Agenda

Board of studies for M.Phil., Zoology– June 2019

1. The syllabus for M.Phil Zoology has been designed as per the guidelines provided
2. Mandatory and Electives paper are selected as per the suggestions given.

Members:

1. Dr.T.Kumaran

Dr. T. KUMARAN, M.Sc., M.Phil., Ph.D.,
HEAD OF THE DEPARTMENT OF
ADVANCED ZOOLOGY & BIOTECHNOLOGY,
Dr. AMBEDKAR GOVT. ARTS COLLGE
VYASARPADI, CHENNAI - 600 039.

2. Dr. K.Sivakumari

Dr. K. SIVAKUMARI
M.Sc.,M.Phil.,Ph.D.,F.A.Z.,
Professor and Head
Department of Zoology
Presidency College (Autonomous)
Chennai-600 005

3. Dr.M.G.Raghunathan

Dr. M.G. RAGUNATHAN,
M.Sc., M.Phil., Ph.D.
Associate Professor & Head
Dept. of Adv. Zoology & Biotechnology
Guru Nanak College, Chennai - 600 042.

4. Dr.A.Premalatha

5. Dr P.Arumugam

Dr. P. ARUMUGAM, M.Sc.,M.Phil.,Ph.D.,
Director
ARMATS BIOTEK TRAINING & RESEARCH INSTITUTE
No. 14/18C, Mettu Street, (Link Road),
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Chennai - 600 032.
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MINUTES OF THE MEETING- HELD ON 10.6.2019

(Board of studies for M.Phil Zoology)

The board of studies decided the following recommendations / modifications be made to M.Phil Zoology syllabus / examination pattern with effect from 2019-20 onwards.

1. Suggestions for change in theory paper pattern - Removal of 40 marks internal and 60 marks external
2. Question paper pattern changes - suggested
3. Five out of eight questions – Essay type answers for theory examinations
4. Each questions 20 marks – 5 x 20 = 100 marks
5. Dissertation to be valued for 100 marks – 75 marks + 25 marks (viva voce examination)
6. Internal marks to be removed for dissertation - suggested
7. Total of 400 marks to be followed – suggested

Dr.Ambedkar Government Arts College (Autonomous)

Vyasarpadi, Chennai-600 039

Department of Advanced Zoology and Biotechnology

Minutes of the meeting of Board of Studies (M. Phil - Zoology) held on 10.6.2019
The following members were present during the meeting

S.No	Name of the Members	Designation & Institution	Signature
1	Dr.T.Kumaran Convenor	Assistant Professor & Head Department of Advanced Zoology and Biotechnology Dr.Ambedkar Govt. Arts College Vyasarpadi, Chennai-39.	
2	Dr. K.Sivakumari University Nominee	Associate Professor & Head PG & Research Dept. of Zoology Presidency College (Autonomous), Chennai-600005	
3	Dr.M.G.Raghunathan Subject Expert I	Associate Professor & Head PG Department of Zoology Guru Nanak College (Autonomous) Chennai-600045	
4	Dr.A.Premalatha Subject Expert II	Associate Professor & Head Department of Advanced Zoology and Biotechnology Meenakshi College for Women Kodambakkam, Chennai-24. .	
5	Dr P.Arumugam Industrialist	Director Armot Biotech Maduvankarai Ekattuthangal, Chennai.	

Dr.Ambedkar Government Arts College (Autonomous)
Vyasarpadi, Chennai-600 039.

Department of Advanced Zoology and Biotechnology

The following resolutions were adopted in the meeting held on 10.6.2019

RESOLVED that the draft syllabi proposed for (M. Phil - Zoology) by the Department of Advanced Zoology & Biotechnology are discussed and approved for the students admitted from the academic year 2019-2020.

S.No	Name of the Members	Designation & Institution	Signature
1	Dr.T.Kumaran Convenor	Assistant Professor & Head Department of Advanced Zoology and Biotechnology Dr.Ambedkar Govt. Arts College Vyasarpadi, Chennai-39.	
2	Dr. K.Sivakumari University Nominee	Associate Professor & Head PG & Research Dept. of Zoology Presidency College (Autonomous), Chennai-600005	
3	Dr.M.G.Raghunathan Subject Expert I	Associate Professor & Head PG Department of Zoology Guru Nanak College (Autonomous) Chennai-600045	
4	Dr.A.Premalatha Subject Expert II	Associate Professor & Head Department of Advanced Zoology and Biotechnology Meenakshi College for Women (Autonomous) Kodambakkam, Chennai-24.	
5	Dr P.Arumugam Industrialist	Director Armot Biotech Maduvankarai Ekattuthangal, Chennai.	

Dr. Ambedkar Government Arts college (Autonomous), Vyasarpadi, Chennai-39.

Department of Zoology

Board of Studies Meeting held on 10th June 2019

List of Staff Members

S. no	Name of the staff members	Designation	Signature
1.	Dr. T. Kumaran	Head and Assistant professor	
2.	Mrs. I. Malaichelvi	Assistant professor	
3.	Dr. V. Mathivanan	Assistant professor	
4.	Dr. M. Sasikala	Assistant professor	
5.	Dr. T. Mathuram	Assistant professor	
6.	Dr. K. Samyappan	Assistant professor	
7.	Dr. S. Gladis Helen Hepsiba	Assistant professor	
8.	Dr. R. Saravanan	Assistant professor	
9.	Dr. N. Thirunavukkarasu	Assistant professor	

Dr.AMBEDKAR GOVERNMENT ARTS COLLEGE

(AUTONOMOUS)

VYASARPADI, CHENNAI- 600 039.

DEGREE OF MASTER OF PHILOSOPHY

SYLLABUS FOR M.PHIL. ZOOLOGY

(FOR THE CANDIDATES ADMITTED FROM THE ACADEMIC YEAR 2019 – 2020 ONWARDS)

Objectives:

To provide a fundamental course for postgraduates in Zoology which will aid in strengthening their foundations for undertaking M.Phil research work in theoretical and applied zoology.

Eligibility for Admission:

Good academic record with first or Second class (55% and above) Masters Degree in Zoology from the Madras University or in examinations recognized as equivalent thereto.

Duration:

The duration of the M.Phil course will be one year with two semesters.

Course Structure:

Course Structure for M.Phil (Zoology)

(For the candidates admitted from the year 2016-2017 onwards)

Semester	Course	Course Title	Exam Hours	Internal Mark	External Mark	Total Marks
I	Paper- I	Research Methodology	3	40	60	100
	Paper-II	Recent Advances in Zoology	3	40	60	100
	Paper-III	Optional subject	3	40	60	100
II		*Dissertation Evaluation	-	60	100	160
		Viva – voce	- -	- -	40	40
		Total				**500**

* For 200 Marks

PAPER – III – (GUIDE PAPER - ANY ONE OF THE FOLLOWING PAPER TO BE CHOSEN)

1. Insect Biology and Pest Management
2. Eco Toxicology
3. Aquaculture and Fisheries
4. Crustacean Endocrinology and Reproduction

Examinations:

Question paper pattern for M.Phil Zoology Course.

Duration : 3 Hrs
Maximum Marks: 75

Part A - (5x4=20 Marks)

Answer **any FIVE** questions **OUT OF SIX**

Part B - (4x10= 40Marks)

Answer any **FOUR** questions out of **SIX**

(Atleast one question from each unit)

Controller of examination will conduct the examination for Paper-I and Paper-II at the end of First Semester.

- Research Supervisor will provide the syllabus and Question paper for paper III. The controller of examinations will conduct the examination for Paper-III (Guide paper) at the end of First semester.
- Passing minimum in each paper is 50%.

Theory Papers:

Total mark for each Paper is 100 out of which 25 marks for Internal and 75 marks for Semester examination. The Internal assessments may be in the form of combination of periodical tests and assignments for theory papers. The internal mark components are as follows

1. Test	=	**10 Marks**
2. Assignment	**=**	**10 Marks**
3. Seminar	**=**	**5 Marks**
Total	**=**	**25 Marks**

Dissertation:

The Dissertation is evaluated 200 marks and the components are:

Evaluation :

1.	Evaluation of Project report by External Examiner	**:**	**100 Marks**
2.	Evaluation of Project report by Internal Examiner	**:**	**40 Marks**
	Project presentation **and Viva-Voce** conducted by Supervisor and External Examiner	**:**	**60 Marks**
		Total =	**200 Marks**

- The Dissertation will be valued by the supervisor and the external examiner.
- The Viva-voce will be conducted by the supervisor and the external examiner.

Paper – I Research Methodology

Unit I: Microscopy, Histology and Histochemistry

Microscopy - Electron Microscopy - Scanning and Transmission electron microscope - Principles and applications - Histological preparations of tissues for SEM & TEM. Photography – Photomicrography - Image analyzer- Principle and applications.

Principles of Microtechniques - Types of Microtome (Rotary, Freezing and Ultra microtomes) - Steps involved in tissue processing - Fixation- Chemical fixation and Fixation by Freezing- Fixatives , Histological stains - Methods of Staining -Types of Mounting- Preparation of whole mounts.

Histochemistry – Principles involved in identification of Carbohydrates, Proteins, Lipids and Nucleic acids.

UNIT II: Analytical Techniques

pH meter – Principles and applications. Types of buffers and its applications. Centrifuge-Types of ultra centrifuge –its components, working principle and applications. Centrifugation- Sedimentation coefficient- Differential and Density gradient centrifugation.

Spectrophotometry – Principle, Structural components of instrument, applications of UV and Visible spectrophotometer, NMR-Working principle and applications. Colorimeter – Principle and applications. Atomic Absorption Spectrophotometer – Flame photometer. Flow cytometry.

X-Ray diffraction –Principles and determination of structures of biological molecules..

UNIT III: Seperation Techniques

Chromatography – Principle and Applications of Paper, Thin layer, Column, Gas and High Pressure Liquid Chromatography (HPLC) .

Electrophoresis : Principles and Applications of Paper, Agarose Gel, PAGE, SDS-PAGE- Transilluminator and Gel documentation system

Immunological Techniques : Antigen - Antibody Reactions – Immunodiffusion (Double and Radial) – Principle of Immunoelectrophoresis and Rocket immunoelectrophoresis, ELISA (Direct, Indirect, Competitive and Sandwich methods)- RIA. Blotting Techniques- Southern , Northern and Western blot

Unit IV : Research Design, Literature Survey And Thesis Writing

Criteria and Steps involved in Selection of Research Problem – Experimental approach (Types of research design and its selection) – Designing of Methodology – Planning and Execution of Experiments

Literature survey- Methods of literature collection- Library resources - Journals ,

Technical papers, Reviews, Monographs, Newsletters and Abstract services. Internet Resources- Website, Information storage and retrieval, Preparation of index cards.

Thesis Writing and parts of a thesis - Methods of Editing and Proof reading of manuscripts .

Preparation and presentation of research papers for Symposia , Conference and Journals - Preparation of Manuscript - Method of writing an Abstract - Impact factor-citation index- Standard of research journals- paid and refereed journals-Online data base library.

UNIT V: Biostatistics and Statistical softwares

Statistical methods and application : Experimental designs – Sampling – Probability – Normal curve – Test of Significance – Student's 't'– test – Chi – Square test, 'F' test – Analysis of Variance – one way, two way and multiple way of analysis – Correlation coefficients – Simple, Linear and Multiple Correlations – Regression Analysis-Regression line, Regression equation and Multiple regression.

Statistical Softwares- Types of statistical softwares- COSTAT and STATISTICA Applications of Biostatistical packages - Use of MS- EXCEL in Biostatistics - SPSS package.

REFERENCE BOOKS :

1. Anderson, Durston, Polle (1970) Thesis and Assignment Writing, Wiley Easter Limited.
2. N.Gurumani (2006)-Research Methodology for Biological sciences-MJP publishers-TamilNadu Book House- Chennai
3. Bums, D.M. & MacDOnald, S. G. G. (1979) Physics for Biology and Premedical students. Elbs and Addisson - Wesley Publishers Ltd., London.
4. Das, D. (1982) Biophysics and Biophysical Chemistry. Academic Publishers. New Delhi.
5. Palanichamy, S and Shanmugavelu, M. (2006) Research Methodology for Biological Sciences. Palani Paramount Publication, T. N.
6. Pattabhi,V and N. Gautham (2001) Biophysics. Narosa publication, T.N.
7. N.Veerakumari –(2006) BioInstrumentation-MJP Publishers-TamilNadu Book House.

Paper II - RECENT ADVANCES IN ZOOLOGY

UNIT I: Molecular Biology and Genetics

Cell Signalling –Types of cell signalling- Mechanism of cell signalling by steroid hormones-Cell surface receptors-Peptide hormone action through G protein and second messenger systems.

Molecular biology of cancer- Oncogenes - Retroviral and Proto-oncogenes - Action of Oncogene products -Tumour Suppresor genes and its action .

Chromosomal studies- - Karyotyping- Fluorescence in situ hybridization- Detection of genetic diseases- Amniocentesis- screening and genetic counselling- Human gene therapy

Mutation - Mechanism of action of mutagens. Molecular basis of mutations. DNA methylation, Transposons

DNA finger printing - Techniques and Applications. Nucleic acid hybridization-Cot curves-Dot and slot blot.

UNIT II: Biochemistry

Proteins-Structure of proteins (Primary, secondary, tertiary, quaternary structure)-Enzymes- Enzyme kinetics and Michaelis - Menten constant, Line Weaver Burk equation, Ramachandran plot, Diagnostic importance of enzymes (GOT, GPT, ALP, ACP, GGT, LDH) -Isoenzymes- Antioxidant enzyme systems

Eukaryotic DNA replication- DNA damage and repair- Gene amplification-Mechanism of Transcription in eukaryotes- RNA processing- Translation and post translational modification –Antisense RNA.

Structure and biological significance of glycoproteins and peptido-glycans.Tumour markers.

UNIT III: Recombinant DNA Technology and its applications

Genetic Engineering: Gene manipulation –Restriction enzymes- Gene cloning vectors-Plasmids, Bacteriophage vectors and viral vectors-Construction of recombinant DNA and introduction into host cells- Recombinant selection.Expression of cloned genes in E.coli and eukaryotic systems. Production of insulin by recombinant DNA technology. Application of recombinant DNA technology in medicine.

DNA sequencing (Maxim Gilbert and Sanger's method) . PCR -Types of PCR-Techniques and Applications

Biofertilizers - Biopesticides - Single cell proteins – Production, sources and applications.

Transgenic plants - Applications of transgenic plants. Transgenic animals -. Applications and Ethical concern

Enzyme Technology.- Industrial applications of microbial enzymes - Immobilized enzymes and their applications.

UNIT IV: Animal cell culture

Animal cell culture - Substrates for animal cell culture and culture media - Organ culture and methods of organ culture - Tissue engineering

Cell lines- Types and characteristics- Methods for cell line culture (Monolayer, Suspension and Immobilized)

Stem cells and types –Characteristics, Culture and Maintenance -Stem cell therapy.-Applications of stem cells

Knock out genes– Ethical issues. Assisted Reproductive technologies (ART) in humans - in vitro fertilization - History and Types

UNIT V: Immunology and Environmental Management

Humoral and Cell mediated immunity- Hypersensitivity reactions. Complement pathways.

Vaccines – Whole organism, subunit , recombinant antigen (Hepatitis), Recombinant vector, DNA ,synthetic peptide, multivalent subunit vaccines - Development of vaccines for AIDS and malaria.

Monoclonal antibodies- Applications and uses in disease diagnosis

Bioremediation- Solid waste management ,Treatment of Industrial waste water and sewage effluents –Recycling of waste water.

Water quality analysis- Physical – (Colour, Turbidity, pH, Hardness, Conductivity, Temperature, Dissolved Oxygen) ,Chemical – (BOD, COD,TDS,TSS, Alkalinity), Biological – (Bacteriological tests - Total coliform - Fecal streptococci).

. Basic concepts of Remote sensing and Geographical information systems(GIS)

REFERENCE BOOKS :

1. Abbas, A.K.,Lichtman, A.K.,Pober , J.S.(1998) Cellular and Molecular Immunology. III Edition W.B.Saunders Company, U.S.A.

2. Benjamin Lewin. (1999) Genes VII. Oxford University Press, New York. Branden, C., Tooze, J. (1999) Introduction to protein structure. II Edition, Garland Publishing , Inc., New York.
3. Desmond, S.T., Nicholl. (1994) An introduction to genetic engineering Cambridge University Press, New York.

4. Jonathan Graves, Dungan Reavey (1996) Global Environmental Change. Plant,

Animal and Communities. Long man.Publishers

5. Hawkins, J.D. (1996) Gene structure and expression. III Edition. Cambridge University Press, New York.

6. King, B. (1986) Cell Biology. London, Allen and Unwin Boston, London.

7. Kumar, D. Kumar, S. (1998) Modern concepts in Microbiology. Vikas Publishing ., New Delhi.

8. Ramakrishnan.S., Swamy, R (1995) Text book of Clinical (Medical) Biochemistry & Immunology, TR.Publications, Madras.

OPTIONAL SUBJECT

PAPER III- INSECT BIOLOGY AND PEST MANAGEMENT

UNIT-I

Classification of insects upto order .Basis of classification of important pests upto order level (any five) insects –factors regulating parthenogenesis and polymorphism with special reference to homoptera: isoptera and Hymenoptera. Reasons for insects being pests- type of damage caused by pest- Pest surveillance, forecasting and monitoring.Biotic and abiotic factors influencing pest population dynamics. Types and estimation of crop losses.

UNIT-II

Abundance & distribution of insect with special reference to diapause. Interspecific and intraspecific interaction with special reference to insect migration & pest out break. Insect life table and its application method of assessing insect pest / populations – plant resistance.Sampling technique-Nets, sticky trap, pit fall and pheromone trap

UNIT-III

Chemical control of insect Pest : I nsecticides- Classification, mode of action- Mechanism of insecticide resistance - Genetic, physiological and biochemical- Insecticide formulation - recent trends in pesticide application technology.

Insect and modern chemicals-Growth regulatory compounds, Microbial insecticides-Pheromones and pest control. Botanical insecticides –plants with insecticidal properties-Pyrethrum, Rotenones, Nicotine, Alkaloids. Plants with insect hormone analogues (Azadirachtin)

UNIT-IV

Hormonal control of insects- Brain, juvenile and moulting hormones. Insect growth regulators- Role in insect control and modes of action.

Non-chemical control and insect pest : Dynamics of prey-predator interaction and host-parasite/parasitoid interaction, genetic and chemical (Semiochemicals, and allelochemical) basis of insect pest control- Juvenodids and Ecdysoids in insect pest management.

UNIT-V

Integrated Pest Management (IPM): Principles , objectives, strategies and ecological basis to pesticides application .Agri ecosystems, Economic injury levels, Integration of tactics and implementation strategies. System analysis .Recent trends in IPM.

REFERENCES

1. William S. Romoser and John G. Stoffolano. Wm. C. (1994). The Science of Entomology .Brown Publishers, England.
2. P. G. Fenemore, Allaprakash, (1992). Applied Entomology: Wiley Eastern Ltd., Delhi..
3. Nayar, K. K, Ananthakrishnan, T. N and B. V. David. (1989). General and Applied Entomology. Tata McGraw Hill Publ., New Delhi.

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Paper-III- OPTIONAL SUBJECT
ECOTOXICOLOGY

Unit I

General Principles of Toxicology: Definition – Scope of Toxicology – Different areas of Toxicology- Classification of Toxic Agents- Introduction- Absorption – Distribution – Excretion of xenobiotic translocation –Route and Site of Exposure- Duration and Frequency of Exposure – Dose Response relationship.

Unit II:

Xenobiotic reactions-Factors affecting toxicity of xenobiotic chemicals –--Bio-transformation of toxicants- Bioaccumulation, Bioactivation, Biomagnification, Bioconcentration of xenobiotics .

Unit III

Toxicity Tests- Types of toxicity tests- Acute toxicity test- Median lethal dose-Median lethal concentration- Graphical interpolation- Sub acute toxicity tests- Chronic toxicity tests Criteria for safety evaluation - upper and lower confidence limits - Cumulative toxicity- Calculation of safe levels. Mutagens and mutagenicity testing.

Unit IV

Toxicological testing mehods – Target organs: Behavioral, functional, pathological and histological, teratogenic, reproductive and carcinogenic tests.

Unit V

Toxic Substances , Risk Assessment and antidotes:– Toxicity of Pesticides – Metals – Types and Common Effects – Mechanism of action of toxicants – Food additives - Testing of Food additives - Endocrine Disruption - Assessment of Safety and Risk- Antidotal procedures-Principles of antidotal treatment.

Reference book

1. Frant C.L.V. 1991. Basic Toxicology II (Eds.), Hemisphere publishing corporation, Washington, London.
2. Casarett and Doulls's 1980. Toxicology: The Basic Science of Poisons.. II (Eds.) Macmillan publishing co., Inc, New York.
3. Butler, G.C. 1987. Principles of Ecotoxicology. John Wiley and Sons, Chichester.
4. Fumi Matsumura, 1980. Toxicology of Insecticides. Plenum Press, New York .
5. Foster L. Mayer, Donald J. Versteeg, Michael, J. McKee and Barnett A. Ratlner, 1992, Biomarkers, physiological and non-specific biomarkers. Lewis publishers, London.
6. Sambasiva Rao K.R.S. 1999. Pesticide impact on fish metabolism. (Eds.) Discovery Publishing House, New Delhi.
7. Thomas J. Haley and William O. Berndt, 1987. Handbook of toxicology. Hemisphere Publishing Corporation, Washington.
8. Bio-pesticides in Insect Pest Management 1999. S. Ignacimuthu and Alok Sen, Phoenix Publishing House Pvt., Ltd., New Delhi.
9. Water Toxicology V.V. Metelev, Kanaev, N.G. Dzasokhova-Amerind Publishing Co., Pvt., Ltd., New Delhi.
10. Woodward, F. I. and Shely, J. E. 1983. Principles and measurements in Environmental Biology Butler Worths - London.

Paper III- OPTIONAL SUBJECT
AQUACULTURE AND FISHERIES

Unit-I

History and scope of aquaculture. Different systems of aquaculture – traditional, extensive, intensive, semi-intensive. Farming methods – ponds, monoculture, polyculture, sewage fed farming, organic aquaculture.

Unit-II

Criteria for candidate species selection, criteria for site selection for various culture practices. Design and construction of aquafarms, soil and water quality management, liming, manuring and fertilization. Aquaculture practices for freshwater fish (carps, catfishes, freshwater prawn, brackishwater and marine shrimp and fish (seabass, cobia), lobster.

Unit-III

Broodstock management and seed production technology – Endocrine control of reproduction, induced breeding, lay-out and design of hatcheries, larval rearing, quarantine and hatchery protocols. Live feeds and their culture – algae, rotifers, *Artemia*, copepods. Larval transportation, packing and transportation

Unit-IV

Pre stocking and post stocking management – Feed - Formulation, dry feeds and feeding methods-

Health and disease management- bacterial, fungal and viral diseases-Cause and control measures, probiotics.

Unit-V

Common ornamental fishes of India. Construction and maintenance of aquarium. Food and feeding of ornamental fishes. Live bearers – sword tail, molly, platy, guppy. Egg layers –gold fish, cichlids, gouramis, catfish. Diseases of ornamental fishes and their control.

References:

1.Baluyut.E.A (1989). Aquaculture systems and practices. A selected review Publishing House, NewDelhi.

2.Jhingaran.C.G (1981). Fish and Fisheries of India, Hindustan Publishing Co, India.

3.PaulRaj.S(Ed) (1995). Shrimp farming Techniques problems and solutions. Palani Paramount Publications, Palani.

4.Pillay,T.V.R.(1990) Aquaculture: Principles and Practices, Blackwell Scientific Publications Ltd.

5.Santhanam.R (1990). Fisheries Science, Daya Publishing House, NewDelhi.

6.Yadav.B.N.(1997). Fish and Fisheries. Daya Publishing House, NewDelhi.

7.Kanthaiyapparaju.M. (2006). Simple guide to aquarium fish keeping. Kasthuri Publishers. pp.122.

8.Dick Mills. (2004). Essential tips aquarium fish. Dorling Kindersley Ltd, Penguin Group (UK). pp.72.

Paper–III OPTIONAL SUBJECT

CRUSTACEAN ENDOCRINOLOGY AND REPRODUCTION

UNIT-I: GENERAL BIOLOGY OF CRUSTACEA

General characters of the phylum Arthropoda – Class Crustacea: General characters; Classification; Types – Various body systems – Osmoregulation – Feeding mechanisms – Diversity and conservation of crustacea.

UNIT-II: NEURO-ENDOCRINE SYSTEM OF CRUSTACEA

Neuro-secrtory system of crustacean brain – Sinus gland X-organ complex – Y-organ – Hormonal regulation in molting, growth and reproduction – Hormonal manipulation of crustacean reproduction – Mechanism of vitellogenin synthesis – Fertilization – Various types of parental care of eggs - Stages of embryonic development – Metamorphosis – Different larval forms.

UNIT-III: AQUACULTURE OF CRUSTACEA

Prawn culture – Crab culture (fattening) – Lobster culture – Site selection and preparation of culture ponds – Physicochemical factors – Hatchery production of seeds – Food: Live feed; Artificial feed; Balanced diet (iso-nitrous and iso-caloric) – Predators and Parasites in aquaculture
- Economics of Aquaculture.

UNIT-IV: TOXICOLOGY and PATHOLOGY OF CRUSTACEA

Xenobiotic substances and their toxic effects on crustaceans - Toxicity tests – Causes for different diseases - Disease causing pathogens and their preventive measures in aquaculture of crustacea – Cellular stress and Immune responses – Defense and Detoxification systems – Wound healing - Apoptosis - Probiotics in health and growth of crustaceans.

UNIT-V: GENETIC ENGINEERING and BIOTECHNOLOGY OF CRUSTACEA

Molecular cytogenetics of crustacea – Nanostructures and materials in crustacea - Isolation and Purification of DNA and RNA - Isolation and Purification of Enzymes and Hormones – Recombinant DNA technology – Blotting techniques – PCR techniques – Gel documentation – Proteomics, Genomics and Bioinformatics of crustacea.

Reference Books

1. Mc Vey, J (Ed.), Crustacean Aquaculture, , CRC Press.
2. Fulks, W & Main, K.L (Eds.),Disease of Cultured Penaeid Shrimp in Asia and The United States, Argent Laboratories Press.
3. Wyban, J.A. & Sweeney, J.N. (Eds.), Intensive Shrimp Production Technology, Argent Laboratories Press.
4. Albert GJ Tacon (Ed.), Standard Method for the Nutrition and Feeding of Farmed Fish and Shrimp, Argent Laboratories Press.
5. Ennion, S.J. & Goldspink, (Eds.),Gene Expression and Manipulation in Aquatic Organisma, Cambridge University Press.
6. Rudolfs K Zalups & James Koropatnick (Eds.), Molecular Biology and Toxicology of Metals,Taylor and Francis

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