DAVANGERE UNIVERSITY



Syllabus for

MASTER OF SCIENCE IN ZOOLOGY

Choice Based Credit System (CBCS)

Effective from -2020-21

DEPARTMENT OF STUDIES IN ZOOLOGY DAVANGERE UNIVERSITY DAVANGERE-577007

DAVANGERE QUNIVERSITY

Department of Zoology Shivagangothri, Davangere

Prof. C B Ganesh BOS (PG), Chairman

Date: 07-03-2020

Proceedings of the meeting of Board of Studies in Zoology (PG) held on 07th March 2020 at the Department of Zoology, Davangere University, Shivagangothri, Davangere at 10.30 am.

MEMBERS PRESENT:

- 1. Prof. C B Ganesh.
 Professor and Chairman
 Department of Zoology,
 Karnatak University
 Dharwad..
- Prof. Basavarajappa S.
 Professor,
 Department of Zoology,
 Mysore University
 Mysore.
- 3. Dr. Ambaresha Chabbi
 Assistant Professor,
 Department of Zoology,
 Davangere University,
 Davangere
- 4. Dr. Renuka C. Khaple
 Assistant Professor
 Department of Zoology,
 Davangere University,
 Davangere

Members Absent:

1. Prof. Nagaraj
Professor
Department of Zoology,
Kuvempu University,
Shimoga

Ragistrar Davangere University Shivagangotri, Davangere Chairman

Member 00

Internal Member and Convener

Internal Member Julia 2000

 Prof. M.G.Venkatesha Professor Department of Zoology, Bangalore University Bangalore The Chairman welcomed the board members and placed the agenda before the committee for discussion.

Agenda

1. Updating the Examiners Panel (PG):

The BOS has prepared and approved the panel of examiners as per seniority for examination to be held during 2020-21 onwards.

2. Revision/update of syllabus for M.Sc. Zoology course of I and II semester with effect from 2020-2021.

The syllabus has been revised / updated as per CBCS Scheme, UGC guidelines.

All the members read the syllabus and approved.

Further, it is resolved to prepare III and IV semester syllabus in next BOS meeting.

The Chairman thanked all the members for their active participation and kind cooperation.

Prof. C B Ganesh
Chairman
Dard of Studies in Zoo

Board of Studies in Zoology, Davangere University. Chairman

PGBOS in Zoology Davanagere University

Davangere University Shivagangotri, Davangere



DEPARTMENT OF STUDIES IN ZOOLOGY SHIVAGANGOTRI, DAVANGERE

Prof. C. B. Ganesh BOS (PG), Chairman

Date: 09.02.2021

Proceedings of the meeting of Board of Studies in Zoology (PG) held on 9th March 2021 at the Department of Zoology, Davangere University, Shivagangothri, Davangere at 10:30am.

Members Present:

1. Prof. C. B. Ganesh
Professor and Chairman
Department of Zoology,
Karnatak University
Dharwad.

 Prof. Basavarajappa S. Professor Department of Zoology Mysore University Mysore

3. Prof. Nagaraja
Professor
Department of Zoology
Kuvempu University
Shimoga

4. Dr. Ambarisha Chabbi Assistant Professor Department of Zoology Davangere University Davangere

5. Dr. Renuka C. Khaple Assistant Professor Department of Zoology Davangere University Davangere

Members Absent:

Prof. M.G. Venkatesha
 Professor
 Department of Zoology
 Bangalore University, Bangalore

Chairman

External Member

External Member

Internal Member and Convener

Internal Member

External Member

Prof. C B Ganesh, B.O.S. Chairman welcomed the board members and briefed about the following agenda before the committee for deliberations. The board has discussed thoroughly about each agenda.

Agenda:

- 1. The board has approved the revised/updated syllabus for M.Sc. Zoology course of in and IV semester which is focused on employability, entrepreneurship and skill development.
- 2. The board has given approval for the syllabus of open elective courses (ZOO3.5A Economic Zoology, ZOO3.5B Human Genetics and ZOO3.5C Biology of Reproduction) for III semester, P.G Students of Davangere University.
- 3. The board has prepared the syllabus and approved the Value added course (ZOO Aquaculture and by-products) for the students of M.Sc. Zoology and P.G students of Davangere University from other disciplines.
- 4. The board has given approval for the program outcomes, program specific outcomes and course outcomes (course objectives and program objectives).

Chairman
PGBOS in Zoology
Davanagere University

Davangere University

Department of Studies in Zoology

M.Sc. Zoology (CBCS) Course Structure (2020-21 onwards)

| | | | | | Marks | Marks | | | |
|--------------|--|--|--------------------------|-------------|------------------------|--|---------|----------------------------------|--|
| | Subject/Paper Code Little of the Paper | | Instruction Hrs./week | Examination | Internal Assessment | Total Marks | Credits | Examatination duration (Hrs.) | |
| | THEORY PAPERS | | | | | | | | |
| | ZOO 1.1 Animal Systematics and Biology of Non-Chordates | | 4 | 70 | 30 | 100 | 4 | 3 | |
| Ξ | ZOO 1.2 | Biology of Chordates | 4 | 70 | 30 | 100 | 4 | 3 | |
| EF | ZOO 1.3 | Basic and Applied Entomology | 4 | 70 | 30 | 100 | 4 | 3 | |
| ST | Z00 1.4 | Biochemistry and Instrumentation | 4 | 70 | 30 | 100 | 4 | 3 | |
| 9 | | PRACTIC | AL PAPE | RS | | | | | |
| SEMESTER-I | Z00 1.5 | Animal Systematics and Biology of Non-Chordates | 4 | 50 | - | 50 | 2 | 3 | |
| | Z00 1.6 | Biology of Chordates | 4 | 50 | | 50 | 2 | 3 | |
| | Z00 1.7 | Basic and applied Entomology | 4 | 50 | | 50 | 2 | 3 | |
| | ZOO 1.8 | Biochemistry and Instrumentation | 4 | 50 | | 50 | 2 | 3 | |
| | | Credits: English Language | | | | | | | |
| | | Communication Skills | 2 | - | - | - | 2 | - | |
| | THEORY PAPERS | | | | | | | | |
| | ZOO 2.1 | Advanced Cell Biology | 4 | 70 | 30 | 100 | 4 | 3 | |
| = | ZOO 2.2 | Genetics and Molecular Biology | 4 | 70 | 30 | 100 | 4 | 3 | |
| ₹ | ZOO 2.3 | Developmental Biology | 4 | 70 | 30 | 100 | 4 | 3 | |
| E | ZOO 2.4 | Animal Physiology | 4 | 70 | 30 | 100 | 4 | 3 | |
| SEMESTER-II | PRACTICAL PAPERS | | | | | | | | |
| Z | ZOO 2.5 | Advanced Cell Biology | 4 | 50 | - | 50 | 2 | 3 | |
| SE | ZOO 2.6 | Genetics and Biostatistics | 4 | 50 | _ | 50 | 2 | | |
| | ZOO 2.7 | Developmental Biology | 4 | 50 | - | 50 | 2 | 3 | |
| | ZOO 2.8 | Animal Physiology | 4 | 50 | - | 50 | 2 | 3 | |
| | | Credits: Computer Skills | 2 | - | | | | 3 | |
| | Mandatory | THEORY | | | - | • | 2 | - | |
| | Z00 3.1 | Animal Biotechnology | 4 | 70 | 20 | 100 | 4 | - | |
| | ZOO 3.2 | Parasitology and Immunology | 4 | 70 | 30 | 100 | 4 | 3 | |
| | | Evolutionary Biology and | 4 | 70 | 30 | 100 | 4 | 3 | |
| | ZOO 3.3 | Ethology | 4 | 70 | 30 | 100 | 4 | 3 | |
| 具 | ZOO 3.4 | Applied Zoology | 4 | 70 | 30 | 100 | 4 | 3 | |
| SEMESTER-III | ZOO 3.5 | A: Economic Zoology/ B: Human | | 40 | 10 | 50 | 2 | 2 | |
| | PRACTICAL PAPERS | | | | | | | | |
| | ZOO 3.6 | Animal Biotechnology | 4 | 50 | _ | 50 | 2 | 3 | |
| | ZOO 3.7 | Parasitology and Immunology | 4 | 50 | _ | 50 | 2 | 3 | |
| | ZOO 3.8 | Evolutionary Biology and Ethology | 4 | 50 | - | 50 | 2 | 3 | |
| | ZOO 3.9 | Applied Zoology | 4 | E0. | | 50 | 2 | 2 | |
| | | THEORY PAPERS & PROJE | CT WOR | 50 K/DIES | EDT ATI | 50 | 2 | 3 | |
| SHA | NAME AND ADDRESS OF THE OWNER, WHEN PERSON AND POST | The state of the s | VV () N | 16/11/16 | | TIME TO SERVICE THE PROPERTY OF THE PROPERTY O | | | |

| | | Reproduction | | | | 1 | | |
|------|---------------|---|---------|---------|----------|-------|-----|---|
| | ZOO 4.2 | Environmental Biology | 4 | 70 | 30 | 100 | 1 | - |
| | ZOO 4.3 | Biodiversity, conservation and Biostatistics | 4 | 70 | 30 | 100 | 4 | 3 |
| | Z00 4.4 | Project Work/Dissertation | 6 | 70 | 30 | 100 | 6 | 2 |
| | | PRACTICAL PAPERS & | STUDY T | OUR/FIL | TI D VIS | IT IV | 1 0 | |
| | ZOO 4.5 | Endocrinology and Biology of Reproduction | 4 | 50 | - | 50 | 2 | 3 |
| | ZOO 4.6 | Environmental Biology | 4 | 50 | | 70 | | |
| | ZOO 4.7 | Biodiversity and conservation | | | • | 50 | 2 | 3 |
| | Study Tour/ | Field Visit | 4 | 50 | - | 50 | 2 | 3 |
| 1000 | Mandatami | Condita B | - | - | - | - | - | |
| | Triandatory | Credits: Personality Development | 2 | - | | | 2 | |
| | 1 otal Credit | s for the Course | 134 | 200 | 10 | 2400 | 100 | |

- 1.1.3 Average percentage of courses having focus on employability/ entrepreneurship/ skill development during the last five years (10)
- 1.2.1 Percentage of new courses introduced of the total number of courses across all programmes offered during the last five years (30)

| Course Code | Name of the Course | Year of introduction | Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development |
|----------------|---|----------------------|--|
| 2001.1 | Animal Systematic and Biology of Non- Chordates | 2020-21 | Students develops the skill of classifying the animals on the basis of taxonomic keys. Student develops the skill of collection, identification and preservation of specimens in the field and also inculcate the skill of curating and cataloging the specimen. Students develop the skill of using biometric techniques in taxonomic procedures. Students develop the skill of using biometric techniques in taxonomic procedures. After developing the skill of collection, identification, preservation the students can be employed in zoological museums and as curators or field experts. |
| 001.2 | Biology of Chordates | | Students develop skill of identification and classification of different chordate animals based on their peculiar features. The gained skill may provide employability as scientific assistants/curators at Zoological museums. |

| | | | Students develop the skills involved in insect collection, processing, preservation and identification. Potential careers include the agricultural entomologist, veterinary entomologist, medical entomologist, taxonomic entomologist, forensic entomologist. They can explore the domains of consultancy pest and vector management services, field survey officers for entrepreneurship. Employment opportunities in pest monitoring, vector control and management services, research associates in forensic labs, medical |
|--------|-----------------------------------|---------|--|
| ZOO1.3 | Basic and Applied Entomology | 2020-21 | labs, insect collectors, in government sector as agriculture or horticulture officers, teachers in schools, colleges and universities. |
| Z001.4 | Biochemistry and instrumentation | 2020-21 | Develop skills in different biological techniques such as chromatography, flow cytometry, ELISA, spectrophotometer, calorimeter, NMR, FISH, GISH, PCR, Electrophoresis, microtomy and cryostat microtomy. |
| ZOO2.1 | Advanced Cell Biology | 2020-21 | Students learn to apply the knowledge of cellular functions to various diseases including cancer and employment opportunities in teaching, research sectors. |
| ZOO2.2 | Genetics and Molecular Biology | 2020-21 | Students learn basic fundamental concepts of genetics and gene, chromosomal aberrations, disorders, pedigree analysis. Knowledge and application of biostatics in life science. Employment opportunities in teaching, human genetics research institutions. |

| ZOO2.3 | Developmental Biology | 2020-21 | Gained knowledge from this course will help students to get job opportunities at development biology labs as expert assistants and teaching profession at colleges/universities. |
|--------|---|---------|---|
| ZOO2.4 | Animal Physiology | 2020-21 | Develop the skill of measuring different physiological activities such as lung capacity, ECG and measuring sugar levels in urine samples. Teaching field, as lab assistants in pathology departments. |
| ZOO3.1 | Animal Biotechnology | 2020-21 | Teaching, research laboratory settings. |
| ZOO3.2 | Parasitology and Immunology Evolutionary Biology and | 2020-21 | Inculcate the skill of identifying and differentiating different types of pathogens and their developmental stages. Identify blood groups, HIV tests etc. Teaching field, microbiology lab experts. Can start their own diagnosists bases and parasitology and immunological studies done in theory and practicals. Course enables the students to recognize the significance of process of natural selection and adaptation in evolution. They acquire knowledge about social and sexual behavior, behavior of different embryos, parental care and defensive behavior animals. Employment opportunities in teaching, research laboratory and |
| ZOO3.3 | Ethology | 2020-21 | zoological garden, museum settings. |
| Z003.4 | Applied Zoology | 2020-21 | Study of this course introduces students to learn the rearing and management practices in pisciculture, pearl culture, aquaculture, apiculture, Sericulture, vermiculture, poultry science, dairy technology, and their products. It could motivate the learners for entrepreneurship. |

| ZOO3.5 | Economic Zoology | 2020-21 | This course will help students to aquire knowledge about aquaculture, apiculture, Sericulture, vermiculture, poultry science, dairy technology, and their products and could motivate the learners for entrepreneurship. |
|-------------|---|-----------|--|
| ZOO 3.5B | Human Genetics | 2020-21 | Students learn to establish relationship between the chromosome mutations and genetic diseases. Opportunities in teaching, research and medical laboratories. |
| ZOO 3.5C | Biology or Reproduction | f 2020-21 | The gained knowledge may provide employability as technician/scientific assistants at cryobanks and fertility research centers |
| ZOO4.1 | Endocrinology and Biology of Reproduction | | Develop the skill of pregnancy testing and identify different hormonal imbalances. Teaching field and as endocrinologists in labs. |
| ZOO4.2 | Environmental Biology | 2020-21 | Study about natural resources, environmental problems, pollution, global ecology could encourage learners to find job opportunities in science journalism, may provide employability as technician/scientific/research assistants at research laboratories, scientific officers at pollution control boards, research associates in NGOs, teachers in schools/colleges/universities. |
| ZOO4.3 | Biodiversity, | 2020-21 | Develop the skill of capturing and marking techniques which would help in during fieldworks involving census and monitoring the health status of wild animals in national parks, sanctuaries and salt water |

| | | | lakes. Learn about different statistical procedures, graphical representation for analysis of biologicaldata/samples.Opportunities in teaching, research and NGOs. |
|--------|---------|---------|---|
| Zoo4.4 | Project | 2020-21 | Students can gain practical knowledge about identification of the research problem and application of appropriate research methodology to reach goals. Develop skills in handling of research animal models, biological techniques and field studies. Learn and acquire skills related to tools for data collection and analysis, scientific writing and preparation of dissertation. |



I. Program outcomes:

PO1: Understand the fundamental aspects of animal sciences, and interpret the complex interactions among various living organisms and Correlate the physiological processes and the functional significance of organ systems.

PO2: Gain in-depth knowledge about classification, organization, origin and evolution of organisms and their phylogenetic interrelationships.

PO3: Recognize the need for conservation of the environment, biodiversity and endangered species.

PO4: Gain knowledge about agro-based small scale industries like sericulture, apiculture, fish, dairy and poultry farming and vermicompost preparation.

II. Program Specific outcomes:

PSO1: students will be well-versed with the knowledge, tools and methods applied in the field of animal sciences. They would have plethora of job opportunities in the education, health-based sectors, environment, and agriculture related sectors.

PSO2:Students will be made competent to undertake competitive exams successfully. The broad skills and the deeper knowledge in the field would make them highly successful and excellent researcher in advanced areas of research in the Biological sciences.

PSO3: Develop the ability to participate in academic discussions.

III. Course outcomes:

ZOO 1.1 Animal systematics and Biology of non-chordates

Course outcomes:

- 1. Understand, identify and classify animals and gain in depth knowledge of taxonomic keys, different hierarchies and rules of animal's nomenclature.
- 2. Gain experience about practical collection, curating, cataloging and processing of taxonomic non-chordate species, their physiological processes such as movement, respiration, excretion, nervous system, reproductive system and circulation.
- 3. Acquire knowledge to create phylocode, grades, clades, cladistics and learn different biometric techniques.
- 4. Identify the different larval forms and their importance in the process of evolution.

ZOO 1.2 Biology of Chordates

- Gain in-depth knowledge about classification, organization, and origin and evolution of chordates. Awareness of phylogeny and systematic position of protochordates. A deep understanding about phylogenetic interrelationship with each other.
- 2. Develop scientific awareness about adaptations and migration among fishes and birds.
- Inculcate sound basics about sensory physiology in fish, and behavior and parental care in vertebrates and acquire proper understanding about integuments and their derivatives.

ZOO 1.3 Basic and Applied Entomology

Course outcomes:

- 1. Acquire knowledge about origin, evolution, diversity, importance of insects, insect collection, processing and preservation and dentify the divisions and morphological organization of insects and comprehend growth and development of insects.
- 2. Understand the internal anatomy and physiology of digestion, respiration, excretion, circulation, reproduction, neuro-endocrine systems and pheromones.
- 3. Comprehend insect pests, nature, type of damage caused and treatment/ preventive measures for insect pests of important agricultural crops, horticultural plants, stored products and domestic animals.
- 4. Distinguish between various methods involved in pest management and appreciate insects of economic importance and describe insect vectors, household pests and their infestation and elucidate the utility of insects in medico-criminal investigations.

ZOO 1.4 Biochemistry and Instrumentation

- 1. Describe the aspects of scope and principles of biochemistry and biophysics, atom structure, thermodynamic principles, Van der walls interaction of biomolecules, carbohydrates, configuration, classification of proteins and structural organization of Ramachandran plot and Christian Anfinsen's concept.
- 2. Learn about lipid organization, biosynthesis, enzyme concept and applications, DNA and RNA structure, types, disease concept and understand the principles and applications of various biological techniques.
- 3. Develop skills in different biological techniques such as chromatography, flow cytometry, ELISA, spectrophotometer, calorimeter and NMR
- 4. Understand the gene or protein localization using radiolabeled probes subjected to FISH, GISH, PCR, Electrophoresis, microtomy and cryostat microtomy.

ZOO 2.1Advanced Cell Biology

Course outcomes:

- 1. Gain knowledge on the structure of the eukaryotic cell and its components
- 2. Understand the functions of the cell atbasic and molecular level
- 3. Apply the knowledge ofcellular functions to various diseases including cancer.
- 4. Describe the internal structure of cell, and correlate its functional relationship with various metabolic functions of organisms.

ZOO 2.2 Genetics and Molecular Biology

Course outcomes:

- 1. Recognize the importance of genetic material and get an insight into its functional significance in living organisms.
- 2. Understand the patterns of inheritance and gene interactions.
- 3. Understand the mechanism of gene regulation in prokaryotes and eukaryotes.
- 4. Gain knowledge on human karyotyping and its applications in various diseases and syndromes.

ZOO 2.3 Developmental Biology

- 1. Understand the mechanisms involved in regulation of developmental process in organisms
- 2. Understand the process of fertilization and sex determination in different animals
- Acquire knowledge about environmental and chemical disruption of normal development and understand the importance genes and their expression patterns in determination of body axis in *Drosophila* and mammals
- 4. Gain knowledge about hormones and their receptors and mechanisms of signal transduction in cell death and neuron formation and understand the molecular mechanisms of metamorphosis in amphibians and regeneration in hydra and planaria.

ZOO 2.4 Animal Physiology

Course outcomes:

- 1. Understand the concept of homeostasis and feedback mechanisms and explain the physiology of digestion and absorption of different biomolecules.
- 2. Discuss about the patterns of respiration and circulation in animals and understand the importance of osmotic regulation and excretion
- 3. Comprehend the physiological mechanisms involved in muscle movement and contraction.
- 4. Appreciate the regulatory mechanisms of body temperature in animals. And describe the structure, function and organization of nervous system.

ZOO 3.1 Animal Biotechnology

Course outcomes:

- 1. Describe the scope and applications of biotechnology and get acquaintance with various cell/tissue culture techniques
- 2. Explain the tools used in genetic engineering and applications of r-DNA technology in Medicine, environment and industries and describe thestem cell technology and scientific awareness about policies and ethics in stem cell research.
- 3. Understand the significance of *in vitro*-fertilization, Embryo transfer and cloning in mammals.
- 4. Acquire knowledge ingene therapy and production of transgenic animals and clarify the ethical issues involved in production transgenic animals

ZOO 3.2 Parasitology and Immunology

- Gain basic knowledge about pathogenic micro-organisms of man and domestic animals
- 2. Recognize the pathogenicity of nematodes and trematodes and learn about treatment process and preventive measures.
- 3. Understand the life cycle of some of the pathogens and roles played by vectors in transmission of diseases like malaria, filaria, dengue etc.

4. Gain basic knowledge about the immune system and types of immunity and elucidate the importance of B and T cells in immune response and clarify the utility of the vaccines.

ZOO 3.3 Evolutionary Biology and Ethology

Course outcomes:

- 1. Gain knowledge about the processesof evolution and understand the concept of molecular clocks and gene trees.
- 2. Elucidate the significance of fossil records in understanding of the evolutionary trends and construction of phylogenetic treesand evaluate biogeographic evidences of evolution, patterns of distribution of flora and fauna.
- 3. Recognize the significance of process of natural selection and adaptation in evolution and appreciate the process of speciation, coevolution and different types of interactions and macroevolution.
- 4. Recognize different habitats selection, behavioral patterns and biological clocks in animals and acquire knowledge about social and sexual behavior, behavior of different embryos, parental care and defensive behavior animals.

ZOO 3.4 Applied Zoology

- 1. Get comprehensive idea about different types of aquaculture systems and various economically important fin and shell fishes
- Understand the importance of fish and its by-products and fish disease management and get scientific awareness about ecological and economic importance of earthworms and vermicomposting preparation
- 3. Understand rearing of dairy and poultry breeds and appreciate the value of dairy and poultry products and gain knowledge about Agro based small scale industries like fish farming, vermicomposting, dairy and poultry farming, sericulture and apiculture and gain knowledge on mulberry cultivation and silk worm rearing, diseases and pests of silk worm.
- 4. Learn about diagnosis, control and management of various silkworm diseases and get a basic understanding of biology of honey bees, rearing of bees and social organization in bee colony, importance of products and by products of apiculture.

ZOO 3.5A Economic Zoology (Open Elective)

Course outcomes:

- 1. Understand the scope and importance of economic zoology; recognize and elucidate the materials and methods involved in vermiculture practice.
- 2. Identify different breeds of fowls and cattle; Describe practices involved in poultry rearing and cattle breeding, management; and recognize the importance of products and by products of poultry and dairy.
- 3. Understand the history, development and management of beekeeping and lac culture; Identify important products and by products of apiculture and lac culture and comprehend the history, development and management practices of Sericulture.
- 4. Describe the economically important products of sericulture and learnthe methods of fish, prawn and pearl culture and importance of value addition of fish and its by-products.

ZOO 3.5B Human Genetics

Course outcomes:

- 1. Understand the basic concepts of human genetics.
- 2. Describe the ultra-structural organization of human chromosomes and the pattern of inheritance
- 3. Establish relationship between the chromosome mutations and genetic diseases.
- 4. Comprehend the salient features of the human genome and its application in understanding of genetic diseases.

ZOO 3.5C Biology of Reproduction

- Acquire basic knowledge about biological processes of sex determination and differentiation of gonads and gonadal ducts.
- 2. Learn the structure and functions of male and female reproductive organs
- Understand the importance of hormonal regulation of reproductive cycles in female and clarify the reproductive disorders in females.

4. Acquire knowledge about the onset of puberty, implantation, gestation, parturition and lactation in mammals.

ZOO 4.1 Endocrinology and Biology of Reproduction

Course outcomes:

- Get basic understanding aboutthe synthesis hormones from different endocrine glands and their biological significance and acquire knowledge about implantation, gestation and lactation in female and fertility control in male and female.
- Acquire knowledge about hormone receptors, signal transduction and mechanism of hormone action
- 3. Understand the physiological importance of different growth factors in vertebrates and discover the biological processes of sex determination and differentiation of gonads and gonadal ducts.
- Learnthe structure and functions of male and female reproductive organs and describe the importance of hormonal regulation of reproductive cycles in female and clarify the reproductive disorders in females.

ZOO 4.2 Environmental Biology

- 1. Understand and organize the fundamental concepts in ecology and structure, functions and importance of different ecosystems and comprehend the concepts related to energy, energy flow, productivity, energy based classification of ecosystem and differentiate between different ecological pyramids.
- Describe basic types of biogeochemical cycles, watershed biogeochemistry, elucidate recycling pathways, cycling index and analyze global climate change scenario.
- Acquire knowledge about concepts and interactions related to community ecology, bioaccumulation, biomagnification and identify the relevance of ecosystem development to human ecology.
- 4. Understand levels-of-organization concept, temporal and spatial scale, and describe the concepts related to landscape ecology, geometry and sustainability and recognize and discuss various environmental problems and policies, environmental laws and compare and contrast the use of renewable and non-renewable resources.

ZOO 4.3 Biodiversity, Conservation and Biostatistics

Course outcomes:

- Understand the concept and importance of biodiversity and biodiversity at different levels.
- Monitor and evaluate biodiversity in field studies and understand the realms of the world and hotspots of India and biodiversity and explore unique animals of Indian biodiversity and distribution and get an awareness about endemic and keystone species.
- 3. Learn the capturing andmarking techniques which would help in during fieldworks involvingcensus and monitoring the health status of wild animals in national parks, sanctuaries and salt water lakes and understand about reasons for loss of biodiversity, different social movements and methods of conservation.
- 4. Get enlightened about different biodiversity conventions, laws and projects for conservation of different wild animals and learn about different statistical procedures, graphical representation for analysis of biological data/samples.

ZOO 4.4 Project Work

- Gain practical knowledge about identification of the research problem and application of appropriate research methodology to achieve goals.
- 2. Develop skills in handling of research animal models, biological techniques and undertake successful field studies.
- 3. Learn tools for data collection and analysis.
- 4. Acquire skills related to scientific writing and preparation of

Value added course ZOOVAC01-Aquaculture and by-products

- Explore island fisheries, process of eggs collection, hatching and fries maintenance.
- 2. Understand the techniques of breeding of carps, transportation and rearing inponds and comprehend the knowledge about exotic fishes and sewage fisheries in India.
- 3. Acquire knowledge about riverine fisheries of Ganga, Brahmaputra and Indus riverine systems along with coastal riverine system, fishing crafts and gears and get awareness about marine fisheries resources, sea fishing crafts and gears.
- 4. Learn about estuarine fisheries, fish composition, processing techniques and fish by-products and gain in-depth knowledge about advantages and disadvantages of cage culture, exotic and indigenous larvicidal fishes in India.

ZOO 1.1 Animal Systematics and Biology of Non-Chordates

64 hours/week - Semester

Unit I:

10 Hours Importance of taxonomy, classification, nomenclature. PCK Role of systematics. Forms of classification: Linnaean hierarchies. Principles of zoological classification. Taxonomic keys. Challenges in taxonomy.

Unit II:

12 Hours

Methods of Zoological classification: Taxonomic collections, process of identification, taxonomic characters. Qualitative and quantitative analysis of characters. Collections, identification and preservation of specimens. Curating-types and cataloging. Taxonomic tissue and molecular material labelling, barcoding.

Unit III:

10 Hours

Principles and Application of Zoological nomenclature: ICZN, Rules of zoological nomenclature. Biocode, phylocode. Interpretation, grades and clades, cladistics analysis, pattern of cladistics, cladogram, vertical and horizontal relationship. Biometric techniques.

Unit IV:

12 Hours

Coelom, nutrition and locomotion in non-chordates:

Evolution, organisation and significance of coelom. Acoelomates, pseudocoelomates and coelomates. Protostomia and deuterostomia. Amoeboid, flagellar, cilliary movements in protozoa. Hydrostatic movement in annelida. Filter feeding in polychaetes, molluscans, crustaceans and echinoderms.

Unit V:

10 Hours

Respiration, Excretion and Circulation:

Organs of respiration in invertebrates: gills, book lungs, trachea, and lungs; respiratory pigments: hemoglobin, hemocynin, hemerythrin and chlorcruorin. Excretory organs: Flame cells, nephridia, coxal glands, green glands and malpighian tubules; Morphology and mechanisms. Patterns of circulation and functions of body fluids.

Unit VI:

10 Hours

Nervous system, Reproduction and minor phyla:

Primitive nervous system- Cnidaria and echinoderms; adavance nervous system- annelida, arthropoda and mollusca. Patterns of reproduction in non-chordates. Larval forms and their evolutionary significance. Minor phyla- sipunaclida chaetognatha and ctenophore.

References:

- 1. Barnes, R.D. Invertebrates Zoology. IInd Saunders, Philadelphia, 1968. 2. Barrington, E.J.W. Invertebrates structure and Function. Nelson, London, 1967.
- 3. Barrington, E. J. W. Structure and Function of Invertebrates. ELBS, 1971
- 4. Hyman, L.H. The Invertebrates. Vol. I-VI. McGraw-Hill, New York, 1940-67.
- 5. Mayr, E. Principles of Systematic Zoology. Tata-McGraw-Hill, New Delhi, 1997. 6. Mayr, E. and Ashlock, P. D. Principles of Systematic Zoology. 2nd Edition, McGraw-Hill,
- 7. Kapoor, V.C. Theory of Animal Taxonomy. Oxford IBH Co. Pvt. Ltd, New Delhi, 1998.
- 8. Marshall, A.J. and Williums W.D. (Eds). Text book of Zoology- Invertebrates, VII Ed. Vol. I
- 9. Russel Hunter, W.D. Biology of Lower Invertebrates. Macmillan Company, New York, 1968. nimal taxonomy. Columbia University Press, New York, 1961.

Unit I:

12 Hours

Protochordates and chordates: Introduction, general characters, organization, unique features and classification of chordates. Origin and evolution of chordates. Different theories of chordates origin. Phylogeny. systematic position and general organization of urochordata and cephalochordata. Significance of retrogressive metamorphosis. Affinities to chordate.

Unit II:

10 Hours

Vertebrates: Origin and evolution of vertebrates. Distinctive character and classification of agnatha and gnathostomata. Cyclostomes, ostracoderms and placoderms. Adaptive radiations in chondrichthyes elasmobranchs and holocephalians. Acanthodians, adaptive radiations osteichthyes -actinoptyrigians and sarcopterygians. Aquatic adaptations and migration in fishes, sensory organs in fish.

Unit III:

12 Hours

Herpets: Origin, evolution and adaptive radiations in amphibians. Stegocephalians-Ichthyostega and acanthostega and labyrinthodonts, parental care in extant amphibians. Neoteny: Types and significance. Distinctive characters of salamanders and caecilians. Origin, evolution and adaptive radiations in reptiles. Stem reptiles, amphibious adaptation of reptiles and extinction of mesozoic reptiles. Phylogenetic relationship between amphibians and reptiles. Parental care in reptiles.

Unit IV:

10 Hours

Aves: Origin and evolution and adaptive radiations of birds. Distinctive characters and classification of birds. Aerial adaptations, mechanism of flight. Courtship and breeding behavior, parental care, migration in birds. Aquatic/amphibious birds, flightless birds. Phylogenetic relationship of birds with reptiles.

Unit V:

10 Hours Mammals: Origin, evolution and adaptive radiations of mammals: prototherians, eutherians and placental mammals. Old World monkeys. Volant and aquatic adaptations in mammals. Migration and parental care in mammals. Dentition in mammals. Phylogenetic relationship of mammals with reptiles.

Unit VI:

10 Hours

Comparative anatomy and osteology: Integument and its derivatives, dermal and epidermal derivatives. Comparative anatomy of heart, aortic arches, brain and Kidney in vertebrates.

Osteology: Axial and appendicular skeletal system in humans.

References:

1. Marshall, A.J. and Williams W.D. (Ed). Text Book of Zoology: Vertebrates-VII (Ed.) Vol. II AITBS Publishers and Distributors, 1995.

2. McFarland, W.N. Harvey Pough, F. and Heiser, J.B. Vertebrate Life. Collier-Macmillan Publihers, London, 1979.

3. Pough, H.F. Heiser, J.B. and McFarland, W.N. Vertebrate Life. IV Ed. Prentice-hall of India, Pvt. Ltd, New Delhi, 1999

4. Pough, F.H. Janis, C.M. & Heiser, J.B. Vertebrate Life. Pearson Education, Inc., 2002 5. Romer, A.S. The Vertebrates Body. Saunders, Philadelphia, 1956.

6. Romer, A.S. and Parsons, T.S. The Vertebrates Body. Saunders, Philadelphia, 1986 7. Young, J.Z. The Life of Vertebrates. III Ed. Clarendon Press, Oxford, 1981.

ZOO 1.3 Basic and Applied Entomology 64 hours/week

12 Hours Introduction to insects: History, scope, importance and overview of Unit I: entomology. Evolution of insects. General characters, habitat, distribution of insects, systematic position and classification of insects up to orders. Salient features of insect orders and families with examples. Methods of insect collection, processing and preservation. Economic importance and ecological role of insects.

12 Hours Morphology and life cycle of insects: Divisions and organization of body. Head-general structure and functions of antennae, mouthparts, compound eyes, thorax, appendages, wings and abdomen. Structure and functions of cerci and external genitalia. Sense organs in insects. Life cycle: Growth and development of insects.

Unit III: Insect anatomy and physiology: Structure and functions of digestive system, respiratory system, circulatory system, excretory system, reproductive system and nervous system of insects. Endocrine gland and pheromones, bioluminescence in insects.

10 Hours Applied entomology: Origin of insect pests, general account on nature, type of damage of few important insect pests of agricultural (rice, jowar and maize), horticultural (coconut and aracanut) and commercial (sugarcane and cotton) plants, stored food grains (cereals and pulses), forest plants (teak, sandal, eucalyptus and neem). Major pests of domestic animals -poultry and cattle.

10 Hours Unit V: Integrated pest management: Physical, chemical, biological, genetic and quarantine methods. Insect venoms, Economic importance of insects: Honeybees, silkworms and lac insects.

10 Hours Unit VI: Medical and forensic entomology: Insect vectors - Mosquitoes, lice, flies and fleas. Pests: Cockroaches. Ticks and mites - infestation and economic importance. Uses and importance of insects in medicocriminal investigations.

References:

- 1. Ananthakrishnan, T.N. and Shivaramakrishnan, K.O. Ecological entomology: Insect life in odd environment. Scientific publishers, India. 2008.
- 2. Awasthi, V.B. Introduction to general and applied entomology. Scientific publishers, India. 2009. 3. Chapman, R.F. The Insects; structure and function. IV Ed. Cambridge University Press,
- Cambridge, 2004. 4. David, B.V. and Ananthakrishnan, T.N. General and applied entomology. II Ed. Tata McGraw-Hill publishing company limited, New Delhi. 2004.
- Dent, D.R. Insect pest management, Westville publishing house, Delhi. 1998.
- 6. Dent, D.R. and Walton, M.P. Methods in ecological and agricultural entomology. CAB international, United Kingdom, 1997.
 7. Eilenberg, J. An ecological and social approach to biological control. Springer. 2005.
- 8. Eldridge, B. Medical entomology. Springer. 2004.
- Gennard, D. Forensic entomology: An Introduction. John Wiley and Sons, Haboken, New Jersy. 2013. 10. Howse, P. E., Stevens, I.D.R. and Jones, O.T. Insect pheromones and their use in pest management, Chapman and Hall, London. 1998.
- 11. Jha, L.K. and Sarma, P.K.S. Forest entomology. APH Publishing corporation, New Delhi. 2019.
- 12. Lehane, M.J. Biology of blood sucking insects. Harper Collins Academic, London. 1991.
- 13. Snodgrass, R.E. Principles of insect morphology. Cornell University Press. 1993.

ZOO 1.4 Biochemistry and Instrumentation 64 hours/week

10 Hours

Scope and principles of biochemistry. Atoms, molecules, orbitals. Chemical bonds-Covalent bond, ionic bond, Hydrophobic and Van der waals interaction. Principle of biophysical chemistry: pH, buffer, thermodynamic principles, molarity, normality of solutions.

12 Hours Unit II: Carbohydrates composition of biomolecules: and and biological properties classification, physical, chemical carbohydrates, sugar derivatives, configuration, stereoisomers, chair and boat shaped configuration. Proteins - classification, physical, chemical / and biological properties of proteins, biological values of proteins. Structural organization of proteins: Ramachandran plot and Christian

12 Hours Unit III: Lipids and enzymes: Classification, structure and properties of fatty acids. Biosynthesis of lipids and steroids. Beta oxidation, bile salts and bile pigments, ketone bodies. Enzymes: Classification, kinetics, inhibition, factors affecting enzyme activity. Coenzymes, isoenzymes and abzymes. Clinical applications of enzymes.

Anfinsen's experiment. Protein folding and misfolding.

Unit IV: 10 Hours Nucleic acids: Classification, chemical composition and structural organization of RNA and DNA. Types of RNA and DNA. Biosynthesis of purines and pyrimidines, nucleosides and nucleotides. Salvage pathway. Disorders of nucleic acid metabolism.

Unit V: 10 Hours Chromatography: Principles, types and application of ion exchange chromatography, gas chromatography, column chromatography, liquid high proficiency chromatography, liquid chromatography. Principles, Spectrophotometry: types and application. spectrophotometer, calorimeter and its applications. Flow cytometry and ELISA.

Unit VI: Principles and applications - NMR, radiolabelling immune assay (RIA), FISH, GISH, PCR, electrophoresis. Microtomy and cryostat microtomy.

References:

- 1. Berg, J.M. Tymoczko, J.L. Stryer, L. and Gatto, G.J. Biochemistry. IX Ed. Kate Ahr Parker Berg, J.M. Tymores, W.H. Freeman company, 41 Madison Avenue, New York. 2012.
- Conn, E.E. Stumpf, P.F. Bruening, G. and Dooi, R.H. Outlines of Biochemistry. John Wiley and Sons, Singapore, 1995.
- 3. Garrett, R.H. and Grisham, C.M. Biochemistry. Saunders college publishing, Florida, 1995. Garrett, R.H. and Ordenstrand, U. Biochemistry. III Ed. Arunabha Sen, Books and Allied,
- Satyanaraya, C. Ltd. Kolkata, 2007.
 Voet, D. and Voet, G.J. Biochemistry. IV Ed. VP and publisher, United States of America, 20011. Voet, D. and Cox, M.M. (2008). Lehninger Principle of Biochemistry. VI Ed. W. H. Freeman

10 Hours

Discovery of cells, basic properties of cell, prokaryotic and eukaryotic cells. The origin of eukaryotic cells. Cell junctions and cell adhesion. Visualizing cells: Principles and applications - light microscope, phase-contrast microscope, fluorescent microscope, laser scanning confocal microscope, scanning and transmission electron microscope (SEM and TEM). Cell fractionation and cell differentiation

12 Hours Unit II:

Cellular membranes: A brief history of studies on plasma membrane structure, chemical composition of bio-membranes, structure and functions of membrane proteins - carrier proteins, channel proteins, and multidrug resistance transport protein. Movement of substance across cell membranes - passive transport, active transport, membrane pumps, pinocytosis, phagocytosis, receptor mediated endocytosis and transcytosis.

12 Hours Units III:

Endoplasmic reticulum (ER): Protein secretion, targeting proteins into ER, the signal hypothesis, insertion of proteins into ER membrane, export of proteins and lipids from the ER, fate of misfolded proteins. Golgi complex: Ultrastructural organization, protein glycosylation within golgi, lipid and polysaccharide metabolism in golgi, protein sorting and export from the golgi. Lysosomes: Lysosomal acid hydrolases, pathways and mechanisms of intracellular digestion, lysosomal secretion/defecation, lysosomal storage diseases.

12 Hours Winit IV: Mitochondria: Ultrastructure of mitochondria, electron transport chain and electron transport complexes, mechanism of transport of proteins into

mitochondria, mechanism of ATP synthesis, Mitchell's hypothesis, synthesis and targeting mitochondrial proteins, peroxisomes, glyoxysomes, spherosomes.

Unit V:

Nucleus: Structure of nuclear envelope, nuclear pore complex (NPC), nuclear

export and import of proteins. Structure and function of nucleolus.

Cytoskeleton: Ultrastructure and function of different cytoskeleton, cytoskeleton assembly and regulation of cytoskeleton filament, structure and dynamics of ciliary and flagellar movement.

Unit VI:

Cell Cycle: Molecular events during cell cycle, cyclins and cyclin dependent protein kinases (CDKs). Regulation of CDK cyclin activity. Cell aging: characteristics and causes of aging; telomeres and aging; Apoptosis: Mechanism and significance.

Cancer Biology: Characteristics and properties of cancer; angiogenesis,

development and causes of cancer, diagnosis; treatment; oncogenes, tumour viruses, tumor suppressor genes.

- 1. Alberts, B. A. Jhonson, J. Lewis, M. Raff, M. Roberts, K. and Walter, P. Molecular Biology of the cell. V Ed. Garland Science, New York. 2008.
- 2. Alberts, B. Dennis, B. Julian, L. Martin, R. Roberts K. and Watson J.D. Molecular biology of Cell. Garland publishing Inc. New York, 1994.

3. Brachet, J. Molecular Cytology, Academic Press, New York, 1985.

Cellis, J.E. Cell Biology. A Laboratory hand book Vol. I and II. Academic Press, 1998.

 Cooper, G.M. and Hausman, R.E. The Cell – A Molecular Approach. ASM Press, 2004.
 Furukawa, R., and M. Fechheimer. The structure, function and assembly of actin filament bundles. Int. Rev. Cytol. 175: 29-90, 1997. 7. Lodish, H., A. Berk, C.A Kaiser, M.P. Scott, A Bretscher, H. Ploegh, P. Matsudaira. VI Ed. Molecular

Cell Biology. W. H. Freeman and Co., New York, 2008.

8. Malacinski, G.M. and Freifelder D. Essentials of Molecular Biology III Ed. Jones and Bartlett Publishers, 1998.

Pollard, T. D. and Earnshaw, W. C.Cell Biology. Saunders, 2002

A Chromatine Structure and function Academic Press. N. Y. 1995

ZOO 2.2 Genetics and Molecular Biology 64 hrs/week

10 Hours

Overview of Mendel's principles, Incomplete dominance, codominance. interaction of genes (epistasis, suppressors), lethal alleles, penetrance and expressivity, pleiotropy, phenocopy, multifactorial and polygénic inheritance, inheritance of autosomal and sex chromosomal traits.

10 Hours

Unit II:

Giant chromosomes- Polytene and lampbrush chromsomes.

Structural aberrations in chromosomes- deletion, duplication, inversion and translocation. Numerical aberrations in chromosomes - polyploidy and aneuploidy. Gene mutations, transposable genetic elements; Linkage maps. Genome imprinting- multifactorial and polygenic inheritance.

Unit III: 10 Hours

Fine Structure of the gene: Classical concept. Studies in Bar eye and Lozenge loci in Drosophila. Benzer's work on rll locus in T4 phages. The concept of cistron, recon and muton.

Extra chromosomal inheritance: Mitochondrial and cytoplasmic inheritance, maternal inheritance. Examples: Chlamydomonas, Neurospora, Paramoecium, Yeast and Drosophila.

Unit IV:

10 Hours Human karyotyping, International System for Human Cytogenetics Nomenclature (ISCN), Karyotye and Idiogram-Pedigree analysis. Genetic counselling and genetic screening- amniocentesis, chronioic villus sampling and cardocentesis. Chromosome banding techniques.

Unit V:

Structure of bacterium and bacteriophage. Life cycle of bacterophage- lysogenic and lytic. Horizontal gene transfer-Transformation, transduction and conjugation in bacteria. Mechanism of recombination in bacteria. Plasmids and episomes. Bioinformatics: Databases- Nucleic acid and protein sequence databases, structure databases, bibliography databases and secondary databases, predictive methods using DNA sequences.

Unit VI:

DNA structure and functions: DNA as the hereditary material-Experiments; Watson-Crick model and alternative models of DNA; Replication-Models of replication, Enzymology and mechanism of DNA replication in prokaryotes and

Transcription- Mechanism of transcription in prokaryotes and eukaryotes, Post-transcriptional modifications; Translation- Mechanism of protein synthesis and post-translational modifications; Regulation on gene expression in eukaryotes- cis and trans regulation, epigenetic. DNA damage and repair

Genome projects of Human, Caenorhabditis elegans and Drosophila.

- 1. Gardner, E. J. Simmons, M. J. and Snustad, D.P. Principles of Genetics. John Wiley &
- Sons. INC. New York. 1974.

 2. Griffiths, A. J. F., Muller, H. J., Suzuki, D. T., Lewontin, R. C. and Gelbart. W. M. An introduction to genetic analysis. W. H. Greeman. New York, 2000.

3. Higgins, D. and Taylor, W. (Eds). Bioinformatics Sequence, Structure and Databanks.

Oxford Univ Press, 2000 4. Lewin, B. Genes VIII. OxfordUniversity Press. Oxford, 2003

- Lewin, B. Genes viii. Calculation of the Control of t 6. Miglani, G. S. Adavanced Genetics. Narosa Publishing House, New Delhi, 2002
- 6. Migiani, G. S. Principles of genetics, IV Ed. John Wiley and Sons (Asia) Pvt. Ltd. New
- 8. Strickberger, M. W. Genetics. Mac Millan Publishing Co. NewYork, 2000 9. Tamarin, R H. Principles of Genetics. McGraw-Hill, 2009.

10 Hours

Issues in developmental biology, mechanisms regulating developmental process, multicellularity: The evolution of differentiation. Developmental patterns among metazoans, developmental mechanism of cell specification, morphogenesis and cell adhesion, morphogenetic movements and selective affinities of cells in frog. Nucleo-cytoplasmic interactions during development in amoeba and frog.

10 Hours

Fertilization- Structure of gametes, egg and sperm recognition, sperm capacitation, fusion, strategies for monospermy and conservation of species, Egg activation, prevention of Polyspermy, rearrangement of cytoplasm in frogs egg, sex determination in Drosophila, reptiles and mammals.

10 Hours

Environmental disruption of normal development- Dosage compensation, The environmental basis of human anomalies - Teratogenic agents and their assault on human development (alcohol, retinoic acid, thalidomide, endocrine disruptors), developmental symbiosis, embryonic diapause, phenotypic plasticity (Polyphenism - nutritional, seasonal, predator induced polyphenism).

12 Hours

The embryological origins of the gene theory, genomic equivalence, methylation pattern and control of gene expression, determination of primary body axis in Drosophila -anterior/posterior, terminal group genes, dorso/ventral axis, segmentation genes (gap genes, pair-rule genes, segment polarity genes in Drosophila. Homeotic selector genes in flies, mammals (Hox code), left-right axis in mammals.

10 Hours Induction and competence, paracrine factors, cell surface receptors and their signal transduction pathways (RTK, Smad and JAK-STAT pathways), cell death pathways, neural tube, neuronal types, the neural crest, axonal

specificity and pathfinding (attractants and repulsive signals), target selection and forming the synapse, somites and their derivatives.

12 Hours Molecular mechanism of ecdysone action-cellular choice between apoptosis and differentiation, molecular responses to thyroid hormone during metamorphosis in amphibians, blastema formation and differentiation regeneration, genetic mechanisms-heterotopy, heterochrony, during heterometry, heterotypy, homologous genetic pathways of development. Regeneration in hydra, planaria and salamander.

References:

1. Alberts, B, Johnson, A. Lewis, J. Roff, M. Roberts, K. and Walter. P. Molecular Biology of the Cell. IV Ed. Garland Science, New York, 2002.

2. Gilbert, S. F. Developmental Biology. John Wiley Publishing, 2003.

3. Graur, D. and W.H. Fundamentals of molecular evolution. Sinauer Associate,

4. Lodish, H., A. Berk, C.A Kaiser, M.P. Scott, A Bretscher, H. Ploegh, P. Matsudaira. . VI Ed. Molecular Cell Biology. W. H. Freeman and Co., New

5. Subramoniam, T. Developmental Biology. Narosa Publishing House, 2002.

6. Twyman, R. M. Instant Notes: Developmental Biology. Bios Scientific Publishers Ltd, 2001.

14 Hours

Unit I:

Scope of animal physiology. Central themes in animal physiology: structurefunction relationship, acclimatization and acclimation, concept of homeostasis, negative and positive feedback mechanisms.

Physiology of digestion and absorption of carbohydrate, protein and fat in gastrointestinal tract. Secretions of esophagus, stomach, intestine liver and

pancreas.

Energy metabolism: Metabolic rate and its measurement; standard metabolic rate and basal metabolic rate; energy cost of locomotion; effect of high altitude.

14 Hours Unit II:

Respiration: Gaseous exchange in water: Gills; gaseous exchange in air: Lungs (mammals and birds) and tracheal systems; air breathing fishes; Respiration in eggs; neural regulation of breathing; oxygen and carbon dioxide transfer in blood: Oxygen dissociation curves; facilitated diffusion; acid-base physiology.

Circulation: General plan of circulatory system; the heart; hemodynamics; the peripheral circulation; regulation of circulation; cardiovascular response to

extreme conditions.

Unit III: 08 Hours

Osmotic regulation: Osomoregulators and osmoconformers; osmoregulation in fresh water, marine water and terrestrial environments; challenges to change in salinity. Excretion: Basic mechanisms of kidney function.

Unit IV: 10 Hours

Muscles and movement: Physiologic anatomy of the striated muscle, structure and role of of contractile proteins - actin, myosin, troponin, tropomyosin. mechanism of muscle contraction. Transmission neuromuscular junction.

Transient production of force - twitches and tetanus; energetics of muscle contraction; Adaptation of muscles for various activities- jumping; swimming; sound production; asynchronous flight muscles of insects; buoyancy.

06 Hours

Thermoregulation in ectotherms, heterotherms and endotherms; Specialized metabolic states: Dormancy- sleep, torpor, hibernation, winter sleep and

Unit VI:

Nervous system and sensing of environment:

12 Hours

Overview of neuronal structure, function and organization; Initiation and propagation of action potential; transmission of information within a single neuron and between neurons; electric and chemical synapses; presynaptic and postsynaptic mechanisms; neurotransmitters.

General properties of sensory reception; chemical senses; mechanoreception; electroreception; thermoreception; vision; limitations of sensory reception.

References:

1. Eckert, R. and Randall, D. Animal Physiology: Surject publications New Delhi, 1982

- 2. Guyton A.C, Hall J.E. Text book Of Medical Physiology. Philadelphia, PA: Elsevier, 13th Ed,
- 3. Hoar, W.S. General and Comparative Animal Physiology. Prentice Hall Inc., New Delhi, 1983 4. Neilsen, K.S. Animal Physiology Adaptation and Environment. IV Ed. Cambridge University Press, 1995.

5. Pestoniee, D.M. Stress and Copping, Sage Publications, London, 1999.

6. Poole, M.C., Pilkey, Grant and Johnson E.C. Biology in Action, Harcort Brace, Canada, 1995. 7. Prakash, M. and Arora, C.K. Encyclopedia of Animal Physiology, Anmol Publications New

8. Randall, D., Burggren, W and French, K. Animal Physiology.W.H. Freeman and Co., New York,

ZOO 3.1 Animal Biotechnology

64 hours

Unit I:

Concept and scope and applications of Biotechnology. 10 Hours Animal cell culture: History and developments of tissue culture, types of tissue culture, laboratory facilities required for animal cell culture, aseptic handling. Advantages and limitations of cell culture methods, Applications and importance of cell culture.

Unit II:

10 Hours

Animal cell culture media and preservation of animal cell culture: Growth media composition, growth regulators and their effect on cell growth differentiation and organogenesis, study of MS BS and HiTech media. Isolation of different tissues from chick and mouse embryos, primary cell culture and its types, monolayer and suspension culture. Maintenance and preservation of cell cultures.

Unit III:

12 Hours

Genetic engineering: Definition and scope, Tools of genetic engineering- Restriction endonucleases, DNA ligase. Cloning vectors: prokaryotic and eukaryotic vectors, Gene transfer methods- Microinjection, Electroporation, Polycations, Lipofection and Retroviral infection. Recombinant clone selection and screening methods.

DNA libraries-gDNA and cDNA libraries, chromosome walking and jumping, Genetic engineering approaches and applications of r-DNA technology in Medicine, environment and industries.

Unit IV:

12 Hours

Stem Cell Technology: Definition, Source and isolation of stem cells, Embryonic and adult stem cells, culture and maintenance of stem cells. Generation and manipulation of mouse and human embryonic stem cells and properties of stem cells, Differentiation of stem cells, Advantages and limitations of Stem cell technology, Novel sources of multipotent stem cells. Science policies and Ethics in Stem Cell Research.

Unit V:

Transgenic animals and Gene Therapy: Production of transgenic animals, Gene targeting, Knock-out and Knock-in Technology. Transgenic animals- Ethical concerns and Patenting. Gene therapy: Somatic versus- germ line therapy, Gene therapy in animals.

Unit VI:

10 Hours

In vitro-fertilization, Embryo transfer and cloning in mammals: Procedure and limitations of IVF, Embryo Transfer Technique, Cloning of different mammals.

References:

Brown T.A. (1995) Gene cloning, III edition, Stanley-Thornes Publishers, Ellenberg.
 Chirikjian, J.C. (1995) Biotechnology: Theory and Techniques Vol. I-II. Jones and Bartlett.

- 3. Freshney R. I. (1992) Animal cell culture a practical approach, II edition, OU publishers, Oxford.
 4. Freshney R. I. (2000 & 2005) Culture of animal cells: A manual of basic technique, IV&V Edition, Alan R.
- Glick B.R. and Pasternak J.J. (1998) Molecular Biotechnology, Principles and Applications of Recombinant DNA, II edition, Library of Congress- cataloging in publication data, USA 6. Glick, B.R. and Pasternak, J.J. (1998) Molecular Biotechnology: Principles and Applications of Recombinant

DNA II (Ed) A.S.M. Press, 7. Grosreld, G. F. Kollians (1992) Transgenic animals, Academic Press Ltd., Sandiago

Kruse P. F (1973) Tissue culture methods and application, Academic Press, London.

Primrose, S.B. (2001) Molecular Biotechnology- II (Ed). Panima Publishing Corporation, New Delhi

10. Sasidhara R. (2006) Animal Biotechnology. MJP publishers, Chennai, 2006. 11. Watson J. D, Gilman M, Witkowski 党 Zoller M (1992) Recombinant DNA, II edition, Scientific American Books, New York.

ZOO 3.2 Parasitology and Immunology

64 hours 10 Hours

Pathogenic micro-organisms: Brief outline and classification of micro-organisms. Pathogenic Protozoa: Amoebiasis and differentiation of different amoebae. Giardiasis, Trypanosomiasis of man and domestic animals. Haemosporidians man and domestic animals.

10 Hours

Pathogenic Nematodes and Trematodes: Etiology, epidemiology, pathogenesis, diagnosis, prevention and control of diseases caused by Trichinella spiralis, Nectar americanus, Ancylostoma duodenale, Fasciola hepatica and Schistosoma species.

12 Hours

Pathogenic Cestodes: Life cycle, treatment of diseases caused by Echinococcus, Hymenolepis and Diphyllobothrium.

Life cycle and pathogenicity of fleas, mites, ticks, lices and mosquitoes.

08 hours

Immune system: Organs, tissues and cells of the immune system. Types of Immunity - Innate and acquired immunity.

12 hours

Generation of B and T-cells responses: Maturation, activation and differentiation of B and T cells. Immunogens and immunogenicity, Structure and functions of immunoglobulins, Antigen-Antibody interactions, Major histocompatibility complex and the complement system. Immune effector mechanisms: cytokines and leukocyte activation and migration.

12 hours

Immune response and diseases: Tolerance and Autoimmunity. Transplantation immunology. Hypersensitivity, Host response to Plasmodium, Trypansoma, Leshmaniasis infection and design of malarial vaccines. Innate immunity controls of Candida albicans, infection immunodeficiency and vaccines.

1. Abbas, A.K. and Lichtman, A.H. (2003) Cellular and Molecular Immuology, Fifth Edition, Saunders References:

2. Chandler, A.C (1944) Introduction to Parasitology, With Special Reference to the Parasites of Man, (7th

ed.), New York: Wiley. 710 pp.
3. Despommier, Gwadz, Hotez, Knirsch: Parasitic Diseases (2005). Apple Trees Productions, (5th Ed). LLC.

Elgert K D (2009) Immunology Second Edn. Wiley Blackwell, John Wiley and sons, New Jersey.
 Hoare, C. A. (1950) Hand Book of Medicinal Protozoology. London, Baltimore, Tindall and Cox.
 Kindt, T J. Goldsby, R A, Osborne, B.A. (2007) Kuby immunology, New York: W.H. Freeman and

Company
7. Levine, N. D. (1978) Protozoan parasites of Domestic Animals and Man. II Ed. Minncapolis: Burgess.

7. Levine, N. D. (1976) From the Land Roll, I.M. (2013) Immunology, 8th Edition, Elsevier Saunders, 8. Male, D., Brostof, F. J., Roth, D.B., and Roitt, I.M. (2013) Immunology, 8th Edition, Elsevier Saunders, 9. Molyneux, D Advances in Parasitology- Control of Human Parasitic Diseases, (1st Ed). Academic Press.

10. Noble, E.R. and Noble, G.A. (1961) Parasitology: The Biology of Animal Parasites. London Kimpton, 10. Nobic, E.R. and Nobic, Old (1984) Ruby Immunology Seventh Edn. Macmillan Higher Education 11. Owen J A, Punt J., Stanford S A (2013) Kuby Immunology Seventh Edn. Macmillan Higher Education

12. Ramesh, S. R. (2017). Insects and other Arthropods of Medical Importance, London: British Museum of

National History.

c Diseases Sourcebook, Jones & Bartlett Learning.

ZOO 3.3 Evolutionary Biology and Ethology

64 hours

10 Hours

Theories of evolution: Lamarckism, Darwinism and Neo-Darwinism. Evolution as fact and theory, Tree of life. Evaluating phylogenetic hypotheses. Molecular clocks, gene trees. Difficulties in phylogenetic analysis. Patterns of evolution: Evolutionary history and classification.

Unit II:

12 Hours

Evolution from the fossil record: Geological time scale, Fossil record, Hominid fossil record, Phylogeny and the fossil record. Evolutionary trends. Phyletic graduation and Punctuated equilibrium, Rates of evolution.

Unit III:

14 Hours

Geography of evolution: Biogeographic evidence for evolution. Major patterns of distribution. Phylogeography, Ecological approaches to Biogeography. The origin of Genetic variation: Genes and Genomes, Gene mutation fundamental principles of Genetic variation in populations. Theory of Genetic drift. Neutral theory of molecular evolution. Gene flow and Genetic drift. Natural selection and adaptation.

Unit IV: Evolution of phenotypic traits: Overview of Speciation. Nature of coevolution. Phylogenetic aspects of species associations. Mutualism. Evolution of competitive interactions. Macroevolution.

09 Hours

Ethology and Behavioural Patterns: History and principles of ethology. Selection of habitat, patterns of behaviour. Territoriality, aggression and conflict behaviour. Learning, Motivation, antipredator behaviour. and communication, Biological clocks.

Territoriality and Sexual behaviour: Orientation, Social behaviour and evolution of behaviour. Sexual behaviour. Behaviour of embryos in fish, amphibians, chicken Fighting behaviour, parental care, and defensive and mammalian embryo. behaviour.

Reference:

- 1. Aubrey, Manning and Marian, S. Dawkins. An Introduction to Animal Behavior. Cambridge University, Press, 1995.
- Futuyama, D.J. Evolutionary Biology- III Ed. Sinauer Associates Inc. Massachusetts, 1998. Gerhart, J and Kirchner, M. Cell, Embryos & Evolution. Blackwell Science Publishers, 1997.
- 4. Keynes, R. Charles Darwin's Zoology Notes & Specimen List from H.M.S Beagle. Cambridge
- 5. Krebs, J.R. and Davies, N.B. An Introduction to Behavioural Ecology-III (ed). Blackwell
- 6. McFarland, D. Animal Behavior Psychology, Ethology and Evolution. Pitman Publications. McFarland, D. The Oxford Companion to Animal Behavior
 Price, P.W. Biological Evolution. Saunders College Publishing, 1995.
 Slater, P. J.B. Essentials of Animal Behavior, Cambridge University press, 1999.

- 10. Strickberger, M. W. Evolution. Jone and Barlett Publishers, Boston, London, 2000 11. On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life by Charles Darwin Sahni Publications, New Delhi, India 2009.

14 hours

Unit I: Aquaculture: Overview, history, definition of aquaculture, different types of aquaculture- monoculture, polyculture, pond culture, cage culture, pen culture raceway culture, raft culture, sewage-fed fish culture with suitable examples. Important sea weeds and their uses.

Commercially important fin fishes: Major carps, cat fishes, murrels, aquarium fishes, prawns, breeding of fresh water fish and brackish water prawns.

Commercially important shell fishes: pearl culture, formation and chemical composition of pearl.

08 hours Unit II:

Fish diseases and economic importance: Bacterial, viral, fungal and protozoan diseases of fish and their control measures. By-products and economic importance of aquaculture.

Fish harvesting, processing, preservation and export.

Unit III: 10 hours

Vermiculture: Overview, scope, importance and definition of vermiculture, ecological and economic importance of Earthworms, Indigenous and exotic species of earthworms, biology of Eisenia fetida and Eudrilus eugeniae species, culture methods- indoor and outdoor, vermicomposting, chemical composition of vermicompost, use of earthworm as feed/bait.

Unit IV:

12 hours

Dairy and poultry: Indigenous and exotic breeds of ruminants (Cows and buffaloes), draught breeds, rearing, housing, feed and rationing, Dairy products, Diseases of cows and buffaloes.

Indigenous and exotic breeds of poultry, rearing of poultry breeds, diseases of poultry, products of poultry.

Unit V:

Sericulture: History, mulberry and non-mulberry silk worms, food plants of non - mulberry silkworms, life cycle and rearing of Bombyx mori. bacterial, fungal and viral diseases of silkworm - diagnosis, control and

Unit VI:

Apiculture: History, classification, biology of honey bees, bee flora, social organization in bee colony, rearing of bees, bee keeping equipment, product and by-products of apiculture and their uses. Diseases and pests of honey bees control and preventive measures. Migratory beekeeping.

ZOO 3.5A Economic Zoology (Open elective)

25 hours 6 hours

Unit I:

Overview, scope and importance of Economic Zoology.

Vermiculture: Importance of Vermiculture. Types of earthworms, Life cycle of earthworm, Use of Earthworms for biodegradation of organic waste materials, Techniques of Vermiculture, Harvesting of Vermicompost and Vermiwash, Vermicompost as soil conditioner and Earthworms as source of Protein.

6 hours Unit II:

Poultry Science: Breeds of fowls, Poultry rearing (Broiler and layer farming),

Nutritive value of egg and meat, Poultry diseases.

Dairy Technology: Breeds of cattle: Cow and Buffalo, milch and draught breeds, Breeding and Cattle improvement in India. Disease of dairy, Nutritive value of Milk and Milk byproducts.

hours Unit III:

Apiculture: Importance, history and development of Bee keeping. Bee flora, Types of honey bees. Management of beekeeping, Product and byproduct of Apiculture and their uses.

Lac culture: Lac insect, lac culture, composition of Lac, processing of Lac and its uses.

4 hours Unit IV: Sericulture: Brief History and Development of Sericulture. Types of Silk Moths, Rearing methods of Silkworms. Silk production and uses. Silkworm diseases.

4 hours Unit V: Aquaculture: Freshwater, brackish water and Marine fish culture in India, Preservation and processing of fish; Fish by-products, Prawn and Pearl

culture.

References for ZOO 3.4 and ZOO 3.5A

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3. David, D. V. and Kumarswami, T. Elements of Economic Entomology. Popular Book Depot.

- Dokuhon,Z.S. Illustrated text book of Sericulture. Oxford and IBH publishing Co. New Delhi, 1998.
 Jadhav and Sidiqui. Handbook of poultry production and management. Jaypee publishers,
- 6. Jawaid Ahsan and Sinha, S. P. A hand book on Economic Zoology, S. Chand and Co. Ltd.
- 7. Lee, K.E. Earthworms: Their Ecology and Relationship with Soils and Land use Academic
- 8. M. Seetha Lekshmy, R. Santhi, (2012) Vermitechnology, Sara Publications, Delhi, India,
- 9. Mishra, R.C. Perspectives in Indian Apiculture. Allied Scientific Publishers, Bikaner, India,
- 10. Snathanam, R. Sukumaran, N. and Natarajan, P.: A Manual of Freshwater Aquaculture, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1990.
- 11. Srivasthava, K.P. Text Book of Applied Entomology, Vol. I and II Kalyani Publishers, 1996.

ZOO 4.1 Endocrinology and Biology of Reproduction

64 hours 14

Unit I

Principles of endocrinology: Hormones as biological signals; Classification of hours hormones. Synthesis, secretion and biological roles of Pituitary, hypothalamus, pineal, thyroid, parathyroid, adrenal and pancreas hormones. Concept of neuroendocrine system.

10 hours

Hormone action: Hormone receptors- types, and structure, regulation; Mechanism of hormone action-peptide hormone, receptor signal transduction, G proteins, other membrane messengers, Mechanism of action of steroid hormones, Eicosanoids and their action.

Unit III:

08 hours

Growth factors: Growth hormones and the somatomedins, Neurotrophic growth factors; Hematopoietic growth factors; Epidermal growth factors; Peptide growth factors; Transforming growth factors; Fibroblast growth factors.

Unit IV:

12 hours

Sex determination and differentiation: Sex determination and differentiation of gonads and gonadal ducts.

Male reproductive system: Histoarchitecture of Testis; Sertoli and Leydig cell structure and functions, Spermatogenesis; Hormonal control of spermatogenesis; Functional role of androgens.

Male accessory reproductive organs: Structure and functions of Epididymis, Vasdeferens, Prostate gland, Seminal vesicle, Coagulating and Cowper's glands. Biochemistry of semen and Biology of spermatozoa. Male sterility.

Female reproductive system: Histoarchitecture of Ovary, Role of Folliculogenesis, Follicular atresia, Ovulation, Corpus luteum, Luteinization, and Luteal function. Functional roles of estrogens. Hormonal regulation of reproductive cycles in female menstrual cycle in human and estrous cycle in rat. Female reproductive disorders-Polycystic Ovary Syndrome (PCOs), Endometriosis and Pelvic Inflammatory Disease (PID)

10 hours

Implantation: Types and hormonal regulation of implantation. Endocrine functions of Placenta.Gestation: Endocrine control of pregnancy in Rat. Hormones involved in Parturition. Lactation: Morphological and functional development of Mammary glands, Hormonal control of lactation and milk ejection. Fertility control: Fertility control in male and female: Natural methods, Barrier methods, IUD's, Hormonal contraceptives, surgical methods.

References:

1. Bentely, P. J. Comparative Vertebrate Endocrinology, III Ed. Cambridge University Press, 1998.
2. Degroot, L. J. and Neill, J. D. (Eds). Endocrinology. Vol. I-III. W. B. Saunders Co., 2001.

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 Knobill, E. and Neill, J. D. (Eds). The Physiology of Reproduction. Vol. I and II. Raven Press Ltd. 1994.
 Mandal, A Hand Book of Neuroendocrinology. EMKAY Publications, 1994.

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8. Norris, D. O. Vertebrates Endocrinology III Ed. Academic Press, 1996. Norris, D. O. Vertebrates Endocrapology in Ed. Academic Fress, 1996.
 Turner, C. D. and Bangara, J. T. General and Comparative Endocrinology, 1998.

ZOO 3.5C Biology of Reproduction

25 hrs

Unit I:

my

02 hrs

Sex determination and differentiation: Sex determination and differentiation of gonads and gonadal ducts.

07 hours

Male reproductive system: Histoarchitecture of Testis; Sertoli and Leydig cell Spermatogenesis; Hormonal functions, spermatogenesis; Actions of androgens, Biochemistry of semen and Biology of spermatozoa. Functions of male accessory organs; epididymis, Vasdeferens, Prostate gland, Seminal vesicle, Coagulating and Cowper's glands. Male sterility.

08 hours

Female reproductive system: Histoarchitecture of Ovary, Folliculogenesis, Follicular atresia, Ovulation, Corpus luteum, Luteinization and Luteal function. Actions of estrogens. Hormonal regulation of reproductive cycles menstrual cycle and estrous cycle. Female reproductive disorders- Polycystic Ovary Syndrome.

04 hours

Reproductive processes and their control: Puberty, implantation and functions of placenta; pregnancy, parturition and lactation.

04 hours

Fertility control: Fertility control in male and female: Natural methods, Barrier methods, IUDs, Hormonal contraceptives, surgical methods.

ZOO 3.5B Human Genetics

Unit I: 25hrs
Introduction Historical 5hrs

Introduction, Historical account, Mendelian principles, Pattern of inheritance, Pedigree analysis, polygenic inheritance.

Unit II:

5hrs

Human Karyotyping, International System of Human Cytogenetic Nomenclature (ISCN), Chromosomal aberrations, Dermatoglyphics, dermatoglyphic patterns in human syndromes.

Unit III:

5hrs

Sex determination and dosage compensation in humans, Sex linked inheritance in humans, Chromosome banding technique, Human genome project and its implications.

Unit IV:

5hrs

Genetic basis of syndromes and disorders: Monogenic diseases, Inborn errors of metabolism, Neurogenetic and neuromuscular disorders, Genetic disorders of Haemopoetic systems, Genetic disorders of eye, Learning disorders, Cognitive disabilities, Schizophrenia and Anxiety disorders.

Unit V:

5hr:

Prenatal diagnosis: Noninvasive methods - radiation, Ultrasonography and Fetal echocardiography. Invasive methods - Maternal serum screening, Amniocentesis, Chorionic villus sampling and Fetoscopy Pre-implantation genetic screening. Genetic counseling, Gene therapy.

References:

- Gardner, E. J. Simmons, M. J. and Snustad, D.P. Principles of Genetics. John Wiley & Sons. INC. New York. 1991.
- Griffiths, A. J. F., Muller, H. J., Suzuki, D. T., Lewontin, R. C. and Gelbart. W. M. An introduction to genetic analysis. W. H. Greeman. New York, 2000.

3. Lewin, B Genes VIII. OxfordUniversity Press. Oxford, 2003

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- Simmons, S. Principles of genetics, IV Ed. John Wiley and Sons (Asia)Pvt. Ltd. New Jersey. 2006.
- 6. Strickberger, M. W. Genetics. Mac Millan Publishing Co. NewYork, 2000

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8. White, M. J. D. Animal Cytology and Evolution. CambridgeUniv. Press, 1973

ZOO 4.2 Environmental Biology

64 hours Unit-I: 12 Hours

Ecology: Definition, History and relevance to humankind. Levels of organization hierarchy. Fundamentals of Ecosystem. Structure and function of ecosystem. Gradient and ecotones: mountains, marine, freshwater (lentic and lotic) ecosystem, terrestrial ecosystem and domesticated ecosystem. Microcosms, Mesocosms and Macrocosms. Ecosystem cybernetics.

12 Hours

Energy in Ecological Systems: Fundamental concepts related to energy - laws of thermodynamics. Solar radiation and the energy environment. Concept of productivity. Energy partitioning in Food chains and food webs. Ecological pyramids. Energy based classification of ecosystem.

Unit III: 10 Hours

Biogeochemical Cycles: Basic types of Biogeochemical cycles. Cycling of Nitrogen, Phosphorus, Sulfur, Carbon and hydrologic cycle. Watershed Biogeochemistry. Cycling of non-essential elements. Recycling pathways: The Cycling Index. Global climate change.

10 Hours Unit IV:

Community Ecology: Types of interaction, group selection, interspecific competition and coexistence. Concept of habitat, ecological niche and guild. Strategy of ecosystem development. Concept of climax. Evolution of the Biosphere. Relevance of ecosystem development to human ecology. Bioaccumulation, biomagnifications, biological indicators.

08 Hours Landscape Ecology: Definition and relation to levels-of organization concept. Landscape elements. Island biogeography. Neutral theory. Temporal and spatial scale. Landscape geometry. Concept of landscape sustainability. Domesticated landscapes.

12 Hours

Resources: Renewable and non-renewable resources. Environmental problems and policies. Pollution: Air, water, soil and radioactive pollution, Global warming, photochemical smog, acid rain, ozone depletion. Environmental laws. Global ecology: Ecological-societal gaps. Global sustainability, scenarios, long -term transitions.

1. Eugene P Odum and Gary W. Barrett. Fundamentals of Ecology fifth edition, Cengage References:

Learning India Private Limited, Delhi, India. 2015. 2. Arrora, R. K. Air Pollution, causes and effects, control. Mangaldeep Publications, Jaipur,

Chakraborti, N. K. Environmental Protection and Law. 1994

 Chaktabord, N. R. Ediss, M. J. Ecology: Principles and Applications. Cambridge University
 Chapman, J. L. and Reiss, M. J. Ecology: Principles and Applications. Chikara, M. G. Encyclopedia of Ecology. Environment and Pollution. Vol. I – XIII, 1997.
 Eldon, D. Enger and Bradley, F. Smith. Environmental Sciences, 1995.

7. Kormondy, E. J. Concept of Ecology. III Ed, Prentice Hall of India Publishers, 1994 8. Willmer, P., Stone, G. Johnson, I. Environmental Physiology of Animals. Blackwell Science

Ltd. 4

ZOO 4.3 Biodiversity, Conservation and Biostatistics

64 hours 10

Unit I

Hours

Biodiversity: Concept, definition and scope of biodiversity. biodiversity: Genetic diversity, species diversity and ecological diversity. Agrodiversity and cultivated taxa.

10 Hours Unit II:

Biodiversity Assessment: Inventorying and monitoring. Mega biodiversity centres, Biodiversity Hotspots with special reference to India.

Unit III: 10 Hours

Distribution of diversity with reference to Indian context: Unique Indian animals - diversity and distribution. Endemic species, Keystone species. Capturing and marking techniques. National parks, wildlife sanctuaries, World Heritage sites of Biological importance, Wetlands

Unit IV: 12 Hours

Loss of biodiversity and conservation: Threats to Biodiversity, HIPPO. IUCN Red list criterions and categories. Social movements for biodiversity conservation in India: Chipko, Thairdam, Narmada project etc. Methods for conservation of biodiversity in-situ and Ex-situ methods. Projects for conservation of Tiger, Lion, Elephant, Dolphin and Crocodile.

Unit V-

Biodiversity conventions and Biodiversity legislations: CITES, TRAFFIC, IKS, Biodiversity act 2002. Global biodiversity laws. Biodiversity laws in India.

Unit VI:

Biostatistics: Definition; Importance of statistics in Biology. Data reduction, frequency distribution. Graphical representation, measures of central tendency and depression probability and its types. Regression and correlation, Random sampling, tests of significance: one-tailed test or twotailed test for significance. Variance, proportions, chi-square tests, Analysis of References:

L Krishnamurthy K.V. An Advanced Textbook on Biodiversity Principles and PracticeOxford & 2. Edward O. Wilson. The Diversity of Life. W. W. Norton Company, 1999.

- 3. Forthofer, R. N., and Lee, E. S. Introduction to Biostatistics. Academic Press, New York, 1995.
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 4. Hawksworth, D. L. (Eds). Biodiversity: Measurement and Estimation. Chapman and Hall, 1995.
 5. Heywood, V.H. (Eds). 1995. Golbal Biodiversity, Published for UN Environmental Programme, Cambridge

 6. Khan, T.I and Y.S. Shishodia. Biodiversity Conservation and Sustainable Development.

Pointer Publications, Japur, 1996.

7. Kotwal. P. C., and Banerjee, S. Biodiversity Conservation: In Managed Forests and Protected

Area. Agro Botanica, 1990

8. Kumar, and Asija. Biodiversity: Principles and Conservation. Agrobios (India), 2000

1. Doo P. S. and Richard, J. An Introduction to Biostotics. 8. Kumar, and Asija. Biodiversity. Frinciples and Conscivation. Agrobios (India), 2000
9. Sunder Rao, P. S. S., and Richard, J. An Introduction to Biostatistics. III Ed. Prentice Hall,

ZOO 4.4 Project Work/Dissertation

Value added course ZOO: Aquaculture and by-products

32 hours

Unit I: Inland fisheries - culture of inland fishes: Carps, catfish, sheatfish, feather backs, mullet, herring, Anchovies and Eel. Collection of eggs from rivers. Hatching of eggs. Collection of fries from rivers and other breeding grounds. Breeding of carps in tanks. Induced breeding. Transportation of fries collecting spot to nursery ponds. Rearing pond.

Unit II: 04 Hours Riverine fisheries: Ganga, Brahmaputra and Indus river system, East coast system, Western coast river system. Riverine fishing crafts and gears.

Unit III: Marine fisheries: Overview of marine fishery resources, deep sea and off-shore fisheries, sea fishing crafts and gears.

Unit IV: 08 Hours Estuarine fisheries: Composition of fish flesh, preservation and processing of fish. Freezing and refrigeration, drying, salting, smoking and canning. Fish by-products: Fish oil, fish meal, fish guano, fish flour, fish silage, fish solubles, shark's fins, fish roes, fish glue, Isinglass, fish skin.

08 Hours Unit V: Cage culture of fish: Advantages and disadvantages of cage culture. importance of larvicidal fishes in India. Exotic and indigenous larvicidal fishes. Classification of larvicidal fishes based on mosquitocidal activity. Exotic fishes of India. Cold water fisheries. Indigenous and exotic sewage fed fisheries.

References:

- 1. Bell, F.W. and Canterbary, E.R. Aquaculture for Developing Countries- A Feasibility Study. Cambridge: Ballinger Publishing Co. 1976.
- 2 Jayakumar, S. Basic of fish farming for the beginners. Notion press.com 3. Lucas, J S and Southgate, P C. Aquaculture farming aquatic animals and plants, III
- ED, John wiley and sons ltd. 2007 4. Lucas, J S, Southgate, P C and Tucker, C S. Aquaculture farming aquatic animals
- and plants, III ED, John wiley and sons ltd. 2019 5. Pillay T V S. Aquaculture – Principles and practices (Fishing News Books Oxford),
- 6. Snathanam, R. Sukumaran, N. and Natarajan, P.: A Manual of Freshwater Aquaculture, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1990.
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