mediated cytotoxic (type II) hypersensitivity – immune complex-mediated (type III) hypersensitivity – TDTH-mediated (type IV) hypersensitivity-AUTOIMMUNITY-Autoimmune disease in humans – animal models for autoimmune disease – role of the CD4+ tcell, MHC, and tcell receptor in autoimmunity – proposed mechanisms for induction of autoimmunity – treatment of autoimmune diseases-VACCINES-Active and passive immunization – designing vaccines for active immunization – whole-organism vaccines – purified macromolecules as vaccines – recombinant antigen vaccines – recombinant vector vaccines – synthetic peptide vaccines – multivalent subunit vaccines – anti-idiotype vaccines

UNIT –V: IMMUNE RESPONSE TO INFECTIOUS DISEASES

Viral infections – bacterial infections – protozoan diseases – diseases caused by parasitic worms (helminthes)-IMMUNODEFICIENCY DISEASES-Classification of immune deficiencies – phagocytic deficiencies – humoral deficiencies – cell-mediated deficiencies – combined humoral and cell-mediated deficiencies-THE IMMUNE SYSTEM IN AIDS-Discovery of AIDS and its causative agent- HIV structure and infectious process – clinical diagnosis of AIDS – HIV destruction of CD4+ tcells – immunologic abnormalities in AIDS – serologic profile of HIV infection – screening tests for HIV infection – development of an AIDS vaccine-TRANSPLANTATION IMMUNOLOGY-The immunologic basis of graft rejection – clinical manifestations of graft rejection – tissue typing – general immunosuppressive therapy – specific immunosuppressive therapy – clinical transplantation-CANCER AND THE IMMUNE SYSTEM-Cancer: organ and terminology – malignant transformation of cells – oncogenes and cancer induction – tumors of the immune system – tumor antigens – immune response to tumors – immune surveillance theory – tumor evasion of the immune system – cancer immunotherapy.

Text books:

1. C.V.Rao, An Introduction to Immunology Narosa Publishing House, 35, Greams Road, Thousand light, Chennai -600006.
2. Immunology, 2007. I.Kannan. MJP Publishers, Chennai.
3. Immunology N.Arumugam – Saras publication

Reference books:

1. Blaine T. Smith. (2008). Concepts in Immunology and Immuno-therapeutics,

(4th ed.): American Society of Health-System Pharmacists.
2. Chapel, H., Haeney, M., Misbah, S., & Snowden, N. (2014). Essentials of Clinical Immunology, (6thed.): Willey Blackwell Publishing. Kannan, I. (2013). Immunology: MJP Publication.
3. Male, D., Brostoff, J., Roth, B, D &Roit, I. (2012). Immunology, (8th ed.) Elsevier.
4. Owen, J., Jenni Punt, Sharon Stranford. (2013). Kuby Immunology, (7th ed.): W. H. Freeman.
5. Thomas J. Kind., Richard A. Goldsby., Barbara A. Osborne., Kubi, J. (2000). Kuby Immunology. NewYork: W.H. Freeman.
6. Vaman Rao., (2016). Immunology. New Delhi: Narosa Publishing House Pvt, Ltd.
7. Janis Kuby, Immunology W.H.Freeman and Company, New York.
8. Klans. D. Elgert, Immunology Wiley –Liss Pub. Co. U.S.A.
9. R.M. Coleman, M.F. Lomb and R.E.S. Cord Fundamental Immunology 2nd Edn. W.C. Brown Publishers U.S.A.
10. I.M. Roitt, Essential Immunology E.L.B.S.
11. Donald M.Weir and John Shewart Immunology Churchill Livingston 9th Edn.
12. Geroge Pinchuk 2004.Schum's Outlines Immunology Tata McGraw –Hill.
13. Aruna Bhatia Manual of Practical Immunity Vikas Pub. House Ltd., New Delhi.
14. Talwar .G.P. A hand book practical immunology - Third edition, Backwell scientific publication-ISBN 0-632-01491

LAB ON IMMUNOLOGY

1. ABO blood group identification.
2. Study of lymphoid organs.
3. Haemagglutination assay.
4. Study of antibody titer values.
5. Immunodiffusion – Single /Double andRadial
6. Immuno-electrophoresis. ELISA and Western Blot
7. Lymphoid organs in Rat – Dissection
8. Lymphoid organs – Histology slides
9. Cells – Differential count of blood cells – Staining with Giemsa
10. Lymphocyte separation – Gradient methods
11. Antigen – Antibody reactions – Kits
    a) Determination of blood groups
    b) Diagnostic test for typhoid
    c) Quantitative precipitin assay teaching kit
    d) Test for HBS Ag.
    e) Estimation of serum proteins

Cos cognitive level and mapping with POs and

SEMESTER IV CORE XIV: 4.2 IMMUNOLOGY															
CO	CONGNITIVE LEVEL	PO							PSO						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	K-1 Remember	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	K-2 Understand	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	K-3 Apply	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	K-4 Analyse	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO5	K-5 Evaluate	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO6	K-6 Create	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1)

ENTOMOLOGY

LEARNING OBJECTIVES (LOs)

The objectives of the course are to

- Demonstrate insect identification, structure, and function
- Examine insects deeply within a biological level of analysis
- Impart knowledge on basic aspects of anatomy of different insects
- Identify the potential impact of different insect species on agriculture,
- Understand the principles and methods of managing pest insect populations

COURSE OUTCOMES (COs):

On successful completion of the course the student will be able to

CO1: Classify insects using taxonomic keys.

CO2: Demonstrate the external morphology of the insect body and their appendages and functions

CO3: Identify, collect, and manage different insects of household, man and animals

CO4: Apply appropriate indirect and direct measures to prevent or reduce pest attack

CO5: Analyse the main pest species of crops based on the symptoms of the attack and morphological traits

CO6: Develop strategies to manage the vectors population

CO7: Plan and implement crop protection according to the Integrated Pest Management Principles.

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.

Cos cognitive level and mapping with POs and

SEMESTER IV CORE COURSE: XV 4.3 ENTOMOLOGY																
CO	COGNITIVE LEVEL	PO							PSO							
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	K-2 Understand	3	3	3	3	2	1	-	2	2	1	1	-	-	-	-
CO2	K-3 Apply	3	3	3	2	2	1	-	2	2	1	1	-	-	-	-
CO3	K-3 Analyse	3	3	3	3	2	2	-	2	2	2	1	1	-	-	-
CO4	K-4 Analyse	3	3	3	3	\3	3	1	2	2	2	2	1	-	-	-
CO5	K-4 Analyse	3	3	3	3	3	3	2	3	2	2	2	2	2	1	-
CO6	K-5 Evaluate	3	3	3	3	3	3	2	3	3	3	2	2	2	2	1
CO7	K-6 Creativity	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1)

AQUACULTURE

LEARNING OBJECTIVES (LOs)

The objectives of the course are to

- Creating awareness on the scope & importance, fishery resources of India in general and Tamil Nadu in particular.
- Support different types of Fish culture, fresh water and marine prawn culture and its prospects in India
- Promote, facilitate and influence the best possible standards of fisheries management.
- Provide the technical and general knowledge necessary for competent fisheries management.
- Inform the recent advancement and role of biotechnology in conservation of fishes.

COURSE OUTCOMES (COs):

On successful completion of the course the student will be able to

CO1: Assess the biotic and biotic factor of water necessary for fish life and ecological characteristics of lakes, rivers and marine environment.

CO2: Analyse culture of mussels, clams, oysters and pearl culture, sewage fed fish culture, paddy cum fish culture, frog culture, and sea weed culture.

CO3: Evaluate the fish breeding in natural conditions, hypophysation, stripping, transgenic fishes, hybridization and polyploidy.

CO4: Construction of different types of fish ponds, setting and management of fresh water aquarium.

CO5: Examine common fish diseases such as bacterial, viral, fungal and nutritional deficiency diseases.

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.

LAB ON 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, 3exotic carps)
7. Morphological feature of penaeid and non-penaeid prawn
8. Determination of age of fishes.

Cos cognitive level and mapping with POs and PSOs:

SEMESTER IV **ELECTIVE PAPER I: AQUACULTURE**															
CO	**CONGNITIVE LEVEL**	**PO**							**PSO**						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	K-1 Remember	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	K-2 Understand	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	K-3 Apply	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	K-4 Analyse	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO5	K-5 Evaluate	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO6	K-6 Create	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1)

SERICULTURE

LEARNING OBJECTIVES (LOs)

The objectives of the course are to

- Creating awareness on the scope, importance, Sericulture resources of national and international level.
- Promote the various techniques involved in the rearing of mulberry silkworm.
- Supportpractices for mulberry cultivation and propagation.Methods of propagation, manuring, irrigation,pruning and harvesting of leaves.
- Provide knowledge on physical characters for commercial purposes and Cocoon marketing.
- Inform the recent trends in silk production and marketing and sericulture an entrepreneurship for youth and women.

COURSE OUTCOMES (COs):

On successful completion of the course the student will be able to

CO1: Assess the Silk producing organisms, Non-mulberry silkworms: Eri, Tasar & Muga, their food plants and life history.

CO2: Analyze mulberry varieties, cultivation, propagation, manuring, irrigation, pruning and harvesting of leaves.

CO3: Evaluate the biology of B. mori, voltinism and races suitable for rearing.

CO4: Rearing methods like Chawki rearing and rearing of late age and mature larvae-mounting practices and cocoon marketing.

CO5: Examine diseases of Silkworm like Fungal, Viral, Bacterial diseases and Pest of silkworm and causative agent, symptoms, prevention and control measures.

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.

Lab on 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.

Cos cognitive level and mapping with POs and PSOs:

SEMESTER IV **ELECTIVE PAPER II SERICULTURE**															
CO	**CONGNITIVE LEVEL**	**PO**							**PSO**						
		1	2	3	4	5	6	7	1	2	3	4	5	6	7	8
CO1	K-1 Remember	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	K-2 Understand	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	K-3 Apply	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	K-4 Analyse	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO5	K-5 Evaluate	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO6	K-6 Create	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

Strongly Correlated (3); Moderately Correlated (2); Weakly Correlated (1)

MAJOR PROJECT