H.H THE RAJAH'S COLLEGE (Autonomous)
PUDUKKOTTAI- 622001

M.Sc. ZOOLOGY

S.NO	SEM	SUB CODE	PAPER	HOURS/ WEEK	CREDIT	EXAM HOURS	MARKS		
							INTERNAL	EXTERNAL	TOTAL
1	I		CC I INVERTEBRATES AND CHORDATES	7	5	3	25	75	100
2	I		CC II CELL AND MOLECULAR BIOLOGY	7	5	3	25	75	100
3	I		EC I BIOINSTUMENTATION / POULTRY FARMING	6	5	3	25	75	100
4	II		CC V ANIMAL PHYSIOLOGY	5	5	3	25	75	100
5	II		CC VI MICROBIOLOGY	5	5	3	25	75	100
6	II		EC II FISHERY BIOLOGY / RESEARCH METHODOLOGY	5	5	3	25	75	100
7	II		EDC ECONOMIC ZOOLOGY (ONLINE PAPER)	5	5	3	25	75	100
8	II		CC III PRACTICAL-I (COVERING CCI-CCII)	5+5	5	3	40	60	100
9	II		CC IV PRACTICAL-II (COVERING CC V- CC VI)	5+5	5	3	40	60	100
10	III		CC VII ENVIRONMENTAL BIOLOGY	7	5	3	25	75	100
11	III		CC VIII GENETICS	6	5	3	25	75	100
12	III		CC IX EVOLUTION & ANIMAL BEHAVIOUR	6	5	3	25	75	100
13	III		EC III API CULTURE & SERICULTURE / BIOPROCESS TECHNOLOGY	6	5	3	25	75	100
14	IV		CC XI DEVELOPMENTAL BIOLOGY	5	5	3	25	75	100
15	IV		CC XII IMMUNOLOGY & BIOTECHNOLOGY	5	5	3	25	75	100
16	IV		CC XIII AQUACULTURE	5	5	3	25	75	100
17	IV		CCXIV PROJECT WORK	10	5	3			100
18	IV		CC X PRACTICAL-III (COVERING CC V- CC VI)	5+5	5	3	40	60	100
				120	90				1800

I
SEMESTER

SEMESTER - I - CCI

HOURS/ WEEK – 7
CREDIT- 5

INVERTEBRATES AND CHORDATES

OBJECTIVES:

To understand the salient features of inveretebrates and vertebrates. To have comparative idea about the functions of various systems organs of invertebrates and vertebrates and their evolutionary significance.

UNIT – I: INVERTEBRATES

Symmetry in animal organization – Origin, types and significance of coelom – Evolution of Metamerism – Locomotion in Annelids and Molluscs– Feeding mechanism in Polychaetes, Molluscs and Echinoderms.

UNIT – II: RESPIRATORY AND NERVOUS SYSTEM

Comparative study of respiration in Arthropods and Molluscs. Excretary organs in invertebrates. Nervous system in Arthropods and Echinoderms. Reproduction in invertebrates.

UNIT – III: LARVAL ADAPTATIONS

Invertebrates, larval forms, adaptations and transformation Minor phyla classification Mesozoa, Rotifera, Phronida and Cheatognatha.

UNIT – III: BIOLOGY OF CHORDATES

Integumentary system: Structure – Derivatives (Glands, Hairs, Scales, Horns, Skin Pigments). Dentition in Mammals – Stomach in Mammals – Comparative study of digestive system in vertebrates and circulatory system of fishes and mammals.

UNIT –V: RESPIRATION IN FISHES

Pulmonary respiration in Tetrapods. Excretory system: Types and evolution of kidneys. Reproductive system: vertebrates. Appendicular skeleton – Pectoral and Pelvic girdles of mammals.

REFERENCE BOOKS:

1. Jan A.Pechenik (2014). Biology of Invertebrates. MC Grew Hill Education**.**

2. Ayyar, E.K., and Anandhakrishnan, T.N. (1992). A Manual of Zoology. Vol. II (Chordata).Viswanathan Publishers.

3. Barnes, R.D. (1982) – Invertebrate Zoology, IV Ed., Holt Saunders – International Edition.

4. Barrington, E.J.W. (1979) Invertebrate Structure and Function, II Ed., ELBS and Nelson.

5. Hymen, G.H., (1993). The Invertebrates, Vols. I to VII, McGraw Hill Book Co Inc., New York.

6. Kent, G.C. (1976). Comparative Anatomy of the Vertebrates, McGraw Hill Book Co Inc., New York.

7. Kotpal, R.L., (2002). Minor Phyla.Rastogi Publication, Meerut.

8. Vasantika Kashyap (1997). Life of Invertebrates, Vikas Publishing House Pvt. Ltd., New Delhi.

9. Waterman, A.J., (1971), Chordate Structure and Function.The Macmillan Company.

SEMESTER - I – CC- II

HOURS/ WEEK – 7
CREDIT- 5

CELL AND MOLECULAR BIOLOGY

OBJECTIVES:

This course facilitates to understand the structure at molecular level and function of prokaryote and eukaryote cell. To enlighten our students about the structures and functions of cellular organelles and nucleic acids.

UNIT – I: CELL ORGANELLES: PLASMAMEMBRANE AND NUCLEUS

Plasma membrane: Ultra structure – Modifications (Trilaminar Model, Lattice Model, Micellar Model and Fluid Mosaic Model) – Functions (Permeability, Osmosis, Passive transport, Active transport and Permease system, Endocytosis, Exocytosis and Phagocytosis). Nucleus: Ultra Structure and composition – Functions of nuclear pore complex - Nucleolus
Ultra structure and function.

UNIT – II: CELL ORGANELLES: MITOCHONDRIA, ENDOPLASMIC RETICULUM, GOLGI COMPLEX, LYSOSOME AND CENTROSOME

Mitochondria: Structure – Electron transport system, oxidative phosphorylation. Endoplasmic reticulum: Morphology – Function in protein secretion and transport to Golgi complex. Golgi complex: Morphology - Function in protein sorting and transport from Golgi apparatus. Lysosome and Centrosome – Morphology, Chemistry and functions.

UNIT – III: DNA

DNA Types, Watson and Crick's model of DNA - DNA replication (Messelson and Stahl's experiment) – Enzymes involved in DNA replication in prokaryotes and eukaryotes (Nucleases, polymerases, ligases). Enumeration of genetic code.

UNIT – IV: RNA

RNA Structure: Types of Non genetic RNA: r RNA, m RNA t RNA - Mechanism of transcription in prokaryotes and eukaryotes – post translational modifications- Mechanism of protein synthesis. Reverse transcrption, modification and processing of m RNA.

UNIT – V: VECTORS AND THERAPY

Vector system (cosmids, plasmids, YACS, BACS) - Methods of construction of recombinant vectors- types of viral vectors- application of viral vectors in gene therapy – Prospectus and problems

REFERENCE BOOKS:

1. De Robertes, E.D. P. and De Robertes, E.M.F. (1987). Cell and Molecular Biology, VIII Ed. Lea and Febiger, Philadelphia.

2. Cooper, J.M., Hausman, R.E. (2009). The Cell. Sinauer Associates, Inc., USA.

3. Bruce Alberts and Dennis Brey, (1994). Molecular Biology of the Cell. 3rd Edition. Garland Publishing, Inc. New York and London.

4. Becker and Deamer, (1991). The World of the Cell. 2nd Edition. The Benjamin and Cumming Publishing Company, Inc. California.

5. Alberts, B., Johnson, A., Luwis, J. Raff, M. Robertes, K., Walter, P. (2002). Molecular Biology of Cell. Garland Science (Taylor & Francis Group), New York.

6. Sambrook, J., Russell, D.W., (2001). Molecular cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.

SEMESTER –I- ECI

HOURS/ WEEK – 6
CREDIT- 5

BIO INSTRUMENTATION

OBJECTIVES:

To understand the principle, working and the applications of the instruments used in biological sciences, to acquire knowledege on the recent and advanced techniques used in the field of biological sciences.

UNIT- I - MICROSCOPY

Principle and applications of Light microscope, Phase contrast microscope, Fluorescence microscope, confocal microscope, Scanning and Transmission Electron microscope (SEM and TEM).

UNIT- II - CHROMATOGRAPHIC TECHNIQUES

Principle and applications of Chromatography, Paper Chromatography, Thin Layer Chromatography, High Performance Liquid Chromatography (HPLC), Gas Liquid Chromatography. GC-MS, LC-MS.

UNIT -III - ELECTROCHEMICAL TECHNIQUES

Principle and application of Spectrophotometry – UV visible spectrophotometer, Atomic Absorption Spectrophotometer, IR Spectroscopy, NMR Spectroscopy and Flow cytometry.

UNIT -IV- BLOTTING TECHNIQUES

Southern blotting, Western blotting, ELISA and DNA finger printing. Biosensors and Biochips – Principle and application. Hybridoma technology – Applications of Monoclonal Antibodies.

UNIT -V – ANALYTICAL INSTRUMENTS

Principle and uses of analytical instruments: balances, pH meter, radioactive counters (geiger muller counter) Eletrophoresis techniques (native, SDS-PAGE, AGE). Principle and working of different types of centrifuge.

REFERENCE BOOKS:

1. Daniel, M., (1992). Basic Biology, Wiley International, NewDelhi.

2. Das. A., (1996). Biophysics and Biological chemistry. Academic publishers, Calcutta.

3. P.K. Gupta (2010). Elements of Biotechnology (Rastogi publication), New Delhi.

4. P.S. Verma and V.K. Agarwal (2011).Cytology, S.Chand & Co, New Delhi.

SEMESTER - I - ECI

HOURS/ WEEK – 6
CREDIT- 5

POULTRY FARMING

OBJECTIVES:

The main aim is to give information about the poultry and its importance. It gives an idea for the self- employment opportunities to the students. The role of different research organizations and funding agencies to promote poultry farming.

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UNIT- I INTRODUCTION TO POULTRY SCIENCE

Origin and history of poultry species: Chicken, turkey, duck and quail – Important qualitative traits in poultry. Economic traits of egg-type chicken and their standardization – Economic traits of meat – type chicken and their standardization. Nomenclature of breeds of fowl, classification of fowls, selection of breeds. Housing and equipment – General principles in building poultry sheds, deep litter system, laying cages.

UNIT- II BROODING AND REARING

Natural and artificial brooding - Methods of brooding: brood temperature, space and duration; feed, water and space allowance – vaccination. Management of growers, layers, broilers – lighting of chicks, growers and layers. Summer and winter management, debeaking and culling. Poultry manure – volume, composition, value and disposal.

UNIT- III FEED ADDITIVES

Names, allowance and usage of feed additives – the impact on human health. Food stuffs for poultry in relation to protein, amino acids, minerals (Ca and P), vitamins and fibre content. Feed formulations for chicks, growers, phase I to phase III layers and broilers. Nutritive value of egg, factors affecting egg size, storage and preservation of egg, marketing, incubation and hatching of eggs. Annual egg production in India.

UNIT- IV DISEASE MANAGEMENT

Symptoms, prevention, control and treatment of viral (New castle disease, Fowl pox), bacterial (Salmonelloses, Fowl cholera), fungal (Aspergillosis, Aflatoxicosis and Candidiasis), protozoan and worm infection, ticks, mites and lice affecting fowl.

UNIT- V ECONOMICS OF POULTRY

Processing, Preservation, grading, storage and marketing of eggs and meat. Economics of Poultry production – problems in poultry production.

REFERENCE BOOKS:

1. Ahsan, J. and Sinha, S.P. (2003). A Hand book on Economic Zoology. S. Chand & Company Ltd., New Delhi.

2. Arumugam, N., Murugan, T., Johnson Rajeshwar, J. and Ram Prabhu, R. (2009). Applied Zoology. Saras Publication, Nagercoil.

3. Banerjee G.C. (1992) A textbook of animal husbandary, Oxford and IBM Publishing Co., New Delhi.

4. Crawford RD.(1990). Poultry Breeding and Genetics.

5. Elsevier. Hutt FB. (2003). Genetics of Fowl. Norton Greek Press.

6. Gupta, S.B., Indian Poultry Industry year book (1975) –C-34, New Bactak Road, New Delhi

7. Intensive Poultry Management for egg production. Bulletin NO. 152, London.

8. Shukula, G.S. and Upadhyay V.B. (1997) Economic Zoology, Rakesh Rastogi Meerut.

9. Singh RP and KumarJ. (1994). Biometrical Methods in Poultry Breeding. Kalyani.

10. Tomar, B.S. and Singh, N. (2007). A Text Book of Applied Zoology. Emkay Publications, Delhi.

11. Sunil Kumar Das (1994) – Poultry production, CBC Publishers and Distributors, Delhi.

12. Babu, M. and Lurthu Reetha, T. (2011). A Handbook on Poultry farming. Tamilnadu Veterinary and Animal Sciences University, Tiruchirappalli.

II
SEMESTER

HOURS/ WEEK – 5
CREDIT- 5

SEMESTER -II – CC-V

ANIMAL PHYSIOLOGY

OBJECTIVES:

Animal Physiology helps the students in understanding how the body functions adapts with respect to its external and internal environment, related to nervous integration, sensation, metabolism and reproduction.

UNIT- I- DIGESTION AND NUTRITION

Definition of digestion and types of digestion – extra and intracellular. Nutrition-Food requirements. Physiology of ingestion. Digestion in stomach. Digestive enzymes and their role in the digestion of carbohydrates, proteins and lipids. Absorption and assimilation of digested food materials. BMR and BMI.

UNIT – II – RESPIRATION AND CIRCULATION

Respiration- Structure of Mammalian lungs and gaseous exchange- Transport of oxygen– Formation of oxyhaemoglobin, affinity of haemoglobin - Transport of CO_2, Chloride shift, Bohr Effect. Circulation: Structure of mammalian heart and its working mechanism – Heart beat and cardiac cycle-Functions of blood.

UNIT- III – EXCREATION AND MUSCLES

Excretion – Organization of mammalian excretory system-structure and function of kidney and nephron – Mechanism of urine formation. Muscles –General structure and types of muscles. Sliding filament mechanism of muscle contraction.

UNIT – IV- NERVE AND RECEPTORS

Structure of nerve cell. Nature of nerve impulse – resting potential and action potential. Conduction of nerve impulse, Structure of synapse, mechanism of synaptic transmission – Electrical and Chemical transmissions -Receptors: types, Photoreceptor – structure of human eye. Phonoreceptors – structure of human ear- organ of corti- physiology of hearing.

UNIT- V – ENDOCRINE SYSTEM

Endocrine glands – Relationship between hypothalamus and pituitary gland. Hormones of hypothalamus, Hormones of Adenohypophysis and Neurohypophsis. Hormones of pineal gland, thyroid gland, parathyroid, thymus, adrenal and pancreas. Endocrine control of mammalian reproduction – Male and female hormones – Hormonal control of menstrual cycle in humans.

REFERENCE BOOKS:

1. Baldwin, E. (2004). An Introduction to Comparative Biochemistry, Cup, London.

2. Beck, W.S. (1991). Human Digestion, Harcourt Brace Joranorich Inc.

3. Dawson, H. (1994). General Physiology, Little Brown Co., Boston.

4. Echert, R. and Randall, D. (1987). Animal Physiology, Cbs Publishers and Distributors.

5. Giese, A.C. (2009). Cell Physiology and Biochemistry, Prentice Hall.

6. Prosser, C.L. Brown (1985). Comparative Animal Physiology, Satish Book Enterprise, Agra.

7. Turner, C.D. and Bagnara, J.T. (1976). General Endocrinology, 6th edn. Wb Saunders Co., Philadelphia.

8. Sambasivaiah, Kamalakara rao and Augustine Chellappa (1990). A Text book of Animal Physiology and Ecology, S. Chand & Co., Ltd., New Delhi – 110 055.

9. Parameswaran, Anandakrishnan and Ananda Subramananiam (1975). Outlines of Animal Physiology, S. Viswanathan [Printers & Publishers] Pvt. Ltd.

10. William S. Hoar (1976). General and Comparative Physiology, Prentice Hall of India Pvt. Ltd., New Delhi – 110 001.

11. Wilson, J.A. (1979) Principles of Animal Physiology. Mac millan publishing company.

12. Wood, D.W. (1983). Principles of Animal Physiology. 3rd Ed., 5. Hodder & Stoughton Education publishers.

SEMESTER -II – CC-VI

HOURS/ WEEK – 5
CREDIT- 5

MICROBIOLOGY

OBJECTIVES:

These papers instruct the students, history and Scope of microbiology, Microbial Technology, Microorganisms and Environment, food microbiology, microbial diseases and treatment.

UNIT – I-HISTORY, STRUCTURE AND ECONOMIC IMPORTANT OF MICROBES

History and Scope of microbiology- Classification of microbes- Whittaker's five kingdom concept - Carl Woese's three domains concept-Types of culture – culture media- Isolation of pure culture Colony morphology and growth Concept of Sterilization. Structure of bacteria, virus and fungi- Economic importance of bacteria and fungi.

UNIT – II- MICROBIAL TECHNOLOGY

Genetic engineering of food and additives – Single Cell Protein (SCP) production – Production of organic acids (acetic acid), ethanol – Antibiotics – Microbial toxins – Fermentation products. Microbial Genetics**:** Recombination in Bacteria – Transformation – conjugation – Sex duction; Recombination in Bacteriophage – Transduction – Lytic and Lysogenic cycle.

UNIT – III- MICROORGANISMS AND ENVIRONMENT

Microorganism of different soils - interactions with the atmosphere. Microorganisms in Aquatic Habitats – Microbiological analysis - in fresh water and marine water. Microorganisms in sewage. Microorganism in extreme environments- thermophilic, methanogenic and halophilic. Photosynthetic bacteria, Cyanobacteria, Archaea of cold regions and space.

UNIT- IV- FOOD AND INDUSTRIAL MICROBIOLOGY

Food Microbiology: Microbes of milk and food, – Food preservation: pasteurisation and other methods- Spoilage of food, fruits, vegetables, cereals, meat, egg, seafood and canned products. Factors influencing spoilage- Food borne infections, food poisoning and intoxications (*Clostridium, Salmonella,* and *Staphylo coccus*) - microtoxins in food with reference to

Aspergillus species. Industrial Microbiology: Production of organic acids (acetic acid, ethanol) – Antibiotics – Microbial toxins – Fermentation products.

UNIT – V - MICROBIAL DISEASES

General account of Pathogenic Bacteria – prognosis, diagnosis and treatment for diseases caused by viruses (Yellow fever, Dengue, HIV) - Bacteria (Pneumonia, Diphtheria, Tuberculosis, Typhoid) Fungi (Madura foot, Athlete's foot, Candidiasis) and Protozoa (Malaria, Amoebic dysentery, Trypanosomiasis).

REFERENCE BOOKS:

1. R.C. Dubey, D.U. Maheshwari (2005). A Text book of Microbiology. S.Chand and Company Ltd, New Delhi.

2. Burden, K.L. and R.P. Williams (6th Ed.) (1968). Microbiology. The Macmillan Co., London

3. Dawes, E.A. (Ed.) (1986). Energy conservation in bacterial photosynthesis. The Macmillan Co., London

4. Doelle, H.W. (Ed.) (1969). Fermentation by acetic acid bacteria and lactic acid bacteria. In: Bacterial metabolism. Academic Press. New York, London. 256 – 351 pp.

5. Gevaral .J, Tortora, Berdell R. Funne Christine L. Cara, (1994). Microbiology an Introduction-fifth edition, The Macmillan Co., London.

6. Hay, J.M. (Ed.) (1986). Modern Food Microbiology. CBS publishers, Delhi. 622 pp.

7. Kumarasamy, P, A. Maharajan and V. Ganapiriya. (2012). Microbiology.

8. Reed, G. (4th Ed.) (1983). Prescott & Dunn's Industrial Microbiology. AVI Publishing Co., Inc.

9. Roberts, T.A. and F.A. Skinner (Eds.) (1983). Food Microbiology: Advances and Prospects, Academic Press, Inc. London, 393 pp.

10. Selle, A.J. (Ed.) (1967). Fundamental Principles of Bacteriology. Tata McGraw – Hill Publishing Company Ltd., New Delhi, 822 pp.

SEMESTER - II – EC-II

HOURS/ WEEK – 5
CREDIT- 5

FISHERY BIOLOGY

OBJECTIVES:

The main aim is to give information about the fishery biology. It gives an idea for the self- employment opportunities to the students. The role of different research organizations and funding agencies to promote aquaculture and fishery biology

UNIT- I FISH MIGRATION

History of Ichthyology –. Fishes and their evolutionary history. Fish migration – Types of migratory fishes: Diadromous fishes - Anadromous, Catadramous and Amphidromous - Potomodromous and Oceanodromous fishes. Methods of migration - Factors influencing migration.

UNIT -II MARINE AND FRESH WATER FISHERIES

World and Indian fisheries, Marine fisheries – Sardines, Mackerals, Sciaenids, Silver bellies, Pomfrets, Carangids and Sharks. Inland fisheries – Freshwater, riverine, reservoir, pond and cold water fisheries. Estuarine and brackish water fisheries- Crustacean fisheries, molluscan fisheries and its economic importance. Deep sea fishing.

UNIT- III FISH POPULATION STUDIES

Assessment of fish stocks: marking and recapture method, area sampling method. Age and growth studies- length-frequency methods, scale method, otolith methods and other skeletal parts as age indicators. Length –weight relationship- condition factor.

UNIT- IV FISH CULTURE

Integrated fish farming – rice cum common carp culture, fish cum duck culture- sewage fed fish culture- monosex culture, polyculture, ornamental fish culture. Fish pathology: Parasites – Protozoan (Ichthyophthiriasis, boil disease) Fungal (water-mould disease, Branchiomycosis) Bacterial (Fin and Tail Rot, Eye disease).

UNIT -V FISH PROCESSING AND MARKETING

Factors influencing spoilage of fishes Methods of fish preservation: curing, (drying, salting, smoking, chilling) accelerated freeze drying (AFD). Principles of canning of fish and fishery products. Packageing and marketing: trends of domestic and export marketing of fishes.

REFERENCE BOOKS:

1. Bose, A.N., Yang, C.T., and Misra, A. (1991) Coastal Aquaculture Engineering. Oxford and Ibh Publishing Co., Pvt. Ltd., New Delhi.

2. Chakrabarti, N.M., (1994) Diseases of Cultivable Freshwater Fishes and Their Control. International Books and Periodicals Supply Service, New Delhi.

3. Day, F., (1986). The Fishes Of India, Vols. I & II.Today and Tomorrow's Book Agency, New Delhi.

4. Govindan, T.K. (1992) Fish Processing Technology, Oxford And Ibh Publishing Co., Pvt. Ltd., New Delhi.

5. MPEDA Hand Book of Aquafarming (1992). Freshwater Fishes, Marine Products Export Development Agency, Kochi.

6. New, M.B., Tacon. A.G.J. and Csavas. I. (1993). Farm – Made – Aqua Feeds. Food and Agrilculture Organization of UnitedNations, Rome.

7. Santhanam, R., (1990). Fisheries Science, Daya Publishing House, New Delhi.

8. Seghal, K.K. (1992). Recent Researches in Cold WaterFisheries, Today and tomorrow's Publishers and Printers, New Delhi.

9. Sinha, V.R.P. (1993) A Compendium of Aquaculture Technologies for Developing Countries. Center for Science and Technology and Oxford Publishing Co., Pvt., Ltd., New Delhi.

10. Pillai, T.V.R. (1993). Aquaculture: Principles and Practices. Fishing News Agency, London.

11. Raveendran. S., Muthukumaravel, K. Sathick O and Ramamurthy. V. (2011). Estuarine Biology. Aruma Publications, Koradacherry, Thiruvarur.

12. Biswas, S.P., (1993). Manual of Methods in Fish Biology, International Book Co. Absecon Highlands, New Jersey.

13. Jhingran, V.G., (1991). Fish and Fisheries of India.Hindustan Publishing Copr. New Delhi.

SEMESTER - II – EC-II

HOURS/ WEEK – 5
CREDIT- 5

RESEARCH METHODOLOGY

OBJECTIVES:

To know the principles of research design, thesis writing and reseacrh paper publishing. To learn the methods of data collection and the application of statistical tools in solving biological problems.

UNIT – I RESEARCH OBJECTIVES

Types – significance-Components of research- Research process-Selection and defining a research problem- Sources and retrieval of information**:** journals, monographs, books and computer aided searches-search engines- Formulating a research Hypothesis**-** Research Design**:** features of a good design – concept and principles of Experimental design. Research Paper: oral and poster presentation.

UNIT – II THESIS WRITING

Format of thesis- preparation of manuscript and editing- forms of presentation of results-components of Discussion- citing the references- Research papers for publication-writing a research proposal-Impact factor-citation index- manuscript preparation-IPR and patenting.

UNIT – III JOURNALS AND ONLINE BROWSING OF RESEARCH ARTICLES

Details of Popular Magazines and periodicals (monthly, quarterly and half-yearly journals and reviews). Online browsing of research articles: infonet, inflibnet and Pubmed. Peer-reviewed journals, indexed and non-indexed journals.

UNIT –IV PREPARATION OF SCIENTIFIC PAPER' FOR PUBLICATION IN A JOURNAL

Preparation and presentation of research paper for Symposia, Seminar and Conferences. Technical papers and Monographs. Internet and e-journals. Selection of animal models – Maintenance – CPCSEA regulations. Using computers in research – Computer aided techniques for data analysis, data interpretation and presentation.

UNIT – V BIOSTATISTICS

Collection of data – Collection of primary data, sampling. Descriptive statistics: Measures of central tendency-Mean, median, mode. Measures of dispersion – Standard deviation, standard error, co-efficient of variance. Diagrammatic representation- Bar diagram, Pie diagram, histogram, frequency curve and line graph. Inferential statistics: Hypothesis testing, Student t' test, Chi square test, Analysis of variance (ONE-WAY ANOVA), Correlation, Regression – Application of SPSS package.

REFERENCE BOOKS:

1. Pingoud, A. Biochemical Methods. Wiley-VCH, 2003.

2. Venn, R.F. Principles and Practice of Bioanalysis. Taylor & Francis, 2003.

3. Holme, D.J. and Peck, H. Analytical Biochemistry. 3rd Ed., Pearson Education, 1998.

4. Wilson, K. and Walker, J. Practical Biochemistry: Principles and Techniques. 5th Ed., Cambridge University Press, 2000.

5. Wilson, K. and Walker, J. Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press, 2010.

6. Holmes, D., Moody, P., Dine, D., Moody, P. andHolmes, D.S. Research Methods for the Biosciences. Oxford University Press, New Delhi, 2006.

7. Ramadass, P. and Wilson Aruni, A. Research and Writing-across the Disciplines. MJP Publishers, Chennai, 2009.

8. McCleery, R.H. and WATT, T.A. Introduction to Statistics for Biology. 3rd Ed., Chapman & Hall / CRC, 2007.

9. Kothari, C.R. Research Methodology: Methods and Techniques. 2nd Ed., New Age International Publishers, New Delhi, 2004.

SEMESTER - II - EDC

HOURS/ WEEK – 5
CREDIT- 5

ECONOMIC ZOOLOGY
(Online paper)

OBJECTIVES

To have through exposure to various farming practises that could help the students to establish their own self employment and become entrepreneurs in future.

UNIT I LAC CULTURE

Introduction, Taxonomy of lac insect, important of lac cultivation, lac insect- life cycle. Important lac - host plants and distribution general practise for lac cultivation-composition and properties of lac, lac products and their uses.

UNIT II DUCK FARMING

Introduction- Reasons in favour of duck culture – Advantages of duck rearing over poultry chickens- Breeds of duck- Egg production in ducks- source of duckling's availabity.

UNIT III PEARL CULTURE

Natural and artificial culture pearls- pearl producing methods- marine pearls. Freshwater pearls – Pearl composition property and formation, Natural pearl and cultural pearls – Harvest of pearls – uses of pearls.

UNIT IV DAIRY

Cow- species of cattle, Breeding of cattle- Indian breeds and Exotic breeds – Dairy management – selection and feeding of milch animals- characterics of buffalo- Buffalo breeds buffalo Husbandry, Breeding – Economic uses of Buffalos.

UNIT V PIG AND RABBIT FARMING

Breeding pigs used in India, selection of pigs for farming from the available breed, Housing of pigs – Economy Rabbit breeds, Advantages of rabbit farming- Rabbit house, Rearing feeding and breeding management.

REFERENCE BOOKS:

1. Jawaid Ahsan and Dr. Subhas Prasad sinha (2010). A Hand Book on Economic Zoology- S.Chand Company Ltd.

2. Vinita Jaiswal and Kamal Kumar Jaiswal (2014). Economic Zoology- PHL Learing.

3. Chaudhuri. S. (2017). Economic Zoology – New Central Book Agency (NCBA).

4. Aminul Islam (2006). Text Book of Economic Zoology. IK. International.

SEMESTER – I & II – CC

HOURS/ WEEK – 5
CREDIT- 5

CORE PRACTICAL – I (COVERING CCI&CCII)

INVERTEBRATE AND CHORDATE

VIRTUAL DISSECTION –

Cockroach – Digestive and Nervous System.
Fish – Digestive and Nervous System

MOUNTING -

Teleost : Scales
Shark : Placoid Scale
Honey Bee : Sting

SPOTTERS: Invertebrate – Larval forms, Rotifera, Phoronida, Chaetognatha, Amoeba, Parmecium, *Fasciola hepatica, Taenia solium*, Peripatus, Sepia, Sea urchin, Trilobite, Nautiloids, Hippocampus, Bufo, Labyrinthodent, Hydrophis, Icthyosar, Archeaopteryx and Platypus.

CELL BIOLOGY:

- Onion Root Tip - Squash Preparation – To Study Different Stages of Mitosis.
- Measurement of the Size and Volume of Cells Using Ocular and Stage Micrometer.
- Differntial Cell Count – Human Blood Sample

SPOTTERS:

Ocular Micrometer and Stage Micrometer, Giant Chromosome

MOLECULAR BIOLOGY:

- Isolation of DNA from Animal Tissue
- Isolation of Plasmid DNA from Bacteria (Demo)
- Protein estimation by Lowry Method

SEMESTER - II – CC-IV

HOURS/ WEEK – 5
CREDIT- 5

CORE PRACTICAL – II (COVERING CC- V & CC-VI)

ANIMAL PHYSIOLOGY:

- Estimation of oxygen consumption in fish
- Estimation of haemoglobin in human blood
- Salt loss and salt gain in fish
- Enumeration of RBC in human blood
- Enumeration of WBC in human blood
- Test for urea and sugar in urine sample
- Quantitative estimation of amylase activity
- Quantitative estimation of ammonia and urea

SPOTTERS: Sphygmomanometer (BP apparatus), Stethoscope and ECG.

MICROBIOLOGY:

- Sterilization procedures and maintenance of laboratory.
- Media preparation and bacterial culture inoculation.
- Serial dilution and pour plate method and determination of colony number/gram.
- Culture techniques: Broth culture, Spread plate, Streak plate and Slant culture
- Identification of bacteria by gram staining method.
- Observation of bacterial motility by hanging drop method.
- Enumeration of microbial colony by colony counter.
- MPN technique for the identification of coliforms in water samples.

SPOTTERS **:** Bacteria, Virus, Fungi and culture plates, laminar air flow, Colony Counter, inoculation loop, autoclave.

EDUCATIONAL TOUR:

Visit to R & D labs and different natural habitats zoologically important place such as sea – shore, sanctuary, forest area and the students should write an illustrated study tour report and the same is to be submitted for evaluation at the time of practical Examination.

III
SEMESTER

SEMESTER -III – CC-VII

HOURS/ WEEK – 7
CREDIT- 5

ENVIRONMENTAL BIOLOGY

OBJECTIVES:

The main aim of this paper is to give information about the environment, biotic and abiotic factors, bio-geo chemical cycles, Habitat, population ecology, pollution and their control measures. The toxicant's related with environment and their toxic effects in different fields.

UNIT – I ENVIRONMENT FACTORS

Abiotic factors: Water, soil, light. Biotic factors; Intra (Aggregation, colony formation, social organization) and inter specific associations (Neutralism, symbiosis and antagonism). Structure and function of an ecosystem: -Autotrophic and heterotrophic- producers, consumers - – primary and secondary productivity - methods of measurements -different trophic level - energy flow in an ecosystem - food chain - food web -. pyramids. characteristics of different biomes. Interaction between environment and biota, Energy and nutrient flow.

UNIT – II BIO GEO CYCLES AND POPULATION ECOLOGY

Nutrient cycles – Nitrogen, phosphorus, Carbon and sulphur in nature – role of microbes in environment. .Biotic community – Concepts – Stratification – ecological niches – ecotone and ecological succession. Population ecology and biological control. Population growth – Biotic potential - Regulation of population size –Population interaction – Human population and urbanization.

UNIT – III HABITAT ECOLOGY

Ecosystem - Fresh water, marine, estuary, grassland, forest and desert- adaptations of animals and plants in different ecosystem. Food chain, food web and ecological pyramids of various ecosystem. Remote sensing, Satellite imaging – Aerial photography – Thermal and infrared images, radar in ecological applications. Instrumentation – GPS, radio telemetry and satellite telemetry. Techniques used in ecological research: GIS techniques in ecological research.

UNIT - IV ENVIRONMENTAL POLLUTION

Effects and control measures of Air, Water, Soil and Marine pollution. Acid rain, Ozone layer depletion. Bio accumulation – Bio magnification, BOD, COD, TDS, TSS. EIA – Steps in EIA – Methods of EIA. Acute toxicity – Chronic toxicity – Assessment of safety/risk. Natural

resources - sustainable development –survey. Energy resources - environmental quality standards – soil conservation.

UNIT V BIODIVERSITY AND CONSERVATION

Biodiversity – basic concepts, types, mega diversity and hotspots of bio diversity, status, global warming - biodiversity-monitoring and documentation- biodiversity management approaches. Conservation biology: Principles of conservation, major approaches to conservation of wild life management, Indian inititatives for conservation of wild life (Project Tiger, Project Elephant and Bio reserves).

REFERENCE BOOKS:

1. Chapman, B.C and Reigs. M.J. (1997). Ecology principles and application. Cambridge University Press, U.K.

2. Clark, G.C. (1963). Elements of ecology. John Wiley and Sons Inc., New York.

3. Odum, E.P. (1996). Fundamentals of Ecology (III Ed.). Nataraj Publishers, Dehradun. P 574.

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5. Asthana, D.K and Asthana, M. (2001). Environment problems and solutions. S. Chand and Co., New Delhi.

6. Bhatia, H.S. (1998). A Text Book on Environmental Pollution and Control, Galgotia, New Delhi.

7. Kumar, H.D. (1997). Modern concepts of ecology. Modern Printers, New Delhi. P 478.

8. Paul Colinvaux, (1986). Ecology. John Wiley and Sons, New York.

9. Srivastava, R.P. and Saxena, R.C.1989. Textbook of Insect toxicity. Himansha publications, Rajasthan.

10. Trivedi, P.R and Gurdeepraj, K. (1992). Environmental biology. Akashdeep Publishing House, New Delhi.

11. Williams.R.T (1959). Detoxification mechanisms. Wiley. New York.

SEMESTER -III – CC- VIII

HOURS/ WEEK – 6
CREDIT- 5

GENETICS

OBJECTIVES

To under the functional concepts of genetics, human related genetic problems, inborn errors and genetic counseling. To acquire knowledge on the applied branches of genetics.

UNIT – I INTRODUCTION TO GENETICS

Mendel's laws of inheritance–experiments–Mono–testing pheno types–dihybrid cross–incomplete dominance–over dominance–co–dominance and blood types–multiple alleles–blood group system–Rh and ABO incompatibility–gene interaction–epistasis.

UNIT – II CHROMOSOME AND MUTATIONS

Sex chromosomes – determination of sex. Barr bodies – cytoplasmic inheritance – Linkage – complete and incomplete linkage. Crossing over–definition – mechanism – Chromosome mapping – Chromosome numerical changes: aneuploidy, euploidy (haploidy and polploidy). Structural changes–deletion, duplication, translocation, inversion.

UNIT – III NATURE OF GENETIC MATERIAL

DNA – Genome organization, structure of gene (prokaryotes,eukaryotes) –biochemical evidences, RNA viruses–Fine structure of gene–cistron, recon and muton–Gene expression and regulation in prokaryotes–Lac Operon, Trp Operon, Ara Operon – Gene regulation in Eukaryotes–Britten and Davidson's model. Gene mutations–spontaneous mutation: Base pair substitution, Frame shift mutation and inducible mutations–suppressor mutations–mutagens.

UNIT – IV MICROBIAL GENETICS

Genetics of bacteria–transformation, conjugation, transduction, introduction to plasmids, movable genes. Genetics of viruses–life cycle of bacterio–phage–recombination in phage.

UNIT – V HUMAN GENETICS

Human chromosome and sex determination, Syndromes and metabolic disorders–single and polygenic, eugenics, euthenics and eugenic. Pedigree studies. Human genome project.

REFERENCE BOOKS:

1. Daniel, L. Hartl (1994) Genetics (III Edn) Jones and bartlet publishers, Boston.
2. Elof Axel Carlson (1985) Genetics, Tata McGraw Hill Publishing Co.
3. Jenkins, J.B. (1975) Genetics, Houghton Miffin Co., Boston.
4. Robert, H. Tamarin (1996) Principles of Genetics, WCB Publishers.
5. Ruthwell, M.W. (1978) Human Genetics Prentices Hall of India Pvt., Ltd.,
6. Strickberger, W. (1996).Genetics, Prentices Hall of India Pvt., Ltd.,

SEMESTER -III – CC- IX

HOURS/ WEEK – 6
CREDIT- 5

EVOLUTION AND ANIMAL BEHAVIOUR

OBJECTIVES:

To study the Geological time scale and evolution of animals. To study the different aspects of behaviour in animals.

UNIT – I ORIGIN OF LIFE

Evolution of life- theories and concepts – Darwinism, Lamarckism, and Neo Darwinism - evidences of evolution – modern theories of evolution –sources of variation.

UNIT – II ORIGIN OF SPECIES

Orthogenesis – evolution of horse and man- Zoogeography – mimicry and colourations in evolution – adaptive radiation.

UNIT – III PATTERNS OF EVOLUTION

Divergent evolution- micro evolution- mega evolution- macro evolution- quantum evolution – co evolution. Evolutionary time scale: eras- periods and epoch – major events in the evolutionary time scale. Fossil history and phylogeny of men.

ANIMAL BEHAVIOUR

UNIT - IV ECOLOGICAL ASPECTS OF BEHAVIOUR

Habitat selection, food selection, optimal foraging theory, anti-predator defenses, aggression, homing, territoriality, dispersal, host parasite relations.Biological rhythms: Circadian and circannual rhythms, orientation and navigation, migration of fishes and birds. Learning and memory: Conditioning, habituation, insight learning, associative learning and reasoning.

UNIT – V REPRODUCTIVE BEHAVIOUR

Evolution of sex and reproductive strategies, mating systems, courtship, sexual selection, parental care. Social behaviour: aggregations, schooling in fishes, flocking in birds, herding in

mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness, social organization in insects and primates.

REFERENCE BOOKS:

1. Strickberger's (2008). Evolution. 4th Ed., Jones and Bartlett Publishers, Inc.
2. Goodenough, J., Betty, M. and Wallace, R.A (1993). Perspectives on Animal Behaviour. John Wiley Publishers.
3. Odum, E.P (1996), Fundamental of Ecology (IIIrd Edn), Nataraj Publishers, Dehradun.
4. Bhatia, H.S. (1998). A Text book on Environmental Pollution and Control, Galgotia, Publishers, New Delhi.
5. Clarke, G.L. (1963). Elements of Ecology, Wiley Eastern Limited. New Delhi.
6. Paul Colinvaux, (1986). Ecology. John Wileyans Sons, New York.
7 Alcock, J (2001). Animal Behaviour: An Evolutionary Approach. 7th Ed., Sinaur Associates, Inc.3.
8 Krebs, J.R and Davis, N.B. (2004). Behavioural Ecology. 3rd Ed., Wiley Publishers, New York.
9. Blackwell and Ridley, M. (1993). Evolution. 2nd Ed., (Indian Edition). Blackwell Scientific Publishers, Oxford, UK, 2004.
10. Rastogi, V.B. (2007).Organic Evolution. 12th Ed., KedarNath Ram Nath Publishers, Meerut.

SEMESTER - III – EC- III

HOURS/ WEEK – 6
CREDIT- 5

APICULTURE AND SERICULTURE

OBJECTIVES

The main aim is to give exposure about the culture of silkworm and bees. It gives an idea for the self- employment opportunities to the students and the role of different research organizations and funding agencies to promote Apiculture and Sericulture.

UNIT-I SILKWORM REARING

Types of Silkworm - Mulberry, Tasar, Muga and Eri. Mulberry Silkworms: Morphology and life cycle of silkworms. Silkworm rearing: Rearing house and equipments. Rearing racks and trays, disinfectants, rearing appliances, black boxing, Chawki rearing, bed cleaning, mountages, harvesting of cocoons.

UNIT-II SILKWORM DISEASES AND MANAGEMENT

Pebrine, Flacherie, Grasserie, Muscardine and Aspergillosis. Silkworm pests, parasites and their management: Uzi fly, Dermestid beetles; silk reeling techniques; Quality assessment of silk fibre. Selection of raw material for reeling, Storage and preservation of raw materials. Marketing and the role of Central Silk Board in the Development of sericulture.

UNIT-III MORICULTURE

Mulberry Species – Classification, distribution, cultivation, irrigation andcommon varieties used in India. Harvesting – various methods -leaf picking – shoot leaf harvesting-branch cutting. Chemical composition and nutritional values of Mulberry leaves.Propagation of Mulberry plant – sowing – sampling and plantation methods.Classification of disease of mulberry.Moriculture: Food and feeding habits of silkworm

UNIT-IV APICULTURE METHODS

Natural bee colonies and their yield. Types of bee hives - structure - location and care and management. Setting up an apiary: Langstroth hives and Newton’s hive, brood and storage chambers, iron frames and comb sheets, drone excluder, rearing equipments, handling of bees-managing bees for honey production- managing bees for crop pollination.

UNIT-V DISEASES OF APICULTURE

Diseases of honey bees and their management, Honey harvesting and extraction process; physicochemical analysis of honey.Uses of honey and beeswax in Indian medicine.

REFERENCE BOOK

1. Venkatanarasaiah (2013). Sericulture, APH Publishing.
2. Amarder Singh and Ravinder Kumar, (2013). Hand book sericulture part – I.
3. Suresh K.Rao and Sajana Rawat (2013). Economic importance of Apiculture, Campus Books international.
4. Yoshimaro Tanaka.Sericology, Central Silk Board, 99-B, Meghdoot, Marine Drive, Bombay-2
5. Kovaleve, P.A. Silkworm breeding Stocks, Central Silk Board, Marine Drive, Bombay.
6. Sharma P.L. and Singh, S.H**.** Book of Bee keeping.S.Chand publishers

SEMESTER -III – EC-III

HOURS/ WEEK – 6
CREDIT- 5

BIOPROCESS TECHNOLOGY

OBJECTIVES

This paper provides complete knowledge about various parameters involved in culturing of microorganisms in large scale and designs of fermentor of special purposes.

UNIT- I BIOPROCESS ORGANISMS

Introduction and scope of bioprocess engineering. Screening of industrially important microorganisms - Strain improvement -Preservation and maintenanace of cultures.

UNIT- II FERMENTATION TECHNOLOGY

Types of fermentation-aerobic and anaerobic. Sterilization: air and media sterilization-moist heat, dry heat, batch sterilization and continuous sterilization. Inoculam preparation, development of inocula for bacteria and yeast.

UNIT- III COMPONENTS OF FERMENTOR

Design and components of fermentor. Bioreactor instrumentation –stirrer, agitator, aerator, seal, valves, steam trap, sterilization unit. Sensors – measurement and control of process variables.

UNIT –IV INDUSTRIAL ENZYMES

Thermophilic enzymes, Lipases, Proteolytic enzymes in leather and detergent industries, Enzymes in Fermentation process of cellulose. Enzyme Engineering- Designer enzymes. Antibiotics -penicillin, tetracycline, Food production- cheese, bread, beverages- wine and beer.

UNIT- V PROCESS OF FERMENTATION

Downstream processing**:** Bioseparation - Biomass disruption and removal, Filtration centrifugation, sedimentation, Cell disruption: Physical and chemical methods.
Purification: Membarane based technique- Ultrafiltration, reverse osmosis, and dialysis.

REFERENCE BOOKS:

1) Nakra BC and chaudry KK (2004). Instrumentation and measurement and analysis,. II edition tata McGraw hill publishing co. ltd, New Delhi.

2) Mansi El Mansi and Charli Bryce (2002). Fermentation microbiology and biotechnology. Taylor and Francis ltd., London.

3) Shijie liu (2012). Bioprocess Engineering. Elsevier publisher.

4) Paulne M. Doran (2012). Bioprocess Engineering Principles Elsevier Publisher.

5) Pogaku Ravindra (2016). Advances in Bioprocess technology- Springer Publisher.

IV
SEMESTER

SEMESTER - IV – CC-XI

HOURS/ WEEK – 5
CREDIT- 5

DEVELOPMENTAL BIOLOGY

OBJECTIVES:

This course provides the process of early embryonic development and review the current development in the field of embryology. The formation of embryo and embryological disorders and treatment methodology. Precaution and health care during pregnancy and gestation.

UNIT - I INTRODUCTION TO DEVELOPMENTAL BIOLOGY

Gametogenesis – Spermatogenesis – Cells in seminiferous tubules, spermiogenesis, structure and types of sperm. Oogenesis – origin and growth of oocyte, maturation of egg, egg envelops vitellogenesis, and organization of egg cytoplasm. Types of eggs. Egg cortex - polarity and symmetry of egg. Fertilization : Events of fertilization- acrosome reaction in sperm – cortical reaction in egg - recognition of egg and sperm, gamete fusion, activation of egg metabolism, physiological changes in the organization of egg cytoplasm.

UNIT -II CELLULAR DIFFERENTIATION

Cyto differentiation and chemo differentiation. Stem cells- totipotency and pleuripotency. Embryonic Stem cells and their applications. Cleavage – Patterns of cleavage – radial, spiral and bilateral; Types – meroblastic, holoblastic and superficial, factors affecting cleavage. Blastulation – Types of blastula. Fate maps. Presumptive organ forming areas in frog and chick. Gastrulation in frog and chick.

UNIT- III ORGANOGENESIS

Ectodermal derivatives: formation of central nervous systemdevelopment of brain eye in frog. Mesodermal derivatives: heart and kidney in frog. Endodermal derivative: intestine in frog. Organogenesis in Chick – development of heart. Extra embryonic membranes in Chicks – Placentation – its types.

UNIT- IV POLARITY AND GRADIENT

Dorsal and ventral polarity – homeo box concept.Organiser concept - embryonic induction - mechanism of induct ion. Regeneration: Types of regeneration- amphibian limb regeneration- stimulus and suppression of regeneration. Metamorphosis- types- amphibian

metamorphosis- events and hormonal control. Insect metamorphosis: moulting, growth and hormonal control.

UNIT- V PRECAUTION AND HEALTH CARE DURING PREGNANCY AND GESTATION

Impotency: Causes of Impotency and sterility in male and infertility in female – Concept of test-tube baby - Artificial Insemination in humans - In Vitro Fertilization (IVF) and Gamete-Intra-Fallopian Transfer (GIFT) – Advantages and disadvantages.

REFERENCE BOOKS:

1. Lewis Wolpart, Cheryll Tickle (2010). Principles of Development Biology. Oxford University Press.
2. Lewis Wolpart (2011). Principles of Development Biology. Oxford University Press.
3. Subramaniam T. (2001). Molecular Development Biology. Alpha Science intl. Ltd.
4. Wanninger and Andreas (2015). Evolutionary Developmental Biology of invertebrates, Springer Publisher.
5. Arumugam.N. (1998). Developmental Biology, Saras Publications,
6. Balinsky, B.I. (1981). An Introduction to Embryology. W.B. Saunders Company.
7. Philadelphia.Berry.A.K. (2007). An Introduction To Embryology, Emkay Publications, New Delhi-51.
8. Beril., N.J. (1986). Developmental Biology. Tata Mcgraw-Hill Publishing Ltd. New Delhi.
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10. Deuchar, E.M. (1976). Cellular Interaction in Animal Development, Chapman and Hall, London.
11. Verma, P.S. and Agarwal V.K. (2005). Developmental Biology. S. Chand and Company Ltd., New Delhi.

SEMESTER - IV – CC-XII

HOURS/ WEEK – 5
CREDIT- 5

IMMUNOLOGY AND BIOTECHNOLOGY

OBJECTIVES:

To study the immune system and immune response. To understand the various immunological techiques and its applications.

UNIT – I IMMUNITY

Innate and Acquired immunity- Ultra structure and functions of primary and secondary lymphoid organs. Cell types - origin and specific functions. Antigens and Immunogens - characteristics - epitopes. Immunoglobulins: 3D structure-classes- antigenic determinants.

UNIT – II IMMUNE RESPONSE

Antigen recognition- processing and presentation-interaction of T and B cells – cell mediated and humoral immunity - cytokines and immune response –immunological memory – agglutination - antigen-antibody interactions. Auto immunity, auto immune disease- Rheumatoid arthritis, Lupus and Celiac diseas- mechanism, treatment.

UNIT – III IMMUNOTECHNIQUES

Precipitin reactions**:** immuno diffusion and immuno electrophoresis RIA – ELISA, Western blotting- - Monoclonal antibody production - Fluorescent immunoassay (FIA) - Hybridoma Technology.

UNIT – IV INTRODUCTION TO BIOTECHNOLOGY

Scope – Branches – Current developments – Commercial applications of biotechnology. Strategies of Recombinant DNA technology – Preparation of DNA, vector, types of vectors – Transgenic animals – production (Microinjection, Embryonic stem cell methods) and its applications. Genomics – Human Genome Project - Methods of gene sequencing (Random shotgun, Whole genome Shotgun sequencing).

UNIT – V MOLECULAR MARKERS AND GENE THERAPY

Diagnosis of genetic disorders by RFLP, PCR, Northern and Southern blotting– Treatment of Cancer – Bone marrow transplantation – Gene Therapy: *Ex vivo* and *in vivo* gene therapy, embryonic stem cell methods and Gene silencing.

REFERENCES BOOKS:

1. Roitt, I.M., and Delves, P.J. Roitt's (2001). Essential Immunology. 10th Ed., Oxford: Blackwell Science.

2. William E.Paul (2012). Fundamental of immunology, L.W.W Publisher.

3. Joel Fuhrman M.D. (2013). Super immunity- Harperone Publisher.

4. Abul K. Abbas, Andrew H. Lichman, Shiv Pillai (2014). Cellular and molecular immunology- Saunders publisher.

5. Abul K. Abbas, Andrew H. Lichman, Shiv Pillai (2017). Cellular and molecular immunology- Elsever publisher.

6. Goldsby, R.A., Kindt, T. J. and Osborne, B. A. Kuby's (2003). Immunology. 5th Ed., WH Freeman & Co.

7. Janeway, C. (2001). Immunobiology. 5th Ed., Garland Publications.

8. Benjamin, E., Richard, C., and Sunshine, G. (2000). Immunology: A Short Course. 4th Ed., John Wiley, New York.

9. Chakravarty, A.K (2006). Immunology and Immunotechnology. Oxford University Press. New Delhi.

SEMESTER - IV – CC-XIII

HOURS/ WEEK – 5
CREDIT- 5

AQUACULTURE

OBJECTIVES:

The main aim is to give information about the culture of fishes and crabs. It gives an idea for the self- employment opportunities to the students. The role of different research organizations and funding agencies to promote aquaculture.

UNIT – I – HISTORY AND TYPES OF AQUACULTURE

Definition- Scope of aquaculture- Aquaculture in India, Role of aquaculture on economic development, constraints in aquaculture, types of aquaculture- Freshwater aquaculture, coastal aquaculture and marine aquaculture. Fresh water cultivable fishes, marine water cultivable fishes.

UNIT- II - FISH PONDS

Definition, breeding ponds, nursery ponds, rearing ponds, culture ponds (stocking ponds). Preparation of pond for fish culture, management of fish ponds, water quality management of fish ponds. Importance and composition of feeds; types of feed, wet and dry feeds, Artificial and live feeds- Artemia, Diatoms and Daphnia and Spirulina cultures.

UNIT –III - TYPES OF CULTURES

Extensive culture, Intensive culture and semi-intensive culture, monosex culture, monoculture, polyculture, cage culture and pen culture. Integrated fish farming – paddy cum fish culture, Animal husbandry cum fish culture, sewage fed fish culture. Culture practices: Major carps, Prawns, Lobster, Pearl Oyster, Edible Oyster, Mussels and seaweeds.

UNIT – IV - FISH DISEASE AND INDUSCED BREEDING

Common bacterial, viral, fungal, protozoans and crustaceans diseases, their symptoms and treatment. Sex reversal and production of Monosex fishes and super males and selective breeding. Hypophysation- Definition, principle and procedure of hypophysation – collection, preparation and injection of pituitary extract, selection of breeders, mechanism of pituitary action and advantages of hypophysation.

UNIT- V – TRANSGENISIS

Transgenesis - method of gene transfer in fishes - Production of transgene fishes. Harvesting and transport of fish. Fish preservation and fish processing technology – By products of fish and its uses. Government organizations in Aquaculture. ICAR, CMFRI, CIFRI, CICFRI, CIFA, CIBA, CIFT and MPEDA.

REFERENCE BOOKS:

1. Robert R. Stickney (2017). Aquaculture an introductory text 3rd Edition - Oxford University Press.

2. John S. Lucas, Paul C.Southgate (2012). Aquaculture farming, Wiley – Blackwell, Publishers.

3. Kenn christenson (2015). Aquaculture 3rd Edition – Createspace indepentent Publishing Platform.

4. Pillay, T.V.R. (1995). Aquaculture principles and practices. Fishing New Books, Blackwell Science Ltd., Oxford.

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6. Santhanam, Sugumaran and Natarajan, P. (1997). A Manual of freshwater aquaculture. Oxford and IBH Pub. Co. Ltd., New Delhi.

7. Arumugam.N. (2008). Aquaculture Saras Publications, Nagercoil.

8. Baradach, JE, JH Ryther and WO McLarney (1972) Aquaculture. The farming and Husbandry of Freshwater and Marine Organisms. Wiley Interscience, New York.

9. Chadar, S.L. (1980). Hypophysation of Indian major carps. Satish Book Enterprise, Agra, PP.146.

10. Exporters manual and Documentation (1999). Jain Book Agency. New Delhi.

11. Jhingran.V.C. (1991). Fish and fisheries of India, Hindustan, New Delhi.

12. Kurian, C.V and Sebastin. (1992). Prawn and prawn fisheries of India, Hindustan Publications, New Delhi.

13. Rath, R.K. (2000) Freshwater Aquaculture. Scientific Publishers, (India), PO.Box.91, Jodhpur.

SEMESTER –III & IV CC-X

HOURS/ WEEK – 5
CREDIT- 5

CORE PRACTICAL- III

(COVERING CC-VII, CC-VIII, CC-IX, CC- XI, CC- XII, CC- XIII)

ENVIRONMENTAL BIOLOGY:

- Estimation of dissolved oxygen in water.
- Estimation of dissolved carbon dioxide
- Estimation of chlorides
- Estimation of calcium
- Estimation of total alkalinity
- Estimation of total phosphates
- Identification of freswater and marine water plankton

SPOTTERS: Secchi Disc, Colorimeter, pH meter, Thermometer

DEVELOPMENTAL BIOLOGY

- ✓ Preparation of sperm suspension: Bull's spermatozoa
- ✓ Mounting of blastoderm in chick
- ✓ Effect of thyroxine or iodine on metamorphosis of frog
- ✓ Vaginal smear preparation of cow to study the stages of estrous cycle.

GENETICS

- ❖ Drosophila Culture – Identification of mutants and sexes –
- ❖ ABO Blood groups & Rh factor determination and its genetic significance.
- ❖ Study of mendelian traits in Human beings
- ❖ Identification of syndromes
- ❖ Hardy – Weinberg Law and calculation of gene frequency

SPOTTERS: Drosophila - male and female, Human karyotyping - male and female. Syndromes

EVOLUTION:

SPOTTERS: Fossils (Nautiloid, Ammonoid, and Trilobite), Colouration and Mimicry.

IMMUNOLOGY:

- Identification of lymphoid organs in chick.
- Lymphoid organs- Primary and Secondary.
- Immunodiffusion - Immunoelectrophoresis (Demo)
- WIDAL test

SPOTTERS: T.S of lymphoid organs: Thymus, Bone marrow, lymph node, spleen, T cells and B cells