RAJARSHI SHAHU MAHAVIDYALAYA, LATUR
(Autonomous)
(BoS in ZOOLOGY)

CHOICE BASED CREDIT SYSTEM
(CBCS)
SEMESTER PATTERN
(W.e.f. Academic Year 2021-22)

SYLLABUS FOR M.Sc.-II EXAMINATION
M.Sc. ZOOLOGY

JUNE -2021

Rajarshi Shahu Mahavidyalaya, Latur
(Autonomous)
Department of Zoology and Fishery Science
Course Structure, M.Sc. II Year
Effective from 2021-22

Semester – III

Semester	Course Code	Course Name	Marks		Total	
			Internal	End Semester	Marks	Credits
Semester – III	Core Course (CC) (Compulsory Course)					
	P-DEB-381	Developmental Biology	40	60	100	4
	P-PEE-382	Principles of Ecology and Evolution	40	60	100	4
	P-BIS- 383	Biology of Vertebrate Immune System	40	60	100	4
	Elective courses					
	P-AAZ-484 or P-SYB-384 or P-BMB-384	Animal Behavior and Applied Zoology or System biology or Biostatistics and Mathematical biology	40	60	100	4
	Practical / Lab Course					
	P-LC-385	Lab Course IX(Based on P-DEB-381)	20	30	50	2
	P-LC-386	Lab Course X (Based on P-PEE-382)	20	30	50	2
	P-LC-387	Lab Course XI (Based on P-BIS-383)	20	30	50	2
	P-LC-388	Lab Course XII (Based on P-AAZ-384/ P-SYB-384/ P-BMB-384)	20	30	50	2
	P-TP-389	Seminar	25	-	-	1
		Total(I)			625	25

Semester-IV

Semester	Course Code	Course Name	Marks		Total	
			Internal	End Semester	Marks	Credits
Semester – IV	**Core Course (CC) (Compulsory Course)**					
	P-APH-481	Animal Physiology	**40**	**60**	**100**	**4**
	P-ACT-482	Animal Cell Culture Technology	**40**	**60**	**100**	**4**
	P-GAP-483	Animal biotechnology	**40**	**60**	**100**	**4**
	Elective courses					
	P-FFC- 484 P-AAI- 484 P- ABT-484	Freshwater Fish Culture or Aquaculture and its applications or Genomics and Proteomics	**40**	**60**	**100**	**4**
	Practical / Lab Course					
	P-LC-485	Lab Course XIII(Based on P-APH-481)	**20**	**30**	**50**	**2**
	P-LC-486	Lab Course XIV(Based on P-ACT-482)	**20**	**30**	**50**	**2**
	P-LC-487	Lab Course XV (Based on P- ABT-484)	**20**	**30**	**50**	**2**
	P-LC-488	Lab Course XVI (Based on P-FFC- 484/P-AAI-484/ P-GAP-483)	**20**	**30**	**50**	**2**
	P-PRW-489	Project Work/Dissertation	-	-	50	2
	Total(IV)				650	26
	Total (Sem III + Sem IV)				1275	51

M. Sc. ZOOLOGY-II (SEM-III)

Course Code: P-DEB-381

Course: Developmental Biology

Total Teaching hours: 60 **Marks: 100**

Learning Objectives:

- Be familiar with the events that lead up to and comprise the process of gametogenesis Fertilization, cleavage to gastrulation.
- To understand the cytoplasmic determinants and autonomous cell specification from differentiation, cell migration to tissue interactions.
- To grab the importance of Homeobox concept, Hormones, cell cycle and apoptosis
- Know the broad relationships of Cell diversification in early animal embryo and Stem cell tot potency, muscular and skeletal system formation in embryo.

Course Outcomes:

- Students will get the knowledge and imaginations in the process of fertilization to gastrulation.
- Learners will acquire the cell specifications in germ layer formation and cell differentiation.
- Students will grab the details of cell diversification and will be able it to apply in stem cell therapy and tissue system formation.

Unit I: Introduction to animal development

- Gametogenesis in animals
- Fertilization in animals
- Development in unicellular eukaryotes
- Development patterns in metazoans
- Creating multicellularity
- Cleavage types,
- Blastulation
- Comparative account of Gastrulation

Unit II: Cytoplasmic determinants and autonomous cell specification

- Cell commitment and differentiation
- Cell specification in nematodes
- Germ cell determinants
- Germ cell migration
- Progressive cell – cell interaction and cell specification fate Body Axes
- Establish of body axes in mammals and birds

UNIT III

- Proximate tissue interactions
- Genetics of axes specification in Drosophila.
- Homeobox concept in different phylogenetic groups
- Tetrapod limb development
- Hormones as mediators of development
- Cell cycle and apoptosis – in brief

Unit IV

- Cell diversification in early animal embryo
- Xenopus blastomeres
- Morphogen gradients
- Totipotency and Pleuripotency
- Embryonic stem cells
- Renewal by stem cell – epidermis
- Skeletal muscle regeneration
- Connective tissue cell family

Reference Books

1. Alberts et al.: Molecular biology of the cell. Garland, 2002.
2. Gilbert: Developmental biology. Sinauers, 2003.
3. Kalthoff: Analysis of biological development. McGraw-Hill, 1996.
4. Wolpert: Principles of development. Oxford, 2002.
5. An Introduction to Embryology, 5th edition (2004), B. I. Balinsky. Publisher - Thomas Asia Pvt. Ltd •
6. Developmental Biology, (2001), R. M. Twyman, Publisher - Bios Scientific Publishers LTD.

M. Sc. ZOOLOGY-II (SEM-III)

Course Code: P-PEE-382

Course: Principles of Ecology and Evolution

Total Teaching hours: 60 **Marks: 100**

Learning Objectives:

- Enable students to understand the Principles of ecology and evolution.
- To understand the environment, population ecology.
- To understand the community ecology, ecological succession, ecosystem ecology.
- To understand the biogeography and biogeographically zones of India.
- To understand the Emergence of evolution thoughts Lamarck; Darwin-concept of evolution, Mendelism
- To understand the concept of molecular evolution.

Learning Outcomes:

- After completion of this course students should be able to:
- Understood the knowledge of the principles of ecology and evolution.
- Students should have the knowledge about the environment, concept of habitat and niche.
- Students have an understanding of nature and structure of communities, ecosystem.
- Understood the knowledge of origin of cells and unicellular evolution, molecular evolution

Unit I

- **The Environment**: Physical environment; biotic environment; biotic and abiotic interactions.
- **Habitat and Niche**: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.
- **Population Ecology**: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation –demes and dispersal, intergenic extinctions, age structured populations. Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Unit II

- **Community Ecology**: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones
- . **Ecological Succession**: Types; mechanisms; changes involved in succession; concept of climax.
- **Ecosystem Ecology**: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C, N, and P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine).
- **Biogeography**: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

Unit III

- Emergence of evolutionary thoughts Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; the evolutionary synthesis.
- Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

Unit IV

- Molecular Evolution: Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.
- The Mechanisms: Population genetics –Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

Reference Books:

1. Odum: Fundamentals of Ecology (Saunders, 1971)
2. Odum: Basic Ecology (Saunders, 1985)
3. Turk and Turk : Environmental Science (4rth ed. Saunders, 1993)
4. Primark : A Primer of Conservation Biology (2nd ed. Sinauer Associates)
5. Calabrese : Pollutants and High-Risk Groups (John Wiley,1978)
6. Raven, Berg, Johnson : Environment (Saunders College Publishing, 1993)
7. Sharma: Ecology and Environment (Rastogi Publication, 7th ed. 2000) (55)
8. Cunningham and Saigo: Environmental Science (McGraw Hill Boston, 5th ed., 1999)
9. Ricklefs and Miller : Ecology (Freeman and Company, New York, 4th ed., 2000)
10. Dobzhansky Th. (1964): Genetics and the Origin of Species. Columbia.
11. Dobzhansky Th. et al. (1976): Evolution. Surjeet Publ. (34)
12. Freeman S. and Jon C. Herron (1998): Evolutionary Analysis. Prentice Hall
13. Futuyma D. J. (1998): Evolutionary Biology. Sinauer
14. Hartl D. L. and A. G. Clark (1989 & 1997): Principles of Population Genetics. Sinauer
15. Kimura M. (1984): The Neutral Theory of Molecular Evolution. Cambridge.
16. Li Wen-Hsiung and Dan Graur (1991): Fundamentals of Molecular Evolution. Sinauer
17. Mayr E. (1966): Animal Species and Evolution. Belknap Press
18. Ridley M. (1993): Evolution. Blackwell. 10. Strickberger M. W. (2000): Evolution. Jones and Bartlett 19. White M. J. D. (1978): Modes of Speciation. Freeman

M. Sc. ZOOLOGY-II (SEM-III)
Course Code: P-BIS- 383

Course: Biology of Vertebrate Immune System

Total Teaching hours: 60 **Marks: 100**

Learning Objectives:

- Be familiar with the immunity , lymphatic system, antigen and different types of immune responses.
- To understand the relationship in antigen and antibody and complement system.
- To grab the importance of Histocompatibility Complex in mouse and HLA system in human
- Learners will understand the role of T and B cells and their role.

Course outcomes:

- Students will get the knowledge of immunity and immune responses.
- Learners will acquire the knowledge of antigen and antibody in immune system.
- Students will grab the details of HLA system in human.
- Students will get the knowledge T and B lymphocytes.

Unit I

- Innate and acquired immunity
- Phylogeny and ontogeny of immune system
- Organization and structure of lymphoid organs
- Cells of immune system and their differentiation
- Lymphocyte traffic
- Nature of immune response
- Nature of antigens and super antigens
- Antigen city and immunogenicity

Unit II

- Factors influencing immunogenicity
- Epitomes and haptens
- Structure and functions of antibodies
- Classes and subclasses
- Gross and Fine structure
- Antibody mediated effector functions
- Antigen-Ab interactions in vitro and in vivo
- Complement system

UNIT III

- Major Histocompatibility Complex in mouse and HLA system in human
- MHC haplotypes
- Class I and Class II molecules
- Cellular distribution
- Peptide binding
- Expression and diversity

- Disease susceptibility and MHC/HLA

UNIT IV

- Organization and expression of Ig genes
- T-cell receptors
- B-cell generation, activation and differentiation
- Cytokines-Structures and functions, cytokine receptors, cytokines and immune response
- Immunological tolerance and Anti-immunity
- Hypersensitivity and immune responses to infection agents especially intracellular parasites

Reference Books

1. Kuby.Immunology, W.H. Freeman, USA.
2.W.Paul.Fundamentals of Immunology.
3. I.M.Roitt.Essential immunology, ELBS Edition.

M. Sc. ZOOLOGY-II (SEM-III)
Course Code: P-AAZ-384

Course: Animal Behavior and Applied Zoology

Total Teaching hours: 60 **Marks: 100**

Learning Objectives:-

- To understand different aspects of Ethology like behavior complexity, communication and reproductive behavior
- To learn the importance of evolutionary approach of behavior, learning, competition and territory.
- To understand social interactions with the help of honey bees, best example of social animal.
- To gain knowledge of applied zoology from sericulture to lac culture.

Course Outcomes:

- Students will be able to grasp the knowledge of different angles of animal behavior.
- Learner would acquire the knowledge of learning and its importance in Ethology.
- Students will be able to have the details of Social behavior and its importance in life.
- Learner would acquire the knowledge of applied zoology for the employability/ entrepreneurship.

UNIT I

- Introduction of Ethology
- Patterns of Behaviour:
- Individual behavioural pattern
- Homing behaviour
- Genetics of behaviour
- Genetic basis of behaviour
- Learning behaviour

Unit II

- Evolutionary approach to behaviour; Levels of natural selection
- Reproductive behavioural pattern
- Mating behaviour in animals
- Parental investment
- Stickle back behaviour
- Social organization
- Dominance hierarchies
- Social competition
- Territoriality

Unit III

- Individual social interactions
- Animal communications
- Dance language of the honey bees
- Aggregation

- Social facilitation
- Comparative aspects of learning-definition and forms of learning behaviour, Mechanisms of learning, Imprinting

Unit IV

- Applied Zoology (Basic concepts, process and application)
- Sericulture
- Apiculture
- Fish cuture
- Poultry keeping
- Dairy industry
- Lac culture

Reference Books:

1. Alcock : Animal Behaviour- An Evolutionary Approach. (7th ed.) Sinaur Associates, Inc. 2001.
2. Drickamer & Vessey: Animal Behaviour –Concepts, Processes and Methods (2nd ed.), Wadsworth, 1986.
3. Gadagkar: Survival Strategies-Cooperation and Conflict in Animal Societies. Universities Press,1998.
4. Goodenough et al : Perspectives on Animal Behaviour, Wiley, 1993.
5. Grier : Biology of Animal Behaviour, Mosby, 1984.
6. Hallidy and Slater : Animal Behaviour(vols. I-3) Blackwell Scientific Publ., 1983.
7. Krebs & Davis : Behavioural Ecology. (3rd ed.) Blackwell, 1993.
8. Lehner : Hand Book of Ethological Methods.(2nd ed.) Garland, 1996.
9. Manning & Dawkins : An introduction to Animal Behaviour (5th ed.), Cambridge Univ. Press, 1998.
10. Slater & Halliday : Behaviour and Evolution,(1st ed.) Cambridge Univ. Press, 1994.
11.Shukla and Upadhyaya:Economic Zoology(Rastogi publication)
12.Srivatsava :Text Book of Applied Entomology (Kalyani publishers)
13.Venkitaraman:Economic zoology(Sudarshana publishers)

M. Sc. ZOOLOGY-II (SEM-III)
Course Code: P-LC-385
Lab Course IX (Based on P-DEB-381)

Total Teaching hours: 60 **Marks: 100**

Learning Objectives:

- Be familiar with the events that takes place in cleavage, embryonic and development in Chick and Frogs.
- To understand the developmental process with the help of Chick and Frog as model organisms in knowing the embryonic process.
- Be familiar with the process of regeneration in Invertebrates.
- Be able to understand the developmental process with the help of Chick embryology.

Course Outcomes:

- Students will get the knowledge of embryonic development in Chick and Frog.
- Learners will acquire the knowledge of happenings in most important events like cleavage to Three germ layer formation and organogenesis.
- Learners will be able to differentiate in the regeneration in invertebrates and development in Vertebrates.
- Students will understand the embryonic steps with the help of mounting of embryos at different stages in Chick and Frog.

Practicals

1. Patterns of cleavages in Frog and Chick (slides) (2P)
2. Study of embryonic and post-embryonic development using frog egg as a model system. (3P)
3. Mounting of chick embryos and preparation of permanent mounts. (2P)
4. Gross anatomy and histology of chick embryos till 96 h. (2P)
5. Experiments in regeneration in Hydra or Planaria. (1P)
6. Study of cell death during limb morphogenesis in chick embryo. (1P)
7. Filter paper ring method for in vitro culturing of chick Embryo. (1P)

M. Sc. ZOOLOGY-II (SEM-IV)

Lab Course: P-LC-386

Lab Course X (Based on P-PEE-382)

Total Teaching hours: 60 **Marks: 100**

Practicals

1. Habitat studies:
Physical and chemical characteristics of soil.
Assessing influence of light, temperature and moisture on plant germination and growth/animal behavior and growth.
Assessing influence of soil nutrient status on plant germination and growth.
2. Community/ecosystem studies:
Assessment of density, frequency and abundance of plants/animal in a community using various techniques i.e. transect, quadrate etc.
2. Comparison of stands/communities and ordination.
3. Biomass and reproductive allocation under various environments.
4. Nutrient uptake and budget for various communities/Food chain assessment.
5. Decomposition of various organic matters and nutrient release mechanisms/role of arthropods and other micro-, and macrofauna in decomposition.
6. Understanding ecosystem succession by studying various stages of vegetation/community assemblage's development.
8. Insect diversity in soil. Landscape studies:
1. Principles of GIS, GPS and RS technology.
2. Interpretation (visual and automated) of remote sensing information for landscape differentiation.w
9. Study of Fossils and evolutionary important animals by using chart/specimen.
10. Study of phylogenetic relationships between different animals according to their evolutionary History.

M. Sc. ZOOLOGY-II (SEM-IV)

Lab Course: P-LC-387

Lab Course XI (Based on P-BIS-383)

Total Teaching hours: 60 **Marks: 100**

Learning Objectives:

- Be familiar with Antigen-antibody interaction in vitro and ELISA
- To understand the isolation of B-Lymphocytes and Phagocytosis in vitro.
- grab the importance of lymphoid organs.
- Able to understand Immunological diagnosis of infection /cancer /Pregnancy

Course outcomes:

- Students will get the knowledge of Antigen-Antibody interaction and immunity.
- Learners will acquire the skill of isolation of B-Lymphocytes.
- Learner will understand the role of lymphoid organs in management of Immunity.
- Students will grab the details of system of diagnosis of infection /cancer /Pregnancy.

Practicals

1. Antigen-antibody interaction in vitro
2. Radioimmunoassay and ELISA
3. Isolation of B-lymphocytes
4. Phagocytosis in vitro.
5. Separation of gamma globulins from serum.
6. Blood film preparation and identification of cells.
7. Histology of lymphoid organs.
8. Immunological diagnosis of pregnancy/infection/cancer.
8. Antigen-antibody interaction in vitro
9. Blood film preparation and identification of cells.
10. Immunological diagnosis of pregnancy
11. Histology of lymphoid organs.

M. Sc. ZOOLOGY-II (SEM-IV)

Lab Course: P-LC-388

Lab Course XII (Based on P-AAZ-384)

Total Teaching hours: 60 **Marks: 100**

Learning Objectives:-

- To learn different aspects of Ethology with the help of earthworm and mosquito larvae.
- To learn the different types of behaviors with the help of maggots of housefly, monkeys etc.
- To learn the intraspecific behavior in Dogs and Cattles.
- To learn the life cycles of honey bee, Silkworm
- To learn the entrepreneurship by visiting different types of farms like fish farm and Apiary Sericulture farm and reporting.

Course Outcomes:

- 1] Students will be able to know angles of Ethology with the help model animals.
- Students will be grab the behavioral aspects with the help study of insects and Monkey, Dogs and Cattles
- Students will be able to capture the details of life cycles of Bombyx mori and Honey bee
- By visiting different types of Farms and culture places entrepreneurship can be developed.

Practicals

1. Habituation in earthworms/mosquito larvae.
2. Feeding behavior of housefly
3. An investigation into the locomotory behavior of maggots of the housefly.
4. Study of behavior of troops of monkeys: Individual pattern of behavior, study of social pattern behavior
5. Intraspecific association-Flocking behavior in Pigeons, Behaviour of dog and cattle
6. Film shows on animal behavior
7. Visit to study the management of the following: Fish farm, dairy farm, apiculture, sericulture. Submit the report on anyone of the above.
8. Life cycle of silkworm and honey bees. (Use chart/model/material)
9. Study of the structural organization of the bee hive.

M. Sc. ZOOLOGY-II (SEM-IV)

Course Code: P-APH-481

Course: Animal Physiology

Total Teaching hours: 60 **Marks: 100**

Learning Objectives:-

- To understand different working aspect of Animal physiology like Digestion , Excretion Circulation, Respiration, Nervous co-ordination and sense organs etc.
- To learn the importance of normal functioning of all systems and their co-ordination and regulation.
- To understand social interactions between Endocrinology and Reproduction
- To gain knowledge of stress and its effects on body physiology leading to adaptations.

Course Outcomes:

- Students will be able to grasp the knowledge of Animal Physiology with the help of mechanism of working.
- Learner would acquire the knowledge of animal physiology and will be able to explain. Students will be able to explain the details of functioning of vital body systems.
- Learner would acquire the knowledge of Animal physiology for the finding the
- Abnormal functioning and cause of it in physiological sense.

Unit-I:

Blood and circulation: Blood corpuscles, Haemopoiesis and formed elements, Plasma function, blood volume, blood volume regulation, blood groups, Haemoglobin, immunity, homeostasis.

Cardiovascular System: Comparative anatomy of heart structure, Myogenic Heart, specialized tissue, ECG – its principle and significance, cardiac cycle, Heart as a pump, blood pressure, neural and chemical regulation of all above.

Unit-II:

Respiratory system : Comparison of respiration in different species, anatomical Considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

Nervous system: Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.

Sense organs : Vision, hearing and tactile response.

Unit-III:

Excretory system : Comparative physiology of excretion, kidney, urine

Formation, urine concentration, waste elimination, micturition, regulation of water Balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

Thermoregulation : Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.

Stress and adaptation

Unit:-IV

Digestive system : Digestion, absorption, energy balance, BMR.

Endocrinology and reproduction : Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation

Reference Books:

1. Essentials of Animal Physiology –Rastogi
2. Ganong's Review of Medical Physiology
3. Schaums Outline of Human Anatomy and Physiology, Third Edition (Schaums Outline Series)

M. Sc. ZOOLOGY-II (SEM-IV)

Course Code: P-ACT-482

Course: Animal Cell Culture Technology

Total Teaching hours: 60 **Marks: 100**

Learning Objectives:

- To give students knowledge about various equipments& materials for animal cell culture technology and characters of cells.
- To give students knowledge about nutritional requirements of cells and growth med
- To teach basic techniques of mammalian cell culture.
- Enable students to understand biology & characterization of cultured cells and cell surgery methods.
- To teach cell fusion methods & applications of animal cell culture.

Learning Outcomes:

- Students have a greater understanding of equipments& materials for animal cell culture technology.
- Students enable to understand characters of cells.
  Students enable to understand nutritional requirements of cells &different kinds of growth media.
- Students enable to understand primary cell culture and types of cell culture.
- Students have greater understanding of preparation & methods of cell surgery

Unit-I:

Equipments and Materials for animal Cell Culture Technology:

- Basic Aseptic Techniques
- Design of Tissue Culture Laboratory
- Equipments : Laminar Flow Hoods, CO2 incubator, Open and closed cultures, Microscopes, centrifuge, Refrigerators and Freezers, pipetting aids, Miscellaneous small items of Equipments, Materials, filters, Miscellaneous Items.
- **Characters of cells :**
- Cells in primary culture
- Established Cell lines
- Tumor/cancer originated cells

Unit-II

Nutritional Requirements of Cells and growth media:

- Basal salt solution (BSS)
- Minimum Essential Medium
- Serum dependent defined media
- Serum independent defined media – Cell specific media

Basic Techniques of mammalian cell culture:

- **Primary Cell culture :** Isolation and separation of cells, viable cell count, maintenance of cell culture
- **Types of cell cultures:**
- a. Monolayer ,b.Suspension ,c.Clone culture , d.Mass culture-microcarrier culture (monolayer) ,d.Stem cell culture

Unit-III:

Biology and Characterization of cultured cells:

- Contamination Testing of Culture
- Viability measurement and cytotoxicity
- Measurement of growth parameters
- Cell cycle analysis and Synchronization of cultures

Cell surgery Methods:

- Preparation of anucleated cells and polykaryon cells
- Preparation of ghost RBCs.
- Preparation of mini cells, microcells
- Surgical manipulation of in vitro fertilization

Unit-IV

Cell Fusion Methods:

- **Fusogens: a.** Virus induced , b. Chemical induced, c. Liposome induced (Preparation of liposomes and use)

- Hybridoma cell preparations and their properties
- Use of Hybridoma technology: eg. M AB and other related techniques
- Mini cells, micro cells and anucleated cells in fusion and their application.

Applications of Animal Cell Culture:

- Evaluation of Chemical carcinogenicity, Cell malignancy Testing.
- Toxicity Testing, Karyotyping and cytogenetic characterization.

Reference Books:

1. Bruce Albert et al “Molecular Biology of the Cell”

2. Cell and Tissue Culture

3. Methods in enzymology (Cell culture)

M. Sc. ZOOLOGY-II (SEM-IV)

Course Code: P- ABT-483

Course: Animal Biotechnology

Total Teaching hours: 60 **Marks: 100**

Learning objectives:

- Provide students with necessary skills for Recombinant DNA technology;
- Enable students to Screening analysis of recombinants ;
- Provide student with the requisite knowledge of Transgenic technology and its applications in fisheries ;
- Enable students to utilization of Synthetic hormones for induced breeding;
- Enable students to design lab set up of Cryopreservation of gametes and embryos. Embryo transfer technology.
- Provide students with knowledge of Feed technology health management algal biotechnology and Post-harvest biotechnology ;

Course Outcomes:

- Upon completion of the course students will be able to:
- Utilize the developed expertise in concepts, theories, and emerging methodologies to succeed in tackling real-world issues in animal biotechnology and aquatic science.
- Demonstrate advanced knowledge and competency in recombinant DNA technology
- Demonstrate hands-on experience in aquatic sampling inventory and measurement techniques.
- Apply practical and theoretical knowledge for aquaculture research and Animal Biotechnology.
- Students will learn to use of animal biotechnology techniques for engineer the animals to improve sustainability, productivity and suitability for pharmaceutical, agricultural and industrial application.

UNIT – I :

- **Biotechnology:** Origin, definition and knowledge of different branches.
- **Genetic Engineering:** Recombinant DNA technology; Tools of genetic engineering – cloning vectors, restriction endonucleases, DNA ligases, topoisomerases, methylases, nucleases, polymerases, reverse transcriptase and their functions.
- **Screening analysis of recombinants:** Colony hybridrization technique, immunological tests.
- **Transgenics:** Principles of Transgenic technology and its applications in fisheries.

UNIT – II

- **Fish breeding:** Synthetic hormones for induced breeding – GnRH analogue structure and function; Selective breeding for improving fish stocks - hybridization in Indian fishes.
- Androgenesis, Gynogenesis, Polyploidy and Sex reversal.
- Hormonal regulation of reproduction and molting in important cultivable crustaceans.

- **Gene bank and Conservation:** Cryopreservation of gametes and embryos. Embryo transfer technology.

UNIT – III:

- **Feed technology:** Micro encapsulated feeds; micro coated feeds; micro particulate feeds and bio-encapsulated feeds; mycotoxins and their effects on feeds.
- **Algal biotechnology:** Biotechnological approaches for production of important microalgae; single cell protein from Spirulina; vitamins, minerals and omega3 fatty acids from micro algae; enrichment of micro algae with micronutrients.
- Application of Nanotechnology in aquaculture; A general knowledge of tissue culture.

UNIT – IV

- **Health management**: DNA and RNA vaccines; molecular diagnosis of viral diseases; Biofilms and its impact on health management; genetically modified microorganisms as probiotics, immunostimulants, bioremediation of soil and water.
- Nitrogen fixation in aquatic environment and Biofertilizers.
- **Post-harvest biotechnology:** Delaying of spoilage; biosensors.

Reference Books:

1. Bhattacharya S.1992.Hormones in Pisciculture. Biology Education,Vol. 9 No.1 pp.31- 41.
2. CIFE. 1998. Summer School Manuals, Mumbai.
i). Recent Developments in Biotechnology: Applications to Aquaculture & Fisheries. ii). Genetics and Biotechnolical Tools in Aquaculture and Fisheries.
3. Felix S. 2007. Molecular Diagnostic Biotechnology in Aquaculture. Daya Publ. House.
4. ICAR. 1992. Biotechnology in Aquaculture. Training Manual. C.I.F.A, Kausalyaganga, Bhubaneswar, Orissa.
5. Lakra WS, Abidi SAH, Mukherjee SC & Ayyappan S. 2004. Fisheries Biotechnology. Narendra Publ. House.
6. Nagabhushanam R, Diwan AD, Zahurnec BJ & Sarojini R. 2004. Biotechnology of Aquatic Animals. Science Publ.
7. Nair PR. 2008. Biotechnology and Genetics in Fisheries and Aquaculture. Dominant Publ.
8. Pandian TJ, Strüssmann CA & Marian MP. 2005. Fish Genetics and Aquaculture Biotechnology. Science Publ.
9. Ramesh RC. 2007. Microbial Biotechnology in Agriculture and Aquaculture. Vol. II. Science Publ.
10. ReddyPVGK, Ayyappan, ThampyDM & Gopalkrishanan 2005.Text Book of Fish Genetics and Biotechnolical
11. Singh B. 2006. Marine Biotechnology and Aquaculture Development. Daya Publ. House

M. Sc. ZOOLOGY-II (SEM-IV)
Course Code: PP-AAI- 484
Course: Aquaculture and Its Application

Total Teaching hours: 60 **Marks: 100**

Learning Objectives:-

- To learn the fresh water aquaculture and its different types aquaculture, enclosure, integrated, Sewage fed fish culture practices with its significance and Importance as food source.
- To learn the importance of Aquaculture engineering, Topography, Pond construction, role of hatcheries and hydrology of ponds.
- To learn the importance of selection of species in aquaculture practices and pre-stocking management
- To learn Post stocking management and growth management , importance of ponderal index of fishes

Course Outcomes:

- Students will be able to get the knowledge of freshwater aquaculture and correlate it with filling of food gap and application of it.
- Learner would acquire the skill of Topography of site selection, pond construction, pond management, in aquaculture which help them in developing entrepreneurship
- Learners would acquire the knowledge of pre-stocking and post -stocking and Post stocking management of ponds.
- .Learners would acquire the knowledge of Soil and Water quality parameters, algal blooms and their adverse effect on aquaculture which will helpful to them during entrepreneurship

UNIT – I

- **Aquaculture Systems and Methods**: Scope and definition; origins and growth of aquaculture; biological and technological basis; Traditional, extensive, semi - intensive and intensive culture; monoculture, polyculture, composite culture, mixed culture, monosex culture; cage culture, pen culture, raft culture, race way culture, culture in recirculatory systems; warm water and cold water aquaculture; sewage – fed fish culture,
- **Selection of Sites:** Survey and location of suitable site – topography; soil characteristics; acid sulphate soils; water source; hydrometerological data.

UNIT – II

- **Aquaculture Engineering:** Design and construction of pond, layout and design of aquaculture farm, construction, water intake system, drainage system; aeration and aerators; recent advances in aquaculture engineering; tips for better aquaculture practices; design and construction of hatcheries.
- **Hydrology of Ponds:** Types of ponds; sources of water – precipitation, direct run off, stream inflow, ground water inflow, regulated inflow; losses of water– evaporation, seepage, outflow, consumptive use, water budgets of embankment ponds; water budget of an excavated pond; water exchange.

UNIT – III:

- **Selection of Species:** Biological characteristics of aquaculture species; economic and market considerations; seed resources, collection and transportation.

- **Pre Stocking Management:** Sun drying, ploughing / tilling, desilting, liming and fertilization, eradication of weed fishes.
- **Stocking:** Acclimatization of seed and release; species combinations; stocking density; ratio.

UNIT – IV:

- **Post Stocking Management:** Water and soil quality parameters required for optimum production, control of aquatic weeds and aquatic insects, algal blooms; specific food consumption, food conversion ratio (FCR), protein efficiency ratio, true net protein utilization, apparent net protein utilization, biological value of protein.
- **Growth:** Measurement of growth; length - weight relationship; methods of determination of age in fishes and shellfish based on length data and growth checks; ponderal index; growth hormones.

Reference Books:

1. Mathew Landau. 1995. Introduction to Aquaculture. Daya Publishing House, New Delhi.

2. Pillay, T. V. R. 1993. Aquaculture: Principles and Practices. Fishing News Books. Black Well Scientific Publications.

3. MPEDA, 1991. Hand Book on Shrimp Farming, Kochi, India.

4. Jhingran, V. G. 1982. Fish and Fisheries of India. Hindustan Publishing Corporation, New Delhi. Chakrabarti, N. M. 1998. Biology, Culture and Production of Indian Major Carps. Narendra Publishing House, New Delhi.

5. Coche, A. G. and J. F. Muir. 1996. Pond Construction and Fresh Water Fish Culture – Pond Farm Structures and Layouts – Simple Methods for Aquaculture. FAO. Daya Publishing House, New Delhi. Upadhyay, A. S. 1995. A Hand Book on Design, Construction and Equipments in Coastal Aquaculture (Shrimp Farming). Daya Publishing House, New Delhi.

6. Wheaton, F. W. 1985. Aquaculture Engineering. MPEDA, Cochin.

7. MPEDA 1990. Aquaculture Engineering and Water Quality Management. Cochin, India

M. Sc. ZOOLOGY-II (SEM-IV)
Course Code: P-LC-485
Lab Course XIII (Based on P-APH-481)
Course: Animal Physiology

Total Teaching hours: 60 **Marks: 100**

Learning objectives:

To make the students to understand the haematological and immunological techniques.
• To make the students to understand the haematological techniques conducted in laboratories including, complete blood count, blood grouping, blood films, differential count.
• To make the students to understand the process of digestion by qualitative detection of digestive enzymes.
• To make the students to understand the analytical techniques know the functional status of different organ.

Learning outcomes

Learners would understand the different physiological process of animals
• Learners would be able to understand functional status of organ
• Learners would be able to understand complete blood count, blood grouping, blood films, and differential count.
• Learners would understand the respiratory status of animals

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- Qualitative detection of digestive enzymes (protease, Amylase and Lipase) in cockroach/ Crab.
- Detection of human salivary amylase.
- Estimation of oxygen consumption in fish/ Crab or any other suitable aquatic animal.
- R.B.C. Counting.
- W.B.C. counting.
- Differential leucocyte count of blood.
- Measurement of blood pressure by sphygmomanometer.
- Estimation of Haemoglobin.
- Estimation of urine / serum creatinine from blood
- Estimation of urine / serum urea by diacetyl monoxime method 11Colorimetric estimation of blood/serum cholesterol.
- ESR of blood.
- Determination of clotting time of blood by capillary tube method.
- Estimation of glucose by Benedict quantitative method.
- Determination of bilirubin in serum
- Qualitative detection of Nitrogenous waste products (Ammonia, Urea.
- To estimate BMI (Body mass Index).

M. Sc. ZOOLOGY-II (SEM-IV)

Course Code: P-LC-486

Lab Course XIV (Based on P-ACT-482)

Course: Animal Cell Culture Technology

Total Teaching hours: 60 **Marks: 100**

Learning Objectives:

- The course in designed to give a basic understanding on the fundamental aspects of cell culture.
- Enable students to understand preparation of glass wares for cell culture.
- Enable students to understand isolation of cells by enzyme digestion.
- Enable students to understand methods for cell separation and viable cell count.
- Enable students to understand cell culture and measurements of growth parameters.
- Enable students to understand about cell cycle analysis.

Learning Outcomes:

- Students enable to understand how to prepare glass wares for cell culture.
- Students enable to understand isolate cells by enzyme digestion.
- Students enable to understand separation of cells.
- Students enable to understand cell cycle analysis & measurements of growth parameters**.**

Practicals:

1. Preparation of glass wares for cell culture
2. Isolation of cells by enzyme digestion
3. Separation of cells by suitable methods
4. Viable cell count
5. Primary cell culture and its maintenance
6. Measurements of growth parameters
7. Cell cycle analysis
8. Karyotype studies.

M. Sc. ZOOLOGY-II (SEM-IV)

Course Code: P-LC-487

Lab Course I (Based on P- ABT-484)

Course: Animal Biotechnology

Total Teaching hours: 60 **Marks: 100**

Learning Objectives

- Enable students to understand basic concept Principles Animal Biotechnology.
- Enable students to understand principal and techniques of Recombinant DNA Technology.
- Enable students to understand Construction of Genomic Library.
- Enable students to understand GMO.
- Enable students to understand food preservation.harmone therapy and advancement in animal biotechnology.

Learning Outcomes:

- Upon completion of the course students will be able to:
- Utilize the developed expertise in concepts, practical, and emerging methodologies in animal biotechnology.
- Can Perform Experiments Like Isolation Of Genomic DNA From Bacteria.
- will able to isolate different probiotics
- Will able to handle Gene Gun, Microinjection, PCR.

Practicals:

1. Isolation Of Genomic DNA from Bacteria
2. Isolation and purification of Plasmid DNA
3. Construction of Genomic Library.
4. Demonstration of Protocol for PCR
5. Demonstration DNA microinjection method
6. Demonstration gene gun method.
7. Demonstration of blotting techniques.
8. Isolation of Lactic Acid Bacteria from Curd.
9. Collection and preservation of fish pituitary gland and preparation of pituitary extract for induced breeding
10. Brood-stock management and selection of carp brooders for injection.
11. Cryopreservation of fish gametes.
12. Determination of some stages of the molting cycle of penaeus duorarum, by microscopic examination.
13. Molecular diagnosis of disease- PCR method.
14. Cell density of algal culture.
15. Eyestalk ablation procedure in crustaceans.
16. Use of probiotics in aquaculture farms.
17. Induced breeding

M. Sc. ZOOLOGY-II (SEM-IV)
Course Code: P-LC-488
Course: Aquaculture and Its Application
Lab Course II (Based on P-AAI- 484)

Total Teaching hours: 60 **Marks: 100**

Learning Objectives:-

- To learn the lay out fresh water / brackish water fish farm and hatchery
- To learn the types of filters and production cost of a fresh water farm
- To learn importance of cultivable fish species, ponderal index, Length weight relationship.
- To learn the design of Chinese hatchery, cages, aerators etc.

Course outcomes

- Learner would acquire the skill of construction of a fresh water fish farm and Chinese hatchery
- The learners will be able to find out the importance of filters and production cost of a fish farm
- Learners will be come to know the importance of Cultivable fish species.
- Learners will be able to know the different aspects of Freshwater Aquaculture.

Practicals:

1. Design and layout of fresh water and brackish water farms.
2. Estimation and calculations of production costs of fresh water fish farm.
3. Different types of filters/ Dark and light bottle -Pond productivity.
4. Length weight relationship
5. Ponderal -index.
6. Study of Cultivable fish & Shell fish Species.
7. Study of different types of Cages.
8. Design and construction of Chinese hatchery
9. Study of Aerators
10. Survey report of one fresh water farm
11. Submission of the model of a fresh water fish farm.
12. Estimation of hardness, alkalinity, salinity of freshwater.
12. Visit to fish farm/Seed production centre or hatchery.