MANONMANIAM SUNDARANAR UNIVERSITY,
TIRUNELVELI-12

SYLLABUS

UG - COURSES – AFFILIATED COLLEGES

Course Structure for B. Sc. Zoology
(Choice Based Credit System)
(with effect from the academic year 2023-2024 onwards)

Semester-VI				
Part	**Subject Status**	**Subject Title**	**Subject Code**	**Credit**
III	CORE	DEVELOPMENTAL BIOLOGY	EMZO61	4
III	CORE	MICROBIOLOGY AND IMMUNOLOGY	EMZO62	4
III	CORE	LAB ON DEVELOPMENTAL BIOLOGY & MICROBIOLOGY AND IMMUNOLOGY	EMZOP6	3
III	ELECTIVE	ANIMAL BIOTECHNOLOGY AND BIOINFORMATICS	EEZO61	3
III	ELECTIVE	APPLIED ZOOLOGY / APICULTURE / AQUACULTURE	EEZO6A/ EEZO6B/ EEZO6C	3
III	ELECTIVE	LAB ON ANIMAL BIOTECHNOLOGY AND BIOINFORMATICS & ELECTIVE - VIII	EEZOP6	2
IV	NAAN MUDHALVAN	(AQUARIUM KEEPING*) * SUBSTITUTE PAPER EXCLUSIVELY FOR REAPPEARANCE ONLY.		2
V	EXTENSION ACTIVITY	(NSS / NCC / YRC / RRC / SPORTS/ Youth Welfare activities)	E5EA61	1

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

A. **Scheme for internal Assessment**:
Maximum marks for written test: **20 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.

The break up for internal assessment shall be:
Written test- 20 marks; Assignment -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	Marks	Letter Grade	Grade point (GP)	Performance
1	90-100	O	10	Outstanding
2	80-89	A+	9	Excellent
3	70-79	A	8	Very Good
4	60-69	B+	7	Good
5	50-59	B	6	Above Average
6	40-49	C	5	Pass
7	0-39	RA	-	Reappear
8	0	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

DEVELOPMENTAL BIOLOGY

Course Objectives

- To create an awareness to the students about the theories, concepts and basics of Developmental Biology.
- To provide students about the idea of sex cells, fertilization, cleavage, differentiation and development of organs.
- To make an awareness of the induction, organizers and development of extra embryonic structures.
- To provide adequate explanation to students about the late embryonic developments and post embryonic development and ageing.
- To give an idea about teratogenesis, invitro fertilization, stem cells and amniocentesis to the students

UNIT I

Gametogenesis & Fertilization Basic concepts of developmental biology. Structure& types of Spermatozoa, Mammalian egg - Egg membranes. types of egg - Spermatogenesis – Oogenesis. Fertilization – mechanism, theories and significance – Parthenogenesis.

UNIT II

Blastulation & Gastrulation Cleavage - Planes and Patterns, Factors controlling cleavage - Fate map and its construction. Blastulation (frog) – types of blastula. Morphogenetic movements - Gastrulation of frog & chick.

UNIT III

Organogenesis Development of Brain, Eye and Heart in frog. Development of Nervous system in chick. Development of Pro, Meso, and Metanephric kidneys. Foetal membranes in Chick. Placentation in Mammals.

UNIT IV

Applied Embryology Organizer concept –Structure – mechanism of induction and competence. Nuclear transplantation - teratogenesis – Regeneration: types - events and factors. Embryonic stem cells & significance. Methods to culture embryo

UNIT V

Human embryology Reproductive organs, Menstrual cycle and menopause - Pregnancy – trimesters – development. Erythroblastosis foetalis -Twins – types. Infertility – causes - Test tube baby and Assisted Reproductive Technology – Embryo transfer – Amniocentesis.

Text Books (Latest Editions)

1. Lewis Wolpert (2007), Principles of development, 3rd edition, Oxford University Press, New Delhi, India
2. Subramoniam, T. (2003), Developmental Biology, Narosa Publishing House, New Delhi, India.

3. Verma, P.S., Agarwal, V. K. (2010), Chordate Embryology: Developmental Biology, S. Chand & Company, New Delhi., India.

Reference Books (Latest editions, and the style as given below must be strictly adhered to)

1. Gilbert S.F. (2010), Developmental Biology, Sinauer Associates, Massachusetts, USA.
2. Balinsky, B.I. (1970), Introduction to Embryology, Philadelphia & London, UK.
3. Berril, N.J. (1971), Developmental Biology, McGraw Hill, New York, USA.
4. Russ Hodge (2010), Developmental Biology, Facts on File, Inc., New York, USA.
5. Carlson, Bruce, M. (2009), Human Embryology and Developmental Biology, Elsevier, Philadelphia, USA

Web Resources

1. https://www.ncbi.nlm.nih.gov/books/NBK10052/
2. https://www.cdc.gov/ncbddd/developmentaldisabilities/facts.html
3. https://anatomypubs.onlinelibrary.wiley.com/doi/full/10.1002/dvdy.20468
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293490/

MICROBIOLOGY AND IMMUNOLOGY

Course Objectives

- To become familiar with the foundation concepts of history of Microbiology.
- To gain the knowledge of bacterial and viral diseases.
- To gain knowledge of microbes in food and environment.
- To understand about different types of immunity and immune response.
- To appreciate about immunoglobulins and immunological techniques.

UNIT I

History and Scope of Microbiology – Whittaker's classification of microorganisms – Ultra structure – Salient features and classification of microbes (Bacteria, Virus, Actinomycetes and Fungi). Bacterial growth and nutritional requirements – culture techniques and types of culture media – media preparation. Staining of Bacteria.

UNIT II

Medical microbiology- study of common bacterial and viral diseases in man: Causative organisms, mode of transmission, pathogenicity, symptoms and preventive measures-Bacterial diseases - Typhoid, Tuberculosis, Leprosy, Syphilis. Viral diseases- Influenza, Poxviruses (Chicken pox) Hepatitis- B, AIDS, Corona (Covid-19), Rabies, Dengue.

UNIT III

Food microbiology - Microbial food spoilage, food poisoning, physico-chemical methods in food preservation. Dairy microbiology- Pasteurization, fermented milk products (Curd and Cheese). Industrial microbiology- Basic design of fermentor,

industrial fermentation of ethanol, penicillin and enzymes. - Biology of Nitrogen fixation and nitrogen fixers.

UNIT IV

Scope of Immunology - Types of Immunity- innate and acquired- Organs involved in immunity – structure and functions- Cells involved in immune response - Immune response- Humoral and Cell-mediated immune response- Mechanism- Primary and secondary immune response.

UNIT V

Immunoglobulins - Structure, types, distribution and biological functions- Antigen-antibody reactions – agglutination- precipitation and immunodiffusion. Hypersensitivity -Types with examples- Autoimmune Diseases - Concept and types- Organ transplantation- types of graft, mechanism of allograft rejection- MHC-Classes- Vaccines- types, vaccination schedule-

Text Books (Latest Editions)

1. Aneja K.R., (2022), Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultivation, New Age International, New Delhi.
2. Aneja K.R., (2022), Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultivation, New Age International, New Delhi.
3. Atlas R.M., (1988), Microbiology – fundamentals and applications, Macmillan Publishing Company, New York.
4. Ravindra Nath, (1990), Fundamentals of Biology Courses for Biotechnology, - Vol.1, Special Bangalore University edition, Kalayani Publishers.
5. Greenwood D, Richard CD, John S and Peuther F (1992), Medical Microbiology, 16th edition. ELBS, Churchill living stone.
6. Kuby, J, Punt, J, Stranford, S, Jones,Pand Owen, J, (2018), Immunology, 8th Edition, W.H.Freeman Publishing, New York.
7. Roitt, M, Peter J. Delves, Seamus J. Martin And Dennis R. Burton, (2017), Essential Immunology, 13th Edition, Wiley-Blackwell Publishing, USA.

Reference Books (Latest editions, and the style as given below must be strictly adhered to)

1. Alexopoulos C.J. and Mims C.W., (1996), Introductory Mycology, New Age International, New Delhi.
2. Thomas M. Bell, (1965), An Introduction to General Virology, William Heinemann Medical books, London.
3. Stanier R.Y., Ingraham J.L., (1999), General Microbiology, Prentice Hall of India Private Limited, New Delhi.
4. Salle A.J., (2007), Fundamental Principles of Bacteriology, Tata McGraw – Hill Publishing Company Limited, New Delhi.
5. Pelczar .J. Chan E.C.S. and Krieg N.R., (1986), Microbiology, McGraw Hill Book Company, New York.
6. Benson Harold J, (2002), Microbiological Applications, WCB McGraw – Hill, New York.
7. Brock T.D. and Madigan M.T., (2010), Biology of Microorganisms, Prentice

Hall of India Private Limited.
8. Collins CH, Patricia M, and Lyne JM (1995). Collins and Lynes Microbiological Methods, 7th edition. Grange, Butter Worth, Oxford.
9. Cappucino JG and Sherman N (1996). Microbiology, A Laboratory Manual, 4th edition. Benjamin Cumings Inc. California.
10. Pelczar MJ, Chan ECS and Krieg NR (1993). Microbiology, 5th edition, Tata McGraw Hill.
11. Madigan MT, Martinko JM and Parker J (2012). Brock Biology of Microorganism, 11th edition Prentice Hall International Inc. London.
12. Abul A. Andrew, Lichtman. H, Shiv. P, (2014). Cellular And Molecular Immunology, 8th Edition, Published By W.B. Saunders.
13. Chapel. H, Haeney. M, Misbah. S, And Snowden. N, (2006), Essentials of Clinical Immunology, 5th Edition. Blackwell Publishing.

Web Resources

1. https://vlab.amrita.edu/?sub=3&brch=73
2. https://learn.chm.msu.edu/vibl/
3. https://mvi-au.vlabs.ac.in/
4. https://virtuallab.tlc.ontariotechu.ca/intro.php
5. https://biochem.oregonstate.edu
6. https://www.merlot.org/merlot/viewMaterial.htm?id=79694
7. https://WWW.AAAAI.ORG/
8. https://WWW.BSACI.ORG/

LAB ON DEVELOPMENTAL BIOLOGY & MICROBIOLOGY AND IMMUNOLOGY

Learning Objectives

- To know the systematic handling procedures and protocols.
- To give importance to the microscopic examination of gametes and microbes.
- To gain knowledge on the basic concepts and principles of techniques.
- To familiarize the blood group identification and immunization.
- To record the spotters and analyse experiments.

UNIT I
DEVELOPMENTAL BIOLOGY

1. Mounting and Observation of live sperms of a vertebrate
2. Mounting and Observation of egg of a vertebrate
3. Temporary mounting and Observation of chick embryo development: 24, 48, 72 & 96 hours.

UNIT II
MICROBIOLOGY

1. Sterilization techniques – Preparation of Media
2. Isolation of bacteria by pure culture- streak plate- pour plate method.
3. Preparation of culture serial dilution technique.

4. Isolation of bacteria from various sources – soil / water / air.
5. Simple staining of bacteria.
6. Gram's staining of bacteria.
7. Microscopic examination of living bacteria - Hanging drop method.
8. Visit to a Microbiology lab and write a report.

UNIT III
IMMUNOLOGY

1. Identification of ABO blood grouping and Rh blood grouping among the students.
2. Lymphoid organs in Rat (Demonstration only)

UNIT IV

Spotters: Blastula of frog, Gastrula of frog, Chick embryo 24, 48, 72 & 96 hours, Discoidal, Cotyledonary, Zonary and Diffuse placenta, Autoclave, Hot air oven, Agar plate, Agar stab, Agar slant, Inoculation needle. T- Cell, B- Cell, Thymus, Bone marrow, Spleen, Lymph node (T.S / entire organ), Immunoglobulins - Ig G & Ig M.

UNIT V

Record / Observation Note (SUBMISSION IS MANDATORY)

Text Books (Latest Editions)

1. Balnisky B.I. (2012), An Introduction to Embryology, W.B. Saunders and Co.
2. Berril NJ, Kars G (1986). Developmental Biology, McGrawHills.
3. Gilbert SF (2010), Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
4. Dubey RC & Maheshwari DK, (2015), A Textbook of Microbiology, S. Chand Publishers, New Delhi.
5. Pelczar MJ, Chan EC, Pelczar MF. (2001), Elements of microbiology. McGraw-Hill International Book Company.
6. Delves PJ, Martin SJ, Burton DR, Roitt IM. (2017), Essential immunology. John Wiley & Sons.

Reference Books (Latest editions, and the style as given below must be strictly adhered to)

1. Majumdar NN. (2015), Vertebrate embryology, Tata McGraw-Hill, New Delhi.
2. Verma PS & Agarwal VK (2018), Chordate Embryology, S. Chand Publishers, New Delhi
3. Willey JM, Sherwood L, Woolverton CJ. (2001), Prescott's microbiology. Singapore: McGraw-Hill.

ANIMAL BIOTECHNOLOGY AND BIOINFORMATICS

Course Objectives

- To impart the skills required to explain the protocols for genetically manipulating cells and produce transgenic animals.
- To encourage the use of the apt molecular techniques to evaluate and analyze animal traits and diseases at the genomic level and employ methods for easy taxonomical identification and classification for biodiversity and environmental studies.
- To study methods of transgenesis and to consider their use in improving animal husbandry and animal health.
- To motivate students to review the ethics and speculate on the environmental implications of animal biotechnological methods.
- To help students to gain knowledge about databases and applications of bioinformatics.

UNIT I

Fundamentals of Biotechnology: Definition, Scope and Importance of Biotechnology. Enzymes- Restriction enzymes – Enzymes useful for genetic engineering. Vectors: Plasmids- types, characteristic features, Plasmid vector: (pBR322, Ti Plasmid), Bacteriophage vector: (Lambda phage and M13), Cosmid, YAC; Animal vector: (SV40), Transposons as vectors. DNA Library.

UNIT II

Techniques in Animal Biotechnology: Gene cloning: steps in cloning, selection of clones. Introduction of recombinant DNA into host cells: prokaryotic and Eukaryotic animal cells (Transformation, Transfection, Transduction, Microinjection, Electroporation, Liposome fusion). Screening and selection of recombinants (Direct selection, Insertional inactivation, blue-white selection, Colony hybridization). Blotting techniques: Methods of different types of blotting (Southern, Northern and Western); DNA sequencing: Sanger method, PCR: principle, types and application. Gel electrophoresis.

UNIT III

Transgenic Animal Technology: Transgenesis: Concept, transgenes, transgenic animal models - knock out mice, sheep- Dolly, Applications of transgenesis - animals as bioreactors. Superbug & bioremediation, Bioweapons. Medical biotechnology: Hybridoma technology -Monoclonal antibodies. Gene therapy: Ex vivo and in vivo, role in cancer treatment; CRISPR gene editing. Molecular markers: RFLP, RAPD, DNA fingerprinting and application.

UNIT IV

Applications and Ethics: Animal cell culture - Basic requirements and techniques of cell culture, natural and synthetic culture media, primary culture and cell lines; Stem cells: types, culture and applications. Organ culture: Artificial Skin. Industrial

biotechnology: Basic concepts of fermentation, production of ethanol. Human genome project: Mapping of human genome, applications. Ethics: Socio-ethical problem, ethical implications. IPR.

UNIT V

Bioinformatics: Definition of Bioinformatics, Databases: Nucleotide sequence database: GenBank, EMBL, and DDBJ. - Protein sequence database: SWISS-PROT, UniProt, - Structural database: PDB. Sequence Alignment: Pairwise sequence alignment – Multiple sequence Alignment. Database similarity search tools: BLAST, FASTA. Protein structure visualizing tools: Rasmol, SPDB viewer, Scope and Applications of bioinformatics.

Text Books (Latest Editions)

1. Singh B. D., (2015), Biotechnology: Expanding horizon, Kalyani publishers.
2. Sasidhara, R., (2015), Animal biotechnology, MJP publishers.
3. Dubey R. C., (2014), A text Book of Biotechnology, S. Chand & Co Ltd, Ram Nagar, New Delhi.
4. Ruby, R.C., (2012), A text book of biotechnology, S. Chand Company, New Delhi.
5. Namita Mendirratta and P Rastogi, (2022), Bioinformatics: Methods and Applications: genomics, proteomics and drug discovery, PHI Learning.
6. Anna Tramontano, (2006), Introduction to Bioinformatics, Chapman & Hall/CRC.

Reference Books (Latest editions, and the style as given below must be strictly adhered to)

1. Dubey S. K., Bandana Ghosh, (2012), Fish biotechnology, Wisdom Press.
2. Dubey R.C., (2014), Advanced Biotechnology, S. Chand Publication.
3. Ramdoss P., (2009), Animal Biotechnology- Recent concepts and developments, MJP publishers.
4. Sathyanarayran U., (2008), Biotechnology, Books and Allied, Kolkata.
5. Ignacimuthu, S., (2008), Basic Biotechnology, Tata McGraw hill, New Delhi.
6. Rastogi S. C., (2007), Biotechnology: Principles and applications, Alpha Science publishers.
7. Ranga, M.M., (2003), Animal biotechnology, Agrobios, New Delhi.
8. Sambamurthy K., Ashutosh Kar., (2009), Pharmaceutical Biotechnology, New Age International (P) Ltd.
9. Godbey W.T., (2014), An Introduction to Biotechnology, Academic press, New York, USA.
10. Peters, P., (2009), Biotechnology – A guide to genetic engineering, WMC brown publisher, UK.
11. Ramawat, K.G and Shailey Goyal, (2009), Comprehensive biotechnology, S.Chand company, New Delhi, India.
12. Primrose S.B., R. M. Twyman and R. W. Old, (2001), Principles of gene manipulation, Wiley- Blackwell, UK.
13. Primrose S. B., (2001), Molecular Biotechnology, Panima Publishing Corporation, New Delhi, India.

14. Hames B.D. and Higgins S.J. (1995). Gene Probes: A Practical Approach, Oxford University Press, UK.
15. Mount D. W., (2005), Bioinformatics Sequence and Genome Analysis, CBS.
16. Jin Xiong, (2007), Essential Bioinformatics, Cambridge University Press.
17. Hamid D. Ismail, (2022), Bioinformatics, Taylor & Francis Ltd.
18. Jonathan Pevsner, (2022), Bioinformatics and Functional Genomics, John Wiley.

Web Resources

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3612824/
2. https://www.isaaa.org/resources/publications/pocketk/40/default.asp
3. https://www.ncbi.nlm.nih.gov/books/NBK207574/
4. https://iopscience.iop.org/article/10.1088/1755-1315/492/1/012035/pdf
5. https://go.nature.com/3zAZmO9
6. https://www.biostars.org

ANIMAL BIOTECHNOLOGY AND BIOINFORMATICS - PRACTICALS

PRACTICALS

1. Isolation of genomic DNA –Demonstration.
2. Isolation of Plasmid –Demonstration
3. Protein separation by PAGE (Poly acrylamide gel electrophoresis)– Demonstration.
4. Quantitative estimation of DNA by spectrophotometry
5. DNA separation by AGE (Agarose gel electrophoresis)- Demonstration.
6. Demonstration of PCR techniques
7. Sequence retrieval from databases (NCBI)
8. Multiple sequence alignment of the sequence – (using the online tool Clustal Omega)

Spotters /Models / Charts / Photos/: PBR 322, Ti plasmid, Lambda Phage, Restriction enzyme, recombinant DNA, Electroporation, Microinjection, Southern blotting, RFLP, RAPD, Monoclonal antibody, Stem cells, Dolly, Laminar air flow, autoclave, Fermentor. Take printouts from NCBI, EMBL, PDB, BLAST and keep them for spot tests.

ELECTIVE: *APPLIED ZOOLOGY / APICULTURE / AQUACULTURE*

APPLIED ZOOLOGY

Course Objectives

- To Know the different types of pests affecting crops and pest control methods.
- To know the insects of commercial importance and their economically important products.
- To gain the knowledge about the waste disposal.
- To gain knowledge of the various types of poultry breeds and their management
- To attain knowledge on the livestock development in India and its future prospects

UNIT I

INSECT PESTS AND THEIR CONTROL Definition of Pest- Causes for insects attaining pest status- Damage and loss due to pests. A brief account on pests affecting agricultural crops. Rice (Rice stem borer, Rice gall midge, Rice hopper), Sugarcane (Sugar cane leaf hopper, root borer, shoot borer), Cotton (Pink and spotted bollworm), Coconut (Rhinoceros beetle), Vegetables (Red pumpkin beetle, Cabbage butterfly, Hadda beetle (tomatoes and potatoes), Brinjal shoot borer), . Insect pests of stored grains (Rice weevil, Khapra beetle (wheat), Pulse beetle). Insect pest control methods (Physical, mechanical, chemical and biological), IPM

UNIT II

BENEFICIAL INSECTS Sericulture- Mulberry and non-mulberry silkworms- common cultivable species- Biology of Bombyx mori- Types of silk. economic importance of silk Apiculture-Types of Honey bees for rearing- Bee hive products- Chemical composition, nutritional and medicinal value of honey. Lac Culture - Economic importance of lac insect

UNIT III

VERMICULTURE Vermiculture- Selection of species for vermiculture – Vermicomposting- Organic resources for vermiculture - Vermicomposting methods (Pit Method and Heap Method)- Harvesting of vermicompost - Factors affecting vermicomposting. Advantages of vermicompost.

UNIT IV

POULTRY MANAGEMENT

Breeds of chicken- Indigenous breeds and exotic breeds (American, Asiatic, English and Mediterranean breeds) - Construction of poultry house- Intensive method of poultry rearing (Deep litter system and Cage system)- Feeding equipment. Incubation of eggs (Natural and artificial). Diseases affecting poultry and their prevention methods.

UNIT V

DAIRY, SHEEP AND PIGGERY FARMING Livestock development in India and its future prospects. Cattle breeds- (Dairy, Draught and Dual purpose breeds). Exotic breeds of cows. Buffalo breeds in India. Indigenous and exotic breeds of sheep for wool and meat production. Piggery - economically important breeds and economic importance.

Text Books (Latest Editions)

1. B.Vasantharaj David and T. Kumaraswami (1982), Elements of Economic Entomology, Popular Book Depot, Chennai.
2. Nayar, K.K., Ananthakrishnan, T.N. and B.V. David,V (1992), General And Applied Entomology, Tata Mcgraw, New Delhi,
3. P.G. Fenemore, (2010), Manual. Silkworm Rearing. FAO Agricultural Service Bulletin, Rome.
4. Sukla, G.S. and Upadhyay, V.B., (2000), Economic Zoology – Rastogi

Publications, Meerut, India.
5. Jawaid Ahsan and Subhas Prasad Sinha, (2000), A Handbook On Economic Zoology- S. Chand & Co., Ltd., New Delhi.
6. Ashok Kumar and Prem Mohan Nigam, (1991), Economic and Applied Entomology, Emkay Publications, New Delhi.

Reference Books (Latest editions, and the style as given below must be strictly adhered to)

1. Shammi, Q.J. And Bhatnagar, S., (2002), Applied Fisheries, Agrobios (India), Jodhpur – India.
2. Major Hall, C.B. (2005), Ponds and Fish Culture - Agrobios (India), Jodhpur – India.
3. Keith Wilson, N.D.P., 2005 A Handbook of Poultry Practice –Agrobios (India), Jodhpur – India.
4. Banerjee, G.C. 1992 Poultry – Iii- Edition –Oxford & Ibh Publishing Co. Pvt. Ltd., New Delhi.

Web Resources

1. https://semo.libguides.com/zoology
2. https://libguides.mssu.edu ›c.php
3. https://www.classcentral.com
4. https://www.thebestwefind.com

APPLIED ZOOLOGY - PRACTICALS

1. Methods of collection of insects.
2. Preparation of permanent mounts of different body parts and their appendages of insects.
3. Dissection of silk glands, digestive and nervous system – silk worm.
4. Mounting of legs, mouth parts and sting of worker bees.
5. Mounting of body setae of earthworm
6. Identification of exotic breeds of cows
7. Determination of adulterations in milk like water, urea.
8. Report on a field visit to a Poultry farm / Diary farm / Piggery farm (Mandatory)

Spotters: Rice stem borer (Scirpophaga incestuous), Pest of Sugarcane: The shoot borer (Chilo infuscatellus), Pest of coconut: The rhinoceros beetle (Oryctes rhinoceros), Newtons bee hive, Bee comb, queen bee, worker bee, silkworm egg, larva, pupa and adult, vermicompost, vermiwash, vermicompost pit, Ranikhet disease, fowl pox, coryza – diagrams or models, Ear tags, Pig pens, Pig waterer

APICULTURE

Course Objectives

- familiarize the organization of bee colony
- know the systematic planning of apiary unit.
- get knowledge about the value of honey and harvesting techniques.
- understand the disease and enemies and behaviour of honey bees.
- provide rural based and welfare oriented knowledge.

UNIT I
INTRODUCTION

Definition, Scope, Classification of bees: Rock bee, Indian bee, Little bee and Dammer bee- their identification and habits, choice of species in Apiculture. Bee colony: Distinctive features, Identification and Functions of queen, drones and workers, Structure and functions of legs, mouth parts and sting of worker bee. Development of Honey bee: egg, larva and pupa- time taken for the development of queen, drone and worker. Food of the bee: bee bread, honey and pollen- royal jelly - propolis. Artificial feeding.

UNIT II
PRINCIPLES OF APICULTURE

Arranging an Apiary: position- space- direction. Acquiring bees: care of newly captured colonies- handling the bees. Bee keeping: Primitive methods – their advantages and disadvantages. Different types of Modern hives: Architecture – Parts of artificial hive and its advantages – other appliances used in apiary The bee comb and its architecture-Different kinds of cells-Burr comb.

UNIT III
HONEY BEE PRODUCTS

Honey: Collection and Extraction, Preservation and storage –Physical properties, Chemical composition, nutritive value, medicinal values- honey as daily food. Bee wax- Production - method of extraction- characteristics and uses. Bee venom- method of collection - composition of venom- its uses.

UNIT IV
ENEMIES AND DISEASES OF BEES

Enemies: Greater wax moth, lesser wax moth, ants, wasps, lice, beetles, birds and their management. Diseases of bees: adult and brood diseases- Bacterial, Fungal, Viral & Protozoan- Prevention and Control measures.

UNIT V
SWARMING AND OTHER BEHAVIOURS

Swarming- Prevention and control. Robbing and Fighting- Prevention and control. Uniting stocks- Different methods. Queen rearing. Supersedure. Foraging, interrelationships of plants and bees. Behaviour of bees- bee dances.

Text Books (Latest Editions)

1. Mishra,R.(2002), Perspectives in Indian Apiculture. Anmol Publisher.
2. Abrol, D.P., (2020), Beekeeping A Compressive guide to bees and beekeeping, Scientific Publishers.
3. Abrol,D.P. (2010), Bee and Bee Keeping in India. Kalyani Publishers, B-1/1292, Rajinder Nagar, Ludhiana-141 008.
4. Cherian, M.C. & Ramachandran, (1952), Bee Keeping in South India, Department of Agriculture, Madras
5. Philips, E.F.(2018), Bee Keeping, Agrobios (India) behind NasraniCinema,Chopasani Road,Jodhpur-342 002.
6. Sadar Singh, (1962), Bee Keeping in India, ICAR, New Delhi.
7. Dharm Singh and Singh D.P., (2006), Hand Book of bee Keeping, Agrobios. Webb,A. (2007), Bee Keeping for profit and Pleasure, Agrobios (India).

Web Resources

1. https://www.beesource.com/
2. https://www.betterbee.com/
3. https://www.honeyflow.com/pages/online-beekeeping-course

APICULTURE - PRACTICALS

1. Mountings of legs,
2. Mounting of mouthparts
3. The mounting sting of worker bees.
4. **Specimen, Model, Slide and Appliances:** Queen, Worker, Drone, Artificial hive (Newton hive), Queen excluder, smoker, honey extractor, honey, scraffing knife, Bee comb, Bee veil and Comb foundation sheet.
4. Report on a field visit to the Apiary farm/ unit. (Mandatory)

AQUACULTURE

Course Objectives

- familiarize the aquaculture potential and practices in India.
- To gain the knowledge about preparation of ponds.
- impart knowledge on fish culture techniques to augment food production from aquatic resources.
- impart knowledge on health management, feed formulation and fish preservation
- To gain knowledge about the preservation techniques.

UNIT I

INTRODUCTION

Definition, scope of aquaculture, cultural techniques, Aquaculture in India - Freshwater, Coastal and marine aquaculture - Culturable organisms - Fin fishes, Shell fishes and their qualities.

UNIT II
PREPARATION OF POND
Types of fish ponds. Nursery pond, rearing pond and culture pond. Fin fish culture - Culture of Indian major carp - Bundh breeding, Induced breeding, Transport of fish seeds. Shell fish culture Culture of marine prawn - Induced breeding - Types of prawn culture in India. Edible Oyster culture and Pearl Oyster culture.

UNIT III
TYPES OF CULTURE PRACTICES
Extensive, Semi-intensive and Intensive culture, Monoculture, Monosex culture, Polyculture, Cage culture, Pen culture. Integrated fish farming - Paddy cum fish culture. Animal husbandry cum fish culture, Sewage fed fish culture.

UNIT IV
FISH FEED AND DISEASES
Artificial feed: feed formulation, feed ingredients, pellets. Live feeds and their culture: Artemia, Diatoms, Rotifers, Micro Algae. Parasites and Diseases of aquaculture organisms: Ectoparasites and Endoparasites, Bacterial, Viral and Fungal diseases - Nutritional deficiency diseases.

UNIT V
GOVERNMENT BOARDS AND MARKETING
CMFRI, CIFRI, MPEDA, FFDA. Post-harvest technology in fishes - Rigor mortis, fish spoilage, fish preservation techniques - freezing, canning, drying. Fish marketing, Co-operative marketing in fisheries. Craft and gears. Water quality management.

Text Books (Latest Editions)
1. Jhingaran, V.G. (1997), Fish and Fisheries of India, Hindustan Publishing Corporation (India), Delhi.
2. Srivastava, C.B.L. (2006), A Text Book of Fishery Science and Indian Fisheries. Kitab Mahal Distributors, 28, Netaji Subash Marg, New Delhi – 110002
3. Beavan, R. (2021), Handbook of Freshwater Fisheries on India. Narendra Publishing House, 1417, Kishan Dutt street, Maliwara, Delhi - 110 006.
4. Biswas, K.P. (2007), Prevention and control of fish and prawn diseases, Narendra Publishing 2 House, 1417, Kishan Dutt street, Maliwara, Delhi - 110 006.

Reference Books (Latest editions, and the style as given below must be strictly adhered to)
1. Dash, M.C. & P.N. Patnik, (1994), Brackish Water Prawn Culture, Palani Paramount Publications,69-D., Anna Nager, Palani – 624602.
2. Dick Mills, (1992), Tropical Aquarium Fishes, Chancellor Press, Michelin House, 81, Fulham Road, London.
3. Khanna, S.S. and Kapoor N., (2019), An Introduction to Fish Biology and Fisheries, Surjeet Publications.
4. Latha Shenoy, (2001), Course Manual in Fishing Technology, Central Institute of Fisheries Education (ICAR), Versova, Bombay - 400061.

5. Mary Chandy, (2013), Fishes. National Book trust. A-5,Green Park, New Delhi-110016.
6. Pandian, T.J., (2015), Sustainable India Fisheries, National Academy of Agricultural Sciences. ICAR, Ministry of Agriculture, New Delhi.
7. Felix Betsy, (2019), Principles of Aquaculture: Practical Manual, Narendra Publishing House.
8. Lucas, J.S., Southgate, P.C., (2019), Aquaculture:Forming Aquatic Animals and Plants, Wiley-Blackwell.
9. Soderberg R., (2020), Aquaculture Technology, CRC Press.
10. Parihar, R.P. (1994), A Text Book of Fish Biology and Indian Fisheries. Central Publishing House, Allahabad.
11. Rath, R. K. (2011), Freshwater Aquaculture. Scientific Publishers. 5A.New Pali Road, Jodhpur, 342001
12. Bhosale M.M., and Mugale R.R. (2023), Basic Principles & Practices in Aquaculture, Narendra Publishing House.

AQUACULTURE - PRACTICALS

1. Determination of pH in two water samples.
2. Estimation of Salinity.
3. Estimation of dissolved oxygen.
4. Estimation of alkalinity in two samples
5. Mounting Placoid, Cycloid and Ctenoid scales.
6. Field visit to Aquaculture unit / Fish farm – Report (Mandatory)
7. **Spotters, Slides, models and Charts:** Catla, Rogu, Mirgal, Channa, Penaeus, Crossostrea, Raft culture, Pinctada, Argulus, Lernaea, Marine and freshwater prawn.

NAN MUDTHALVAN/ AQUARIUM KEEPING*

* Substitute paper exclusively for reappearance only Learning Objectives

Learning Objectives

- To create knowledge on self-employment opportunities based on ornamental fish culture.
- To provide knowledge of ornamental fishes and their equipment
- To understand the different breeding techniques of ornamental fishes

UNIT I

Introduction and scope - Aquarium fishkeeping as a hobby and cottage industry. Commercial aspects like national and international markets. To create knowledge on self-employment opportunities.

UNIT II

External morphology of a typical fish. Exotic and endemic varieties of ornamental fishes.

UNIT III

Aquarium preparation and maintenance - Kinds of tanks, tank setting, biological filter and aeration, water management, planting, lighting and feeds. Budget for setting up an Aquarium Fish Farm as a Cottage Industry

UNIT IV

Live fish transport- handling, feeding and forwarding techniques of fish. Fish Diseases and their control.

UNIT V Breeding – Common characters and sexual dimorphism of Fresh water and Marine aquarium ornamental fish varieties such as Guppies, Mollies, Sword tails, Platy, Siamese fighters and Gold fish, Butterfly fish, Blue morph and Anemone fish.

REFERENCE BOOKS:

1. Santhanam, P., Sukumaran, N. & P. Natarajan, (1987), A manual of freshwater aquaculture, Oxford & IBH Publishing Company Pvt., Ltd., New Delhi.
2. Cliff Harrison, (1980), A colour guide to Tropical Fish, Chartwell Books, INC, Cerkshire, printed in Hon Kong.
3. O'Connell, R. F., (1977), The freshwater aquarium, Arco Publishing Company, INC New York.
4. JingranV.G., (1991), Fish and Fisheries in India, Hindustan Publ.Co. New Delhi
5. Mill Dick, (1993), Aquarium Fish, Daya Pub.co., New Delhi