

BHARATHIAR UNIVERSITY: COIMBATORE – 641 046

M. Sc. ZOOLOGY (CBCS – Univ. Dept.)

Programme Objectives:

- PO 1:** To provide students with a high level of relevant knowledge and expertise in contemporary Zoology subjects, which will be able to engage in significant, independent, and creative research.
- PO 2:** To provide students with a broad understanding of animals and their interactions with the environment and to explain how organisms function at the level of the gene, cell, tissue, organ, organ-system and physiology.
- PO 3:** To provide skill based programs and encourage the students for self-employment in applied field of Zoology.
- PO 4:** To provide knowledge and skills for better planning, conservation and management of animal resources
- PO 5:** To enable the students for preparing various competitive examinations of private and Government sectors.

(For the students admitted for the academic year 2019-2020 batch and onwards-Revised)
Scheme of Examination

Semester	Core/Elective /Supportive Paper	Subject Code 16ZOOA	Title of the Paper	Instructional Hours/week	Internal	External	Total Marks	Total Credits
I	Core-I	13A	Functional Morphology of Invertebrate and Vertebrates	4	25	75	100	4
	Core-II	13B	Molecular Cell Biology	4	25	75	100	4
	Core-III	13C	Animal Physiology	4	25	75	100	4
	Core-IV	13D	Endocrinology	4	25	75	100	4
	Lab Course - I	13P	Functional Morphology of Invertebrate and Vertebrates, Molecular Cell Biology, Animal Physiology and Endocrinology	8	25	75	100	4
	Elective-I	1EA	Nanobiotechnology and Applications	4	25	75	100	4
	1EB	Applied Entomology						
	Supportive-I	1GS	Offered from other Departments	2	12	38	50	2
II	Core-V	23A	Experimental Embryology	4	25	75	100	4
	Core-VI	23B	Immunology	4	25	75	100	4
	Core-VII	23C	Molecular Genetics	4	25	75	100	4
	Core-VIII	23D	Biochemistry and Biostatistics	4	25	75	100	4
	Lab Course-II	23P	Experimental Embryology, Immunology, Molecular Genetics and Biochemistry & Biostatistics	8	25	75	100	4
	Elective-II	2EA	Molecular Taxonomy	4	25	75	100	4
		2EB	Global Warming – Animal Migration and Behaviour					
	Supportive-II	2GS	Offered from other Departments	2	12	38	50	2
III	Core-IX	33A	Animal Phylogeny and Evolution	4	25	75	100	4
	Core-X	33B	Environmental Biology and Toxicology	4	25	75	100	4
	Core-XI	33C	Economic Zoology	4	25	75	100	4
	Core-XII	33D	Conservation Biology	4	25	75	100	4
	Lab Course-III	33P	Animal Phylogeny and Evolution, Environmental Biology and Toxicology, Economic Zoology and Conservation Biology	8	25	75	100	4
	Elective-III	3EA	Aquaculture and Fisheries	4	25	75	100	4
		3EB	Applied Microbiology					
	Supportive-III	3GS	Offered from other Departments	2	12	38	50	2
IV	Elective-IV	4EA	Biotechnology and Bioethics	4	25	75	100	4
		4EB	Introduction to Toxicology					
	4PV	Project Work & Viva-voce	Dissertation	----	----	100	100	4
			Viva-voce	----	----	50	50	2
			4FV & 4SD	Field Trip (Institution, Research Labs. and Industries etc.) & Skill Development (Summer training programme)	----	----	----	50
			* SWAYAM – MOOCS: Online Course (4 weeks duration)				50	2
Total				----	---	----	2250+50	90+2

* Online course is mandatory and it should be completed within third semester.

Supportive papers offered for other Department students:

Semester	Subject Code 16ZOOA	Title of the Paper	Instructional Hours/week	Internal	External	Total Marks	Total Credits
I	GS1	Life Style Diseases	2	12	38	50	2
II	GS2	Introduction to Conservation Biology	2	12	38	50	2
		Marine Bioresources					
III	GS3	Marine Biotechnology	2	12	38	50	2

Eligibility for Admission

Applicants seeking admission into the M.Sc. Degree Course in Zoology should have a Bachelor's Degree in Zoology/ Advanced Zoology/ Applied Zoology/ Animal Science and Biotechnology/ Advanced Zoology and Biotechnology/ Life Sciences/ Biology/ Animal Science. They should have secured a minimum of 50% of marks in Part III of the degree course. In the case of SC/ST students, the required minimum marks for admission will be 45%. The admission to the course will be based on the performance of the applicants in the qualifying examination as well as in the Entrance Test, if any.

Duration of the Course

The duration of the course is two academic years. Each academic year consists of two semesters. The duration of a semester is 90 working days.

Attendance

Each student must put in a minimum attendance of 75 % for the classes in each semester so as to become eligible to appear for the Terminal Examination. Shortage of attendance in regular classes on the part of any student not exceeding 10% below the prescribed minimum of 75% may be condoned on medical grounds. Such condonation shall be granted by the principal on merits. The application for condonation shall be accompanied by a condonation fee as prescribed by the HOD. If a student earns less than 75% attendance in his/her regular classes in a particular semester and is either ineligible for condonation of shortage of attendance or is not granted condonation then he/she shall not be permitted to appear for the Terminal examinations and he/she will have to repeat the semester.

Skill Development (Summer Training):

All the students have to undergo summer training for period of minimum 30 days. Final reports have to submit which will be evaluated.

Industrial visit:

Students have to undertake an industrial /institutional visit and have to submit report for evaluation.

Project work:

The report is the bonafide work carried out by the candidate under the guidance of a faculty authenticated and countersigned by the HOD. This project work must be presented and defended by the candidate in the Department attended by all faculties and reviewed by external examiner. Candidate who has presented the work as "Not qualified as per CBCS" must resubmit the project again in the ensuing academic year.

Question Paper Pattern:

1. Practical Components:

The M.Sc. Zoology Core Practical Examination having the following Marks:

Internal Marks: 25

Major Practical		10 Marks
Minor Practical		5 Marks
Spotters (A, B, C & D)	4x2 1/2 =	10 Marks

Total	=	25 Marks

External Marks: 75

Major Practical		20 Marks
Minor Practical		15 Marks
Minor Practical		10 Marks
Spotters (A, B, C & D)	4x5 =	20 Marks
Record		10 Marks

Total	=	75 Marks

2. Theory Components:

The M.Sc. Zoology Core and Elective theory Examination having the following Marks:

Core and Elective Papers: Maximum Marks – 100

Internal Marks: 25

Test -15 Marks; Assignment - 5 Marks; Seminar - 5 Marks

External Marks: 75

Section A – 10 x 1 = 10 Marks (Question No. 1 to 10)

Choose the best Answer type. Answer all questions. All questions carry equal marks.

Section B – 5 x 5 = 25 Marks (Either or type – Question No. 11 to 15)

Answer all questions. All question carry equal marks. Each answer should not exceed 2 pages.

Section C – 5 x 8 = 40 Marks (Either or type – Question No. 16 to 20)

Answer all questions. All Question carry equal marks. Each answer should not exceed 4 pages.

Supportive Papers: Maximum Marks - 50

Internal Marks: 12

Test - 6 Marks; Assignment - 3 Marks; Seminar - 3 Marks

External Marks: 38

Section A – 5 x 1 = 5 Marks (Question No. 1 to 5)

Choose the best Answer type. Answer all questions. All questions carry equal marks.

Section B – 3 x 3 = 9 Marks (Either or type – Question No. 6 to 8)

Answer all questions. All Question carry equal marks. Each answer should not exceed 1 page.

Section C – 4 x 6 = 24 Marks (Either or type – Question No. 9 to 12)

Answer all questions. All Question carry equal marks. Each answer should not exceed 2 pages.

Title of the Subject : **FUNCTIONAL MORPHOLOGY OF INVERTEBRATE AND VERTEBRATES** No. of Credits: 4

Code No. : 13A No. of Teaching hours: 4 hrs/week

Course Objectives :

- To know the functional aspects of different systems of invertebrates and vertebrates
- To study the fundamentals classification of invertebrates
- To understand the behavior mechanism of non-chordates
- To study the mechanism of various organ systems of invertebrates and vertebrates
- To learn the integumentary and skeletal systems of animals

Unit-I - Principle of animal taxonomy:

General characteristics of animal phyla- Classification of animal phyla upto order levels. Species Concept- Habitats of living Invertebrates in Global levels- Organization of coelom: Acoelomates - Pseudocoelomates – Coelomate groups (Schizocoel, Enterocoel and Mesenchyme).

Unit- II - Locomotion and feeding habits of animals:

Locomotion and adaptive mechanism in invertebrates-Flagellar, ciliary movements in Protozoa - Hydrostatic movement in Coelenterata, Annelida, and Echinodermata. Feeding habits: Nutrition and feeding mechanism in invertebrates-Nutrition in protozoa, Types and mode of feeding-Feeding diversity in insects- Filter feeding in Lower metazoans, Crustacean, Mollusca and Echinodermata - functional mechanism.

Unit- III - Organ system of Invertebrates:

Digestive Systems - Over view of the Circulatory systems, Respiratory systems, Excretory systems, Nervous and sensory system and Reproductive systems of animals.

Unit – IV - Functional systems of vertebrates:

Respiratory Organs-Ventilatory Mechanisms- Phylogeny-Form and Function- Excretory Systems: Urinary System- Structure and function of the Mammalian Kidney- Nervous system: Peripheral Nervous System and Central Nervous Systems- Sensory Organs: Components of a sensory organs- General sensory organs.

Unit – V - Integument and skeletal systems of animals:

General features of the Integument (Dermis and Epidermis); Phylogeny-Specialization of the Integument-Skeletal System: The Skull- Introduction- Overview of Skull Morphology- Overview of Skull Function and Design.

Reference Books:

1. K.S. Kohil, Madan Mohan Trigunayat and Kavita Sahani (2008) Invertebrates Structure

and Functions, Ramesh Book Depot, Jaipur-New Delhi.

2. S.K. Kulshrestha (1999) Comparative anatomy of vertebrates, Anmol Publications PVT.LTD, New Delhi.
3. Fatik Baran Mandal, (2012) Invertebrates Zoology, PHI Learning Private Limited, New Delhi.
4. Barnes. Invertebrate Zoology. Toppan International Co.,
5. Barrington, E.J.W. 1969. Invertebrate Structure and functions. English Language Book Society.
6. Borradile, L.A. The Invertebrata. Cambridge University Press.
7. R.L. Kotpal: Protozoa, Porifera, Coelenterata, Helminthes, Annelida, Anthropoda, Mollusca, Echinodermata and Minor Phyla. Rastogi Publications.
8. Gardinar, M.S. 1972. Biology of the Invertebrates, Mc Graw Hill Book Co., New York.
9. Waterman, A.J. 1971. Chordata Structure and Function. Macmillan Co. London.
10. Young, J.F. 1950. Life of Vertebrates. Clarendon Press. Oxford.
11. Colbert, E.H. 1955. Evolution of the Vertebrates. John Wiley and Sons Inc. New York.
12. Holstead. The Pattern of Vertebrate Evolution. Freeman and Co. San Francisco. U.S.A.

Course Outcomes:

On successful completion of the course, the students will be able to

- CO 1- classify the animal species based on the features
- CO 2- know the behavior of various invertebrates
- CO 3- explain the similar and different morphology of organs in a functional view
- CO 4- learn the process of integument and significance of skeletal systems.
- CO 5- compare the functional morphology of vertebrates and invertebrates.

Course prepared by : Dr. N. Arul

Course Verified by: Dr. M. Ramesh

Title of the Subject : **MOLECULAR CELL BIOLOGY** No. of Credits: 4

Code No. : 13B No. of Teaching hours: 4 hrs/week

Course Objectives :

- To provide students with relevant knowledge, skills and values in contemporary molecular cell biology.
- To apply experimental techniques to carry out high quality teaching and scientific research.
- To acquire advanced knowledge of molecular biology of prokaryotes, and eukaryotes.
- To study principles of cell communication and adhesion
- To study cancer/ oncogenes, virus induced cancer and therapies, Cellular morphology and markers

Unit-I - Basic concepts:

Structure of atoms, molecules, chemical bonds and interactions. Composition, structure and function of carbohydrates, lipids, proteins, nucleic acids and vitamins. Cell organization, Sub-cellular structures of prokaryotic and eukaryotic cells. Synthesis and sorting of plasma membrane. Functions of plasma membrane and cell organelles.

Unit-II- DNA and RNA regulatory mechanisms:

Evidence of basic targets, enzymes, mechanisms of DNA replication in eukaryotes. Extra chromosomal replicons. DNA damage and repair mechanisms. Mechanisms RNA splicing in eukaryotes. t-RNA, m-RNA, r-RNA and hn-RNA structures and folding. Conformation of nucleic acids, and Micro-RNA.

Unit-III - Protein synthesis:

Ribosomes, Genetic code, General control of DNA, RNA and protein synthesis, Post-translational modifications and confirmations of proteins. Protein targeting, Domains, Motif and Folds. Stability of protein and nucleic acids structure.

Unit-IV - Cell communication, signalling and molecule transport:

Regulation of hematopoiesis. General principles of cell communication and adhesion. Neurotransmission and its regulation. Signaling at the cell surface, Types of signaling pathways that control gene activity, Integration of signals and gene controls. Movement of proteins into membranes and organelles, Vesicular traffic, secretion and endocytosis. Metabolism and movement of lipids.

Unit-V- Cell culture:

Regulation of the Eukaryotic cell cycle, Cell birth, Lineage and cell death. Cancer/ oncogenes, Virus induced cancer and therapies, Cellular morphology and markers, Primary and established cell lines, Kinetics of cell growth, Genetics of cultured cells, Stem cell culture, embryonic stem cells and their applications. Cell culture based vaccines. Somatic cell genetics.

References Books:

1. Cell and Molecular Biology, (8th edn)., De Robertis, E.D.P. and De Robertis, E. M.F. 1995, B.I.Waverly Pvt. Ltd., New Delhi.
2. Essential Cell Biology, B. Albert et al., 1998. Garland Publishing, Inc. New York.
3. Principles of Cell and Molecular Biology. (2nd edn.)., Kleinsmith, L. J. & Kish, V.M. 1995.
4. Molecular Biology of the Cell. (3rd edn.)., Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J.D. (eds.) 1994. Garland Publishing, Inc., New York.
5. Molecular Cell Biology (5th Edn.), H. Lodish et al., 2004. W.H. Freeman and Company, New York.
6. Principles of Biochemistry, A.L. Lehninger. 1984. CBS Publishers, New Delhi.
7. Lewin, B. Genes VIII Oxford University Press, Oxford, New York, Tokyo.
8. Culture of Animal Cells, (4th Edition), R. Ian Freshney, 2000, Wiley-Liss.
9. Cell Growth and Division: A Practical Approach, Ed, R.Basega, IRL Press.
10. Molecular Cell Biology (Sixth Edition) by W.H Freeman and Company 2008. ISBN: 10:L0-7167-7601-4
11. Molecular genetics (First Edition) by J.T. Hancock 2000. University of the west of England, Bristol, UK. ISBN: 81-309-0604
12. Fundamentals of Molecular Biology (First Edition) by Jayanta K.Pal 2009. First published in India by Oxford, University press. ISBN: 10: 0- 19.569781.2

Course outcomes:

On successful completion of the course, the students will be able to

- CO 1- Graduates will be able to explain and discuss how processes are integrated at the molecular level to create a functional eukryotic cell.
- CO 2- Graduates will be able to describe the structures and various cellular functions associated with the macromolecules found in cells.
- CO 3- Graduates will be able to explain the techniques and logic of methods employed in molecular biology research.
- CO 4- Graduates will be able to explain the molecular basis of human diseases
- CO 5- Graduates will have experience in and be able to perform techniques employed in molecular biology research.

Course prepared by : Dr. P. Saravana Bhavan

Course Verified by : Dr. M. Ramesh

Title of the Subject : ANIMAL PHYSIOLOGY

No. of Credits: 4

Code No : 13C

No of Teaching hours: 4 hrs per week

Course Objectives :

- To understand the internal physical and chemical functions of animals and their parts
- To study the digestion and excretion, blood and circulatory system,
- To understand the respiration and nervous system
- To understand the sense organs and reproduction of Human
- To learn the mammalian organs

Unit –I Digestion and Excretion:

Digestion, Absorption, BMR- Role of salivary glands, Pancreas and intestinal glands in digestion - Mammalian kidney - Urine formation- waste elimination - regulation of water balance - acid base balance.

Unit –II Blood and Circulation:

Composition of Blood- Blood groups- Plasma function - Hemopoiesis Blood volume - Homeostasis - structure of mammalian heart - myogenic heart - Blood pressure and its regulation.

Unit –III Respiration:

Respiration in Mammals - Transport of Gases - Exchange of Gases - Neural and Chemical regulation of respiration.

Unit –IV Nervous system and sense Organs:

Nerve conduction- synapse- Neurotransmitters- Neurons central and Peripheral Nervous system - Neural control of muscle tone and posture Photoreceptors- hearing and tactile response.

Unit –V Reproduction:

Functional morphology of reproductive organs – Gametogenesis - Reproductive cycles – Pheromones

Reference Books:

1. Animal Physiology by Dr.P.S.Verma, B.S.Tyagi & V.K.Agarwal (2017)

2. Principles of Animal Physiology, Second Edition by Christopher D. Moyes, Patricia M. Schulte (2016)
3. Animal Physiology by Randall, David, Burggren, Warren, French, Kathleen, 2001.
4. Text book Of Animal Physiology by A.K.Berry (2008)
5. Ganong, H, Review of Medical Physiology, 1989. 14th edition, Appleton & Lange publisher, New York.
6. Physiology: A regulatory system approach, Fleur, and Strand, (1978). Macmillan Publishing Company, New York; Collier Macmillan Publishers, London.
7. Shier, D., Butler, J. and Lewis, R., Hole's Human Anatomy and Physiology, (10th edition) 2003. WCB/McGraw Hill, Boston. 2003.
8. Animal Physiology, Eckert, R (5th edition), 2002. W.H.Freeman.
9. Williams S. Hoar (1991) General and Comparative Physiology 3rd edition. Prentice Hall of India- New Delhi.

Course Outcomes:

On successful completion of the course, the students will be able to

- CO 1-Monitor their blood pressure and they can identify blood groups
- CO 2-Function of Heart and types of heart can be understood
- CO 3-Basic function of kidney, Ear, Eyes and main function of nerves will be easily know ledged
- CO 4-learn the nervous system
- CO 5-Understand the circulatory system

Course prepared by: Dr. V. Ramasubramanian

Course verified by: Dr. M. Ramesh

Title of the Subject: **ENDOCRINOLOGY**

No. of Credits: 4

Code No. : 13D

No. of Teaching hours: 4 hrs/week

Course Objectives:

- To study the Nature, function and classification of hormones.
- To acquire knowledge on the structure of Thyroid gland, Parathyroid, Adrenal, Thymus and Pineal gland
- To acquire knowledge on the synthesis of their hormones.
- Understand the gastrointestinal hormones and sex hormones
- To understand the role of hormones in pregnancy and lactation

Unit-I Hormones:

Nature, function and classification of hormones – Feedback control of hormone secretion – Organisation and functions of neuroendocrine systems- Hypothalamo– hypophyseal interactions- Bioactive peptides.

Unit-II Thyroid and Parathyroid Glands:

Thyroid gland – Structure, function and biosynthesis of thyroid hormone - Parathyroid –Structure and PTH – Calcitonin – Role of hormones in calcium and phosphate metabolism.

Unit-III Gastrointestinal and Adrenal hormones:

Gastrointestinal hormones - their secretion, control and function – Insulin and glucagons – Adrenal hormones and Stress management – Catecholamines as emergency hormones- their role in the regulation of carbohydrate, protein and lipid metabolisms.

Unit-IV Adrenal, Pineal and Thymus Glands:

Adrenal gland – Structure and role played its hormones in glucose metabolism – Aldosterone and the rennin- angiotensin system – Pineal gland- structure and its influence on reproduction and pigmentation – Thymus gland – Structure and thymic hormones – their functions in brief.

Unit-V Gonadial Hormones:

Steroid hormone biosynthesis in the ovary and testis – Hormonal regulation of ovarian cycles in mammals – Folliculogenesis, ovulation, corpus luteum formation and regression – Hormones in pregnancy and lactation. Gonadal steroid action on spermatogenesis and spermiogenesis – Role of hormones in sex accessory gland growth and functions.

Reference Books:

1. Williams, R H. 1981. Text book of Endocrinology, Ed. 6th W. B. Saunders Company, Philadelphia, London.
2. De Groot. 1979. Endocrinology, Vol. 1-3, Grune and Stratton, New York.

3. Bondy P.K. and Rosenberg L.E. 1974. Duncan's disease of Metabolism – Genetics, Metabolism and Endocrinology. W. B. Saunders Co., Philadelphia, London.
4. Stephen Nussey and Saffron Whitehead. 2001. Endocrinology - An Integrated Approach, Oxford: BIOS Scientific Publishers; 2001.
5. Mac E. Hadley, Endocrinology. 1996, Prentice Hall
6. M.P. Goswami, Endocrinology and Molecular Cell Biology, 2013. Gaurav book centre Pvt Ltd, Delhi.
7. Yadav, Text book of Endocrinology, 2009, Sonali Publications, New Delhi
8. George Griffing, Endocrinology, 2015, Stat Pearls Publishing, USA

Course Outcomes:

On successful completion of the course, the student will be able to

- CO1- Acquire knowledge on the Nature and functions of hormones and learn the mechanism of hormone action.
- CO2- Learn the structure and functions of Thyroid and Parathyroid gland and familiarise on their hormones.
- CO3- Understand the hormones secreted by gastrointestinal tracts and adrenal glands and their action on stress management.
- CO4- Able to learn the Structure and functions of the adrenal, pineal and thymus glands.
- CO5- Know the feedback control of gonadal hormones and their role in the development of male and female gametes.

Course prepared by: Dr. P. Sundarraj

Course verified by: Dr. M. Ramesh

Title of the Subject: Lab Course - I

**FUNCTIONAL MORPHOLOGY OF INVERTEBRATE AND VERTEBRATES,
MOLECULAR CELL BIOLOGY, ANIMAL PHYSIOLOGY AND
ENDOCRINOLOGY**

No. of Credits: 4

Code No. : 13P

No. of Teaching hours: 8 hrs/week

Course Objectives:

- Aware about invertebrates and to understand the evolution of different types of coelom
- Learn about various animal species and their affinities and their adaptive features
- Understand the working principle of various microscopes, and histochemical techniques for localization of DNA, Proteins and Carbohydrates, RNA, Lipids
- Understand how to prepare the mitotic chromosomes
- Ability to carry out routine clinical analysis of blood
- Understand the working principle and application of Sphygmomanometer, Kymograph, Haemoglobinometer, and ESR
- Learn clinical procedures for blood & urine analysis

Functional Morphology of Invertebrate and Vertebrates

1. Identification and study the selected Protozoans and Helminthes of medical importance.
2. Identification and study the section of certain animals from Coelenterata, Aschelminthes and Annelida to understand the evolution of different types of coelom.
3. Identification and study the larval forms all major phyla of Invertebrates.
4. Study of prepared slides of mouth parts of Honey bee, Housefly, Thrips, Mosquito, Bed bug and Butterfly to relate structure and type.
5. Study of the following specimens to bring out their affinities;
 - a. Amphioxus
 - b. Balanoglossus
 - c. Ascidian
 - d. Peteromyzon
6. Study of the following specimens with Reference to their adaptive features for their respective modes of life:
 - a. Echeneis
 - b. Ichthyophis / Uraeotphlus
 - c. Hyla
 - d. Draco
 - e. Pigeon
 - f. Bat
7. Study of the following skull types with Reference / Books to jaw suspensions:
 - a. Fish
 - b. Frog
 - c. Calotes
 - d. Rat / Rabbit

Molecular Cell Biology

1. Cytological Techniques

Microscopy - Optical and electron microscopy – Phase contrast microscopy - interference microscopy - Dark field, Polarization, Fluorescence and X-ray microscopy. Micrometry - measurements using ocular and stage micrometers - measurements of cells from any prepared slide.

2. Histochemical Techniques

Fixation - Chemical fixation – Freezing - Drying – Staining - Conventional and cytochemical.

Histochemical localization of DNA, Proteins and Carbohydrates, RNA, Lipids - Vital staining.

3. Study of Different Types of Cells

Differential count in Man. Chromosome preparation - Preparation of Fish chromosomes from any tissue - Chromosome preparation procedure. Preparation of meiotic chromosomes from fixed grasshopper testis or any other insects like gryllotalpa.

4. Molecular Biology Techniques (Demonstration only)

Centrifuge - Isolation of DNA - Isolation of RNA – PCR - Isolation and analysis of proteins - Electrophoresis.

Animal Physiology

1. Estimation of RQ in Fish with Reference to temperature.
2. Qualitative analysis of Proteins, Carbohydrates and Lipids in blood.
3. Effect of Insulin and Adrenalin on Blood Glucose level.
4. Estimation of RBC and WBC.
5. Estimation of Blood urea (DAM) and Cholesterol (ZAK'S) using commercially available kit.
6. Blood Clotting time, bleeding time, Preparation of haemin crystal, Estimation of Hemoglobin and ESR.
7. Principles and application of Sphygmomanometer, Kymograph, Haemoglobinometer, ESR.

Endocrinology

1. **Spotters:** Transverse section of Pituitary, Thyroid, Pancreas, Adrenal, Thymus, Ovary and Testis.
2. Hormones in Amphibian metamorphosis - Thyroxine/Iodine solution.
3. Estimation of urea and uric acid.
4. Blood glucose – Oral Glucose Tolerance Test.

Practical records to be submitted to the University Practical Examination.

Reference Books:

1. Jain J.L, Sunjay Jain, Nitin Jain. Fundamentals of Biochemistry

2. Pantin (1948) Microscopical techniques, Cambridge University Press, London
3. Lillie RD (1954) Histopathologic Technique and Practicle Histochemistry, 2nd edition, Blackiston, New York.
4. P.S. Verma, A Manual of Practical Zoology: Chordates, S. Chand Publishing, 2000.
5. Jayasurya, N. Arumugam, N.C. Nair, S. Leelavathy, N.Soundara Pandian, T. Murugan, Practical Zoology, Invertebrate, Saras Publication.
6. J. H. U Brown, A laboratory manual in animal physiology, Gorsuch Scarisbrick, 1983.
7. Chaitanya K.V., Cell and Molecular Biology: A Lab Manual, Prentice Hall India Learning Private Limited, 2013.
8. Harsh Vardhan Bhask, Manual of Practical Physiology and Endocrinology, Campus Books International, 2009.

Course Outcomes:

On successful completion of the course, the student will be able to

- CO 1- Understand the medical importance of Protozoans and Helminthes
- CO 2- Understand the adaptation of various animal groups in invertebrates
- CO 3- Understand the detection of DNA, proteins and carbohydrates, RNA, Lipids and amino acids by staining method
- CO 4- Understand the estimation of blood cell counts in humans and chromosomes form fish.
- CO 5- Understand the analytical instruments

**Course prepared by: Dr.N.Arul
Dr. P. Saravana Bhavan
Dr. V. Ramasubramanian
Dr. P. Sundarraj
Dr. V. Maruthappan**

Course verified by: Dr. M. Ramesh

Title of the Subject : **NANOBIOTECHNOLOGY AND APPLICATIONS**

No. of Credits: 4

Code No. : 1EA

No. of Teaching hours: 4 hrs/week

Course Objectives :

- To understand the overview nanobiotechnology
- To understand the role of nanotechnology in biology
- To learn the different methodology for nanoparticles synthesis
- To learn the various instruments for characterization of nanoparticles
- To understand the impact of nanoparticles on the environment

Unit I - Introduction to Nanotechnology` :

Introduction - Importance of nanoscience and nanotechnology in biomedical applications. Interaction between biomolecules and nanoparticles. Applications of nanotechnology in biotechnology: killing cancer cells, providing oxygen and artificial mitochondria. Nanobiosensors.

Unit II - Nanomaterials for biology:

Carbon based nanomaterials - carbon nanotubes for biomedical applications, SWCNT and MWCNT. Magnetic nanoparticles - Quantum dots - Quantum dot biomolecular tags. Conjugation of quantum dots with biomolecules. Si nanowires. Nanobiomaterials: Biocompatibility; Antibacterial activity; DNA and Peptide based nanomaterials; Polymer nanostructures.

Unit III - Synthesis of nanoparticles:

Top-Down approach, Bottom-Up approach, PVD, CVD, Micro emulsion method, Sol-gel processing. Biological synthesis of nanoparticles - Use of bacteria, fungi, Actinomycetes for nanoparticle synthesis, Role of plants in nanoparticle synthesis.

Unit IV- Characterization of nanobiomaterials:

Basic principles, operations and applications of UV-Visible spectroscopy, FI-IR spectroscopy, SEM, TEM, Fluorescence spectroscopy, Fluorescent resonance energy transfer (FRET), AFM of DNA, STM of DNA and Confocal microscopy.

Unit V - Environmental Nanotechnology:

Nanotoxicology, Environmental and Health impacts of nanomaterials, Waste remediation, Nanoporous polymers and their application in water purification, Energy conversion. Photocatalytic fluid purification, Current status of nanobiotechnology, Future perspectives of nanobiology and safety measures of nanomaterials.

References Books:

1. Nanomaterials by A.K. Bandyopadhyay, 2007, New Age International Publishers, New Delhi.
2. Tissue, cell and organ engineering, by Challa Kumar, 2006, Wiley-VCH, Verlag.
3. The Chemistry of Nanoparticles (Synthesis, Properties and Applications) by C.N.R. Rao, A. Muller, A.K. Chutham., 2006, Wiley-VCH, Verlag.
4. Nanomedicine, Vol. IIA: Biocompatibility by Robert A. Freitas, 2003, Landes Bioscience, Georgetown.
5. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology - Hari Singh Nalwa, 2006, American Scientific Publishers.
6. Nanobiotechnology, by C.M.Niemeyer, C.A. Mirkin, 2004, WILEY-VCH Verlag GmbH & Co. KG aA, Weinheim.
7. Nanocomposite Science & Technology by Pulickel M. Ajayan, Linda S. Schadler, Paul V. Braun, Wiley.
8. Handbook of Nanotechnology - Bharat Bhusha, 2007, Springer.
9. Introduction to Nanotechnology”, C. P. Poole and F. J. Owens, 2006, Wiley.
10. Nanotechnology: A Gentle Introduction to the Next Big Idea”, M. Ratner and D. Ratner, 2002, Prentice Hall.
11. Nanotechnology – Science, Innovation, and Opportunity”, L. E. Foster, 2006, Pearson Education.

Course Outcomes:

On successful completion of the course, the students will be able to

- CO 1- understand the outline of nanobiotechnology
- CO 2- learn the role of nanotechnology in biology
- CO 3- learn the various methodologies for synthesis of nanomaterials
- CO 4- learn the working principle of different instruments for nanomaterials characterization
- CO 5- understand the impacts of nanoparticles on human health and environment

Course prepared by : Dr. T. Muralisankar

Course Verified by : Dr. M. Ramesh

Title of the Subject : **APPLIED ENTOMOLOGY** No. of Credits: 4
Code No. : 1EB No. of Teaching hours: 4 hrs/week

Course Objectives :

- To define applied entomology and classify insects
- To understand insect pest management techniques
- To understand the pest of various crops such as cotton, sugarcane, paddy, food grains, fruits and pulses.
- To understand insect migration, population fluctuation and medical and veterinary importance
- To provide knowledge on sericulture, apiculture and lac culture

Unit-I – Insect Classification:

Classification of apterygota upto families- Classification of following insect orders (a) orthoptera (b) hemiptera (c) dipteral - Classification of following insect order (a) hymenoptera (b) lepidoptera (c) coleopteran -Collection and preservation of insects.

Unit-II - Insect Pest-Management:

Insect pest-Management strategies and tools - Biological control -Genetic control -Chemical control

Unit-III – Pests of Crops and Fruits:

Pests of Cotton - Pests of sugarcane - Pests of paddy - Pests of stored food grains - Pests of citrus fruits and mango - Pests of pulses - Households insect pests

Unit-IV- Insects migration, population and their medical and veterinary importance:

Insects in relation to forensic science - Insects migration, population fluctuation and factors - Insects of medical and veterinary importance - Ecological factors affecting the population and development of Insects

Unit-V-Sericulture, Apiculture and Lac Culture:

Mulberry and non mulberry sericulture – Apiculture - Lac culture - Insects as human food for future.

Reference Books:

1. The Insects Structure and Function by R.F. Chapman, 2012, Cambridge University Press.
2. Comparative Insect Physiology, Biochemistry and Pharmacology by G.A. Kerkut and L.I. Gilbert, 1985, Pergamon Press, New York.

3. Entomophagous Insect by Curtis Paul Clausen, 2010, McGraw-Hill book Company.
4. Principles of Insect Physiology by V.B. Wigglesworth, 1972, Springer.
5. Hand book of economic Entomology for South India by Ayyar, T.V.R, 1992, Narendra Publishing House, New Delhi.
6. Fundamentals of Entomology by Richard J. Elzinga, 2003, Pearson.
7. Insects and plants by Sting, Lawton and South wood.
8. Insect and hygiene by Busvine, J.R. 1951, Published by Methuen & Co, London.

Course Outcomes:

On successful completion of the course, the students will be able to

CO 1 -classify insects up to order

CO 2- explain general insect pest management techniques

CO 3- understand key pest insects of the major horticultural crops and fruits

CO 4- explain migration, population and their medical and veterinary importance

CO5- students should acquire knowledge on sericulture, apiculture and Lac culture techniques.

Course prepared by : Dr. K. Murugan

Course Verified by : Dr. M. Ramesh

Title of the Subject : **EXPERIMENTAL EMBRYOLOGY** No. of Credits: 4

Code No. : 23A No. of Teaching hours: 4 hrs/week

Course Objectives :

- To enable students to understand the cellular and tissue-based events of gametogenesis, fertilization, cleavage, and gastrulation. stages involved in the developing embryo
- To acquire students with basic knowledge of experimental embryology that leads to understanding embryonic organizer, inductions and differentiation.
- To understand organogenesis related to mechanisms of development and differentiation.
- To understand the metamorphosis, regeneration, extra embryonic membrane and placenta in various animals.
- To acquire students with knowledge regarding the cryo preservation techniques and sperm banking utilized in research.

Unit –I - Introduction and scope – Gametogenesis:

Spermatogenesis: Origin of Primordial germ cells – Differentiation of spermatozoa – structure and motility of sperm – egg activation – acrosomal reaction. Oogenesis: Development of Oocytes – types of eggs – Biochemical changes during Oogenesis.

Unit – II - Fertilization process:

Activation of sperm and egg– interaction of sperm and egg – Sequence of events in sperm entry – Egg surface changes. Post–fertilization changes: changes in the organisation of the egg cytoplasm caused by fertilization.

Unit – III - Cleavage:

Cell division and chemical changes during cleavage – pattern of cleavage – Distribution of cytoplasmic substances in the egg – role of egg cortex - morphogenetic gradient in the egg cytoplasm. Gastrulation: Principles and patterns of gastrulation – Fate map.

Unit – IV- Organizer:

Spemann's primary organizer – analysis of nature and mechanism of induction; Organogenesis: Cellular interaction – differentiation and organogeny. Embryonic adaptation: Extra embryonic membrane structure in Reptiles and Birds. Placenta: Classification, structure and physiology.

Unit – V-Post embryonic developmental events:

Metamorphosis (Insects and amphibians); Regeneration in various animals. Asexual reproduction: Occurrence and forms of asexual reproduction. Cryo-preservation of gametes

and embryos – in-vitro fertilization and embryo transfer – sperm banking – Fertility control and regulation.

References Books:

1. Berril, N.T. : Developmental Biology, 1971. McGraw Hill Co., New York.
2. Balinsky. 1981. Introduction to Embryology, 5th edition CBS College Publishers.
3. Scott F. Gilbert. 2006. Developmental biology, 8th edition, INC Publishers.
4. Subramoniam T. 2004. Molecular developmental Biology, Narosa Publishers.
5. Huxley De Beer: The Elements of Experimental Embryology, 1934. Cambridge Univ. Press, Cambridge, Hafher Publishing Co.
6. Nelson, G.F.: The Comparative Embryology of Vertebrates (1979). Blackinston and Co.
7. Bodemer, C.: Modern Embryology (1968). Hold, Rinehart and Winstorn, Inc, New York.
8. Monray, A. Chemistry and Physiology of Fertilization (1978). Halt Reinhart and Winston.

Course outcomes:

On successful completion of the course, the students will be able to

- CO1- Understand the molecular, cellular and physiological mechanisms of development of organisms.
- CO2- Students will develop skills in working knowledge in developmental biology techniques, experimental design, analysis and interpretation of data.
- CO3- Know various techniques used in experimental embryology of animals and their application in research.
- CO4- Students will develop skills to undated the current scientific literature on experimental embryology.
- CO5- To understand the importance of experimental embryology in medical field.

Course prepared by : Dr. M. Ramesh

Course Verified by : Dr. M. Ramesh

Title of the Subject : IMMUNOLOGY

No. of Credits: 4

Code No : 23B

No of Teaching hours: 6 hrs per week

Course Objectives :

- To understand the all areas of immunology,
- To study the innate and adaptive immunity, antigens and antibodies,
- To study the host defense, clinical immunology,
- To study the immunological disorders, and immunotechnology
- To study the new techniques in immunology

Unit – I -Innate and Adaptive Immune System:

Innate and Adaptive Immune System: Basics of Immunity- Innate immunity and Adaptive immunity-B and T cells- Humoral and cell mediated immune responses- Complement system.

Unit – II -Antigens and Antibodies: Antigens:

Antigens and Antibodies: Antigens – Structure and function of antibody molecules - Monoclonal antibodies – Immunoglobulin - structure, function and types of immunoglobulin classes.

Unit-III –Immunopathology:

Immunopathology: Hypersensitivity - Types of hypersensitivity - Major histocompatibility complex and its significance.

Unit-IV -Immunological disorders:

Immunological disorders: Immunodeficiency diseases - Congenital and acquired immunodeficiency - Transplantation Immunology - Types of graft - Mechanism of allograft rejection.

Unit-V –Immunotechnology:

Immunotechnology: Vaccines - Active immunization - Passive immunization - Immunological techniques - RIA and ELISA

Reference Books:

1. Basic Immunology: Functions and Disorders of the Immune System by Abbas (2017)
2. Immunology Paperback by Ramesh (2017)
3. Textbook of Immunology Paperback by Arvind Kumar (2013)
4. Immunology by Dulsy Fatima, N Arumugam (2014)
5. Immunology, S.K. Gupta (1999). Narosa Publishing House, New Delhi.

6. Essential Immunology (8th Edition), Ivan Roitt, 1994. Blackwell Scientific Publication. Immunology W.H. Freeman and Company.
7. Abdul .K. Abbas. Andrew .K. Litchmen and Jordan, 1997, Cellular and Molecular Immunology, 3rd Edn. W.B. Saunder Company.
8. Weir, D.M. and Stewart, J., 1997, Immunology, 8th Edn. Churchill Livingston, New York.
9. Eryl Liddell and Ian Weeks., 1995, Antibody Technology, BIOS Scientific Publishers.
10. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts and James D. Watson.(Eds.), 1994, Molecular Biology of the cell, 3rd Edn., Garland Publishing Inc., New York.
11. Immunology, George Pinchuk (2004). Tata McGraw-Hill Publishing Company Limited, New Delhi.

Course outcomes:

On successful completion of the course, the students will be able to

- CO 1-Importance of vaccine types of vaccine to control the infection at molecular level
- CO 2- Develop the immune system against pathogens
- CO 3-Raise the monoclonal antibodies for identification of infection
- CO 4-Understand the immune system
- CO 5-Study the immunological disorders

Course prepared by: Dr. V. Ramasubramanian

Course verified by: Dr. M. Ramesh

Title of the Subject : **MOLECULAR GENETICS** No. of Credits: 4

Code No. : 23C No. of Teaching hours: 4 hrs/week

Course Objectives :

- To acquire increased theoretical and practical knowledge of various processes of Molecular Genetics.
- To provide graduates with scientific competencies that will allow them to investigate the molecular mechanisms important for the structure and function of the living cells through modern techniques.
- To study the techniques for obtaining genetically modified organisms
- To study development genetics and cytodifferentiation in normal and pathological conditions
- To study DNA interaction with chemical agents, cancer therapies and immunomodulation.

Unit-I- Structure and functions of genetic materials:

Chromatin structure and nucleosome concept, Organization and function of genetic material, Gene paradox, Repetitive DNA, Satellite DNA, Overlapping genes, Split genes, Pseudogenes. Chromatin, nuclear and mitochondrial genome organization, Structures of DNA and RNA, Stereochemistry of bases and secondary structures. Genetic structure analyses of eukaryotic genomes.

Unit-II- Genetic Engineering:

Recombinant DNA technology, Isolation and purification of DNA/ genes, DNA sequencing. Concept of restriction and modification - Restriction endonucleases, DNA modifying enzymes, Ligases. Host-vector system - Cloning vectors for *E. coli*, cloning vectors for Eukaryotes. Genomic libraries, cDNA libraries, Genome project, Gene tagging. DNA forensics, DNA finger printing and paternity decisions.

Unit-III- Gene expression:

Gene regulation in eukaryotes, Gene clustering, Mechanism of positive and negative control of gene expression. Translational and transcriptional control of regulatory mechanism of expression, Environmental effects on gene regulation. Gene silencing, and Epigenetics.

Unit-IV- Chromosomal genetics:

Mendelian principles - Linkage and crossing over - Chromosome mapping - Gene mapping – Sex linked, limited and influenced characters – Ploidy. Genetic diseases (gout, hypercholesterolemia, cystic fibrosis, phenylketonuria, hemophilia, and muscular dystrophy), syndromes (Down, Klinefelter, and Turner), and congenital anomalies. Pedigree analysis and karyotypes. Extra chromosomal inheritance – maternal inheritance.

Unit-V- Mutation:

Mutagens-mutagenesis, types of mutation, mutator genes, sickle-cell anemia, forward and reverse mutation, frame shift mutation, site directed mutagenesis, transposable elements and transposition, and evolutionary significance.

References Books:

1. Genetics (3rd Edition), Strickberger, M.W. 1996, Printice Hall, India Ltd., New Delhi.
2. Molecular Biology of the Cell (3rd Edition), Alberts, B. et. al., 1994, Garland Publishing Inc., New York.
3. Genes VIII. Levine, B., 2004, Oxford University Press.
4. Genetics: Analysis of Genes and Genomes (5th Edn.), Hartl, D.L. & Jones, E.W., 2001, Jones and Bartlett Publishers, Sadbury, Massachusetts.
5. Gene Cloning and DNA Analysis, (5th Edn.), T.A. Brown, 2001, Blackwell Science Ltd.,
6. An Introduction to Genetic Analysis (7th Edn.), A.J.F. Griffiths et al., 2000.
7. Principles of Genetics (6th Edn.), R.H. Tamarin, 1996. WCB/ McGraw-Hill, New Delhi.
8. Principles of gene manipulation, 3rd Edn., Old & Primrose, 1989, Publishers Business Service.
9. Recombinant DNA Technology, (2nd Edn.), J.D. Watson, M. Gilman, J. Witkowski & M. Zoller, 1992, Scientific Americans books, Newyork.
10. r - DNA technology and Biotechnology, K. Kreuzer & A. Massey, 1996, ASM Press, Washington. D.C
11. Techniques for Engineering Genes, Butterworth. Heinemann, 1993, Open Universiteit Nederland.
12. Human Molecular Genetics (2nd Edn.), T. Strachan and A.P. Read, 1999. John Wiley & Sons.
13. Molecular Biology Techniques An intensive Laboratory course by Walt Ream and Kathatory G.Field, 2008. Academic Press, San Diego, London

Course outcomes:

On successful completion of the course, the students will be able to

- CO 1- Graduates will be able to knowing and understanding the organization and functions of genetic material in the living world.
- CO 2- Graduates will be able to explain and interpret various processes, phenomena, states and evolutionary tendencies at a biological system level.
- CO 3- Graduates will be able to develop investigation capacities of biological system's functions and their relation with the environment.
- CO 4- Graduates will be able to applying laboratory methods and techniques to study the structures and functions of nucleic acids and proteins.
- CO 5- Graduates will be able to evaluate the molecular markers used in the genetic characterization of plant and animal species.

Course prepared by : Dr. P. Saravana Bhavan

Course Verified by : Dr. M. Ramesh

Title of the Subject : **BIOCHEMISTRY AND BIOSTATISTICS** No. of Credits: 4

Code No. : 23D No. of Teaching hours: 4 hrs/week

Course Objectives :

- To study the function and structure of biomolecules
- To understand the role of biomolecules in cell membrane
- To learn the strategies of data collection, measurement of central tendency and dispersion
- To understand the goodness of fit for collected biological data
- To understand the significance of correlation, regression and significance testing of data

Unit I- Biomolecules:

Amino acid structure, Classification and code, Protein Structure: Primary, Secondary, Tertiary and Quaternary Structures and α helix and β sheet confirmation, Ramachandran plot, Enzymatic and chemical cleavage of proteins.

Unit II – Membrane Biochemistry:

Proteoglycans and glycoproteins diverse role in Extra Cellular Membrane and ABO Blood antigen determination. Fatty acids; saturated and unsaturated fatty acid, phospholipids, sphingolipids, steroids, prostaglandins, Transbilayer (flip-flop) lipid motion in membranes, Membrane fluidity, fatty acid synthesis and β -Oxidation.

Unit III – Descriptive Statistics:

Types of biological data; frequency distributions; cumulative frequency distributions. Populations; samples from populations; random sampling. Measures of Central Tendency: Mean; median; mode; geometric mean; harmonic mean. Measures of Dispersion: Range; variance; standard deviation, coefficient of variation; standard error.

Unit IV- Goodness of Fit Tests:

Probability Distribution: Normal distribution; binomial distribution and poisson distribution. Chi-square test for goodness of fit.

Unit V – Correlation, Regression and Significance testing:

Simple linear regression; correlation coefficient – hypothesis testing about correlation coefficients; rank correlation; intraclass correlation. Analysis of variance: One-way classification; two-way classification.

References Books:

1. Biochemistry, by D.Voet and J.G. Voet, 2004. John Wiley & Sons, USA
2. Biochemistry, by R.H. Garrett and C.M. Grisham, (3rd Edition) 2007. Saunders College Publishers.

3. Principles of Biochemistry by A.L. Lehninger. 1984. CBS Publishers and Distributors, New Delhi.
4. Physical Biochemistry by D. Friefelder, (2nd edition) 1982. W.H. Freeman & Company.
5. The Physical Basis of Biochemistry, by Peter R. Bergethon, Springer-Verlag, 1998.
6. Principles of Biochemistry by Albert L. Lehninger (4th edition) 2004. CBS Publishers & Distributors, New Delhi.
7. Biochemistry by Lubert stryer (4th edition) 2000. Freeman International Edition.
8. Fundamentals of Biochemistry by J.L.Jain et. al. (4th edition) 1994. S.Chand and Company.
9. Biochemistry. S. C. Rastogi, 2nd edition. 2003. Tata McGraw Hill Publishing Company Ltd., N. Delhi.
10. Gurumani, N. (2003) Biostatistics. Tamilnadu Book House.
11. Milton, J.S. (1992) Statistical Methods in Biological and Health Sciences. McGraw - Hill Inc., New York.
12. Scheffler, W.C. (1968) Statistics for biological sciences. Addison - Wesley Publication Co., London.
13. Snedecor, G.W. and Cochran, W.G. (1967) Statistical Methods. Oxford & IBH Publication Co., New Delhi.
14. Sokal, R.R. and Rohlf, F.J. (1969) Biometry. The principles and Practice of Statistics in Biological Research. W.H. Freeman and Co., San Francisco.
15. Kumar, B.P, 2007. Introduction to Bio-Statistics. S Chand & Company; 3rd Rev. Edn. New Delhi, India.

Course Outcomes:

On successful completion of the course, the students will be able to

- CO 1- understand the chemical structure and functions of various biomolecules
- CO 2- learn the signaling of biomolecules in cell membrane
- CO 3- understand the data collection methods and primary data analysis
- CO 4- learn the testing of goodness of fit of collected or generated biological
- CO 5- understand the proper interpretation of data generated in the biology using correlation, regression and significance tests

Course prepared by : Dr. T. Muralisankar

Course Verified by : Dr. M. Ramesh

Title of the Subject: **Lab Course - II**

**EXPERIMENTAL EMBRYOLOGY, IMMUNOLOGY, MOLECULAR
GENETICS AND BIOCHEMISTRY & BIostatISTICS**

No. of Credits: 4

Code No. : **23P**

No. of Teaching hours: 8 hrs/week

Course Objectives:

- Demonstrate wound healing and regeneration in frog tadpoles
- Demonstrate developmental stages of chick embryo
- Study the histology of lymphoid organs
- Ability to estimate qualitative analysis “ABO” blood group.
- Demonstration of Immunoelectrophoresis technique
- Ability to prepare culture media
- Ability for mounting of salivary glands of Drosophila larvae
- Ability for karyotyping using human metaphase chromosome plates
- Ability to estimate Qualitative analysis of urine
- Understand the computation of statistical data in research

Experimental Embryology

1. Oogenesis and spermatogenesis - histochemical studies in a mammal.
2. Different stages in development - Crustaceans (Crab/Prawn) - insects (Drosophila) - frog.
3. Demonstration: Experimental embryology – Wound healing and cell aggregation in frog embryos. Regeneration in frog tadpoles.
4. Development of chick stage - Observation of living chick embryo and vital staining demonstration only – slide showing C.S. of heart, kidney, lens and limb to demonstrate induction and organization.
5. Slides showing the Uterus cycles in a mammal (Rat).
6. Development of invertebrates - Eggs - cleavage - Gastrula - Study of larva forms Nauplius, Zoea, Veliger, Bipinnaria, Leptocephalus.
7. Developmental stages of fish.

Immunology

1. Histology of Lymphoid organs - Thymus, Spleen, Bone marrow, Lymph node.
2. Enumeration of lymphocytes and cells of Immune system - Human blood.
3. Haemagglutination - Qualitative analysis “ABO” blood group.
4. Haemagglutination - Qualitative analysis - haemaggultination titration.
5. Preparation of Antigen - RBC - Demonstration.
6. Ouchterlony technique - Demonstration.
7. Immunoelectrophoresis - Demonstration.

Molecular Genetics

1. Preparation of culture media. Culture of *Drosophila* - Methods of maintenance. Sex identification of at least four mutants.
2. Mounting of salivary glands of *Drosophila* larvae / Chironomous larva. Analysis of banding pattern.
3. Localization of Barr body in the Buccal smear - squamous epithelial cells. (Smear to be made and the presence or absence of Barr body to be reported, give reasons).
4. Karyotyping using human metaphase chromosome plates (Giemsa stained). Identification of syndromes (Down, Klinefelter and Turner) from karyotype photographs showing clinical features of each syndrome case.
5. Problems relating to the application of binomial theorem in population genetics with Reference to P.T.C. Earlobe attachment etc.
6. Observation of simple Mendelian traits in Man - Identification of color blindness using color charts. Population analysis of color blindness - Visit to primary school.

Biochemistry

1. Buffer preparation and determination of pH - Demonstration.
2. Enzyme kinetics - any one enzyme (Salivary amylase) Maltose standards, influence of enzyme concentration, time course, pH, Temperature, Substrate concentration - (Lineweaver Burk Plot) on enzyme activity.
3. Qualitative analysis of urine - protein, glucose, ketone and acetone bodies.
4. Chromatography: Determination of amino acids in body fluids and tissues of Frog.
5. Quantitative estimation of glucose, protein, cholesterol, urea and creatinine in the serum of chick / goat.

Biostatistics

(Use of scientific electronic calculator must be insisted upon - use of such calculators in theory and practical examinations to be permitted - use of computers, if available or accessible, may be encouraged)

1. Collection, Classification and presentation of data relating to continuous and a discrete variable; obtaining descriptive measures for the collected data (each student shall collect separate primary data - a sample of at least 50 - such as length, weight etc. of fish, frog or any other animal, classify the data –graphically represent them - and obtain descriptive measures such as mean, standard deviation and standard error for the collected data.
2. Problems relating to testing goodness of fit
3. Problems relating to test of significance (Chi – Square test and t-test)
4. Problems relating to correlation and regression.

Practical records to be submitted to the University Practical Examination.

Reference Books:

1. Zsolt Peter Nagy, Alex C. Varghese, Ashok Agarwal, Clinical Embryology: A Practical Guide, Springer-Verlag New York Inc.; 2013
2. Richard L. Myers Immunology: A Laboratory Manual, McGraw-Hill Inc., US; 2nd Revised edition edition, 1994.
3. Chaitanya K.V., Cell and Molecular Biology: A Lab Manual, Prentice Hall India Learning Private Limited, 2013.
4. Victor J. Temple, A practical manual in biochemistry & clinical biochemistry, University of Papua New Guinea Press 2013.
5. James W Archie, Laboratory Manual for Biostatistics, Department of Biological Science, 2015.

Course Outcomes:

On successful completion of the course, the students will be able to

- CO 1- Study and understand the different stages in crustaceans, insects and frog
- CO 2- Understand the regeneration process in frog tadpoles
- CO 3- Understand the methods how to measure blood groups
- CO 4- Demonstrate the Mendalian traits in Man
- CO5- Understand the estimation technique of glucose, protein, cholesterol, urea and creatinine in the serum of chick / goat.
- CO 6- Understand the application of statistical techniques in biological research.

**Course prepared by: Dr.M.Ramesh
Dr. V. Ramasubramanian
Dr. P. Saravana Bhavan
Dr. N. Arul
Dr. T. Muralisankar
Dr.V.Maruthappan**

Course verified by: Dr. M. Ramesh

Title of the subject: **MOLECULAR TAXONOMY**

No. of Credits: 4

Code No. : 2EA

No. of Teaching hours: 4 hrs/week

Course Objectives:

- To learn the basics of taxonomy
- To upgrade on new taxonomical concepts at molecular level
- To acquaint with different genomic databases
- To learn new tools and software used in sequence annotation
- To infer the evolutionary significance and examine different phylogenetic methods

Unit –I- Basic concepts:

Introduction and history of taxonomy - species concept - zoological classification - theories of classification - taxonomic ranks – hierarchy - nomenclature codes: binomial nomenclature, trinomial nomenclature - taxonomical keys: key to the species - Linnaean taxonomy and classical taxonomy - level of taxonomy.

Unit-II- Modern concepts:

Kingdoms and domains - Genomic DNA: nuclear, chloroplast and mitochondrial genomes – DNA and RNA based taxonomy in animals - DNA and RNA based taxonomy in plants - Representative genes in modern taxonomy: COI, cytb, 16s, 18s, 28s rRNA, matK, ITS1, ITS2, rDNA, and trnL-F - Key features of DNA based phylogeny.

Unit-III- Genomic data bases:

Role of genomics in taxonomy - Primary nucleotide sequence databases: GenBank, EMBL, DDBJ and BOLDs. Genome Database: Bioinformatic Harvester, SNPedia, Corn, National Microbial Pathogen Data Resource, Zebrafish Information Network, RGD Rat Genome Database, and Vector Base.

Unit-IV- Tools and Software:

Tools for sequence annotation: BLAST, ORF finder, PHYLIP, pair-wise analysis and multiple sequence analysis - Software: MEGA, DNA SP, BIO EDIT, PAUP, and Chromas Lite.

Unit-V- Phylogeny and Evolution:

History and theories of evolution - Phenetics and cladistics phylogeny - Evolutionary taxonomy - Phylogenetic nomenclature - Genetic variations -Phylogenetic analysis: methods in phylogenetic reconstruction, maximum parsimony, maximum likelihood, Bayesian probability, Bootstrapping and neighbor joining -Problems and errors in phylogenetic reconstruction.

Reference Books:

1. Darwin, C. 1859. On the Origin of Species. London: John Murray (always seeks out the first edition, facsimile version, and avoid later editions).
2. Dobzhansky, T. 1937. Genetics and the Origin of Species. New York: Columbia Univ. Press (there are several later editions, and the title changed in the last).
3. Fisher, R. A. 1930. The Genetical Theory of Natural Selection. Oxford: Oxford Univ. Press (there is a later edition).
4. Hennig, W. 1966. Phylogenetic Systematics. Urbana: Univ. Illinois Press (an English translation of a book published earlier in German). Hall, B. J. (ed.). 1994. Homology, the Hierarchical Basis of Comparative Biology. San Diego: Academic Press (a collection of essays by many authors).
5. Sober, E. 1984. The Nature of Selection, Evolutionary Theory in Philosophical Focus. Cambridge, MA: MIT Press.
6. Gillespie, J. H. 1992. The Causes of Molecular Evolution. New York: Oxford Univ. Press.
7. Kimura, M. 1983. The Neutral Theory of Molecular Evolution. Cambridge: Cambridge Univ. Press.
8. Li, W-H. and D. Grauer. 1991. Fundamentals of Molecular Evolution. Sunderland, A: Sinauer.
9. Hillis, D., C. Moritz, and B. Mable. 1996. Molecular Systematics, second edition. Sunderland, MA: Sinauer.
10. Genetics: Analysis of Genes and Genomes (5th Edn.), Hartl, D.L. & Jones, E.W., 2001, Jones and Bartlett Publishers, Sadbury, Massachusetts.
11. An Introduction to Genetic Analysis (7th Edn.), A.J.F. Griffiths et al., 2000. W.H. Freeman & Co.
12. Molecular Biotechnology, S. Maulik and S.D. Patel, 1997, Wiley. Liss
13. Evolution (Second Edition) by, Monroe W. Strickberger, 1990. Museum of vertebrate zoology, University of California, Berkeley. ISBN: 0-867820-20-892-9.
14. Ghosh, Z. and Mallick, B. 2008. Bioinformatics – Principles and Applications, published in India by Oxford University Press. ISBN: 13-978-0-19-569230-3.
15. Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2006. Bioinformatics – Concepts, skills and applications, second edition. CBS Publishers and Distributors Pvt. Ltd. ISBN: 81-239-1482-2.

Course outcomes:

On successful completion of the course, the students will be able to:

- CO1- describe the concepts of taxonomy and its importance to classification
- CO2- apply this knowledge through the use of molecular systematics
- CO3- effectively extracts information from genomic database software for the analysis of biodiversity database
- CO4- get trained into the most significant taxonomical methods used today for sequence annotation
- CO5- reconstructs the phylogenetic trees by applying bioinformatic tools

Course prepared by: Dr. C. Gunasekaran

Course verified by: Dr. M. Ramesh

Title of the subject : **GLOBAL WARMING – ANIMAL MIGRATION AND BEHAVIOUR**

No. of Credits: 4

Code No. : 2EB

No. of Teaching hours: 4 hrs/week

Course Objectives :

- Describe the greenhouse effect and global warming
- Explain the concept of climate change and use of GIS and RS application
- Explain the impact of global warming on biodiversity
- Understand the green house gases and their impact on behaviour of insects
- Explain conservation and management techniques.

Unit – I- Introduction to global warming:

Basics of Green house gases — Climatic change and its Significance and Causes - Impact of global warming on eco- system - Fossil fuel in Global warming- present and future trends.

Unit – II- Climatic change:

Acid rain-ozone depletion-Green house effect –forest fire-GIS, RS and its application.

Unit – III- Impact on biodiversity:

Behavioral Adaptation - Threats to biodiversity – IPCC and migration of species –biodiversity of land, aquatic and polar ecosystem – Climate change Human Health.

Unit – IV- Green house gases – impact behavior impact behavior:

Transgenic Plants and behavior of insects – Prey Predator and parasitoid system – Climate change and Vector prevalence – Vector Borne diseases - Carbon sequestration.

Unit – V- Conservation and management:

Threatened and Endangered Species - wild animals and plants – Global conservation organizations - Deforestation and Defaunation - integrated conservation strategies.

Reference Books:

1. Ecology (Individuals, population and Communities) by Michael Begon, John L. Harper Colin R. Townsend, 2005, Wiley.
2. Environmental politics and policy by Walter A. Rocenbaun, 2010, CQ Press College
3. The text book of Animal behaviour by Hoshang S. Gunderia and Hare Govind Singh, 2005, S. Chand & Co.)
4. Environmental planning and management by John H. Balduim, 1985, West view Press,
5. Environmental protection and the Law by K. Khitolian

Course outcomes:

On successful completion of the course, the students will be able to:

- CO 1- understand the current knowledge on global warming
- CO 2- explain the importance of GIS and RS techniques to understand the impact of climate change
- CO 3- understand the extent of climate change on biodiversity and human health
- CO 4- understand the greenhouse effect and its impact on insect behavior
- CO 5- demonstrate conservation and management techniques for threatened and endangered Species

Course prepared by: Dr. K. Murugan

Course verified by: Dr. M. Ramesh

Title of the Subject : **ANIMAL PHYLOGENY AND EVOLUTION** No. of Credits: 4

Code No. : 33A No. of Teaching hours: 4 hrs/week

Course Objectives :

- To know the history and concept of evolution
- To understand the mechanisms and factors involving in evolution process
- To understand the process and patterns of social selection of animals
- To know the evolutionary patterns of various animals at classical and molecular level
- To study the interaction and adaptation among species

Unit I-History of Evolution:

Lamarck; Darwin–concepts of variation, adaptation, fitness and natural selection; Mendelism; Spontaneity of mutations; Geological time scale and species evolution; Mass extinction, evolutionary tree.

Unit II – Mechanisms of Evolution:

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 and divergent evolution; Co-evolution.

Unit III –Evolution of Social Life and Selection:

Evolution of Social interaction and Cooperation; Sexual selection, Group selection, Hamilton's Rule, Red queen hypothesis, Kin selection, Parent – offspring conflict, mating systems.

Unit IV- Patterns of Evolution:

Evolutionary pattern of mammals; Human and Horse; Evolutionary pattern of Birds; Evolutionary pattern of invertebrate; DNA Barcoding; Cladogenesis and anagenesis

Unit V – Evolutionary Ecology:

Population and structure, Population growth: Density dependent and independent, Survivorship, life history strategies (r and K selection), Competitions among species: Intraspecific and Interspecific, Lotka-Volterra interspecific competition model, Mimicry and Animal coloration, Island communities and colonization.

References Books:

1. Kotpal, R.L. and N.P. Bali, 1998. Concepts of Ecology, Vishal Publications, Delhi – 7, 264 pp.
2. Rastogi V.B. and M.S. Jayaraj, 1988-89. Animal Ecology and distribution of animals, Kedar Nath Ram Nath, Meerut – 250 001, 429 pp.
3. Clarke, G.L., 2015. Elements of Ecology, Palala Press, Warsaw, Poland.
4. Mayr, Ernst, 1973 – Animal species and Evolution. The Belknap Press of Harvard University, Cambridge.
5. Dobzansky, T. 1976 – Genetics and the origin of species. Oxford and IBH Publishing Co., New Delhi.
6. Savage, J.M. 1976 – Evolution. Amerind Publishing Co. Pvt. Ltd. New Delhi
7. Elic. Minkoff, 1983 – Evolutionary Biology, Addison Wesley.
8. Nielsen, C. 2012. Animal Evolution: Interrelationships of the Living Phyla. Oxford University Press, New York, USA.

Course Outcomes:

On successful completion of the course, the students will be able to

- CO 1- understand the theories and concepts of evolution
- CO 2- learn the process of evolution in animals
- CO 3- understand the evolution of social life in animals
- CO 4- understand the patterns of evolutionary changes in animals
- CO 5- learn the ecological interaction and adaptation of animals.

Course prepared by : Dr. T. Muralisankar

Course Verified by : Dr. M. Ramesh

Title of the Subject : **ENVIRONMENTAL BIOLOGY AND TOXICOLOGY**
No. of Credits: 4

Code No. : 33B No. of Teaching hours: 4 hrs/week

Course Objectives :

- To understand the nature of relationships among organisms that comprise functioning of ecosystems
- To provide the knowledge on interactions between organisms and their environments to drive the dynamics of populations and communities.
- To understand different habitat ecology, resource ecology and their management
- To know the different types of pollution and their management to protect the health and welfare of human population in the world.
- Acquire broad knowledge of the field of environmental toxicology.

Unit – I- Ecosystem:

Review of the concept of ecosystem – pond and Forest as examples of natural ecosystem. Energetics in an ecosystem – Energy flow, Trophic level and structure in ecosystem, Food chain, Ecological pyramids-Review of Bio-geo Chemical cycles.

Unit – II- Limiting Factors:

Concept of Limiting factors - Liebig's law of the minimum – Shelford's law of tolerance. Population and Community Ecology: Natality, Mortality, Growth rate as factors determining the population density- Population interactions. Types of community - Structure – Community Succession, Homeostasis.

Unit – III- Habitat Ecology:

Freshwater habitat – Marine habitat – Estuarine habitat – Terrestrial habitat.

Unit – IV- Resource Ecology and Management:

Concept – classification – Non-Renewable and Renewable resources- Conventional and Non-Conventional source and energy – Conservation and management.

Unit – V- General Principles of Toxicology:

Introduction – Definition – Types - Scope of toxicology – Recent developments – Types of environmental pollution and their biological effects – Air, Water, Soil, Noise and Radiation pollution. Routes of Entry and Testing Procedures: Introduction - Absorption – distribution – Excretion – Bio-transformation-Bioassay – Acute toxicity - Chronic toxicity. Assessment of safety /risk.

Reference Books:

1. Fundamentals of Ecology by Eugene P. ODUM (1972), W.B. Saunders Company, London.
2. Environmental Biology by Michael Reiss and Jenny Chapman, 2000. Cambridge Press, UK.
3. An Introduction to Ecology and Population by Emmel THOMAS, C. (1973), Notron, NY.
4. Fundamentals of Ecology by DASH, M.C., 1993. Tata McGraw-Hill Publishing Company.
5. Principles of Ecotoxicology by BUTLER, O.C., 1978. John Wiley & Sons, USA.
6. Environment and Ecology by Majid Husain, 2015, Access Publishing
7. Population Ecology, by Kirti Agarwal, GAURAV BOOK CENTRE PVT LTD
8. Casarett and Doull's 1980. Toxicology: The Basic Science of Poisons.. II (Eds.) Macmillan publishing co., Inc, New York.
9. Butler, G.C. 198\78, Principles of Ecotoxicology. John Wiley and Sons, Chichester.
10. Fumi Matsumura, 1980. Toxicology of Insecticides. Plenum Press, New York and London.
11. Foster L. Mayer, Donald J. Versteeg, Michael, J. McKee and Barnett A. Ratlner, 1992, Biomarkers, physiological and non-specific biomarkers. Lewis publishers, London.
12. Sambasiva Rao K.R.S. 1999. Pesticide impact on fish metabolism. (Eds.) Discovery Publishing House, New Delhi
13. Gupta, P.K. 1985. Modern toxicology Vol. II. Metropolitan Book co. (P) Ltd., New Delhi.
14. Thomas J. Haley and William O. Berndt, 1987. Handbook of toxicology. Hemisphere Publishing Corporation, Washington.

Course Outcomes:

On successful completion of the course, the students will be able to

- CO 1- Describe energy transformations across trophic levels and to understand how elements are cycling in the environment
- CO2 - Explain the concept of limiting factors and interactions of populations and communities in relation to dynamic environmental processes.
- CO 3 -Describe the habitat ecology and to identify various types of natural resources and their management practice.
- CO 4 - Describe the types, effects and control of pollution
- CO 5 – A strong knowledge concerning the fundamentals in the basic areas of toxicology

Course prepared by : Dr. M. Ramesh

Course Verified by : Dr. M. Ramesh

Title of the Subject : **ECONOMIC ZOOLOGY** No. of Credits: 4

Code No. : 33C No. of Teaching hours: 4 hrs/week

Course Objectives :

- To study the economic importance of agricultural entomology
- To learn the communicable and non-communicable diseases in humans
- To study the importance of animal husbandries
- To know culture practice and economic importance aquaculture
- To learn various techniques for food preservation and preparation of value added products

Unit- I- Agricultural Zoology:

Beneficial insects: spider, mantis, ladybird beetle, damsel fly, mealy bug destroyer, soldier beetle, green lacewing, syrphid fly, tachinid fly, ichneumon wasp and trichogramma wasp-harmful insects: migratory locust, Colorado potato beetle, boll weevil, rhinoceros beetle, aphids, mosquitoes and cockroach - Pests of major crops, their injuries and control: paddy, sugarcane and groundnut - Economic importance of rodents, snakes, owls and bats - Apiculture - Sericulture - Lac culture – Vermiculture.

Unit- II- Medical Zoology:

Infectious/ communicable diseases: small pox, hepatitis, AIDS, influenza, SARS, Ebola, tuberculosis, plague, cholera, amoebiasis, malaria, dengue, chikungunya, trypanosomiasis, and elephantiasis.

Unit- III- Veterinary Zoology:

Important livestock – cattle, goat, sheep, dog, deer and rabbit. Livestock diseases – tetanus, anthrax, Ranikhet and avian influenza. Livestock parasites – helminthes, flies, ticks, lice and mites. Dairy and Poultry industries - Animal breeding - Establishment of Zoo and its importance.

Unit –IV- Aquaculture:

Aquaculture in India: an overview – nutritional value and food security - Site selection and preparation of culture ponds - Fish culture: carps, marine fishes and ornamental fishes. Prawn culture: Freshwater prawns and marine shrimps. Fattening of crabs. Crayfish and Lobster - Molluscs: mussels, clams, chanks and oysters including pearl oyster. Live feeds: micro algae, micro-invertebrates (*Artemia* nauplii, Rotifers, Cladocerans, Copepods, Ostracodes) and worms as live baits – Water quality management and maintenance of sanitation - Plant and animal nutrients - Balanced diet (iso-nitrous and iso-caloric) - Artificial feed formulation – Low cost feed formulation - Aquatic weeds.

Unit-V- Food Processing:

Freshness criteria and quality assessment of fish and prawn – Spoilage and control - Methods of preservation: Canning, Freezing, Drying, Salting, Smoking and Curing - Quality control of processed fish and prawn- Fish and prawn processing industries in India - Processing of poultry meat and eggs - By product utilization - Important microorganisms and the factors affecting their growth and survival in foods - Preparation of value added fishery products: fish deboning, smoking, fish sizzling, sausage - fish ball, fish roll, dry fish, fish and prawn pickle - some instant preparations.

Reference Books:

1. Economic Zoology, G.S. Shukla, V.B. Upadhyay (2006)
2. Text Book of Applied Zoology, Pradip. V Jabde (2005)
3. Textbook of Animal Diseases, Ashok Kumar (2009)
4. Medical Zoology, R.C. Sobti (1991)
5. Modern Textbook of Zoology, R. L. Kotpal (2000)
6. Processed Meats, AM. Pearson & TA Gillett (1996)
7. Egg and poultry meat processing, W.J. Stadelman, V.M. Olson, GA. Shemwell & S. Pasch S (1988)
8. Fish as Food, Vol 1 & 2, HA. Bremner (2002)

Course Outcomes:

On successful completion of the course, the students will be able to

- CO 1- understand the significance of insects in agriculture
- CO 2- know the awareness of diseases in humans
- CO 3- create the self-employment opportunities to students
- CO 4- get better platform aqua-industries
- CO 5- understand the various food preservations techniques.

Course prepared by : Dr. N. Arul

Course Verified by: Dr. M. Ramesh

Title of the Subject: **CONSERVATION BIOLOGY**

No. of Credits: 4

Code No. : 33D

No. of Teaching hours: 4 hrs/week

Course Objectives:

- To learn the fundamentals of biodiversity and gain insights on values of wildlife
- To study grounds of habitat loss in animals and ensure species assessments
- To familiarise with tools and techniques employed for studying wildlife, habitat and ecosystem processes
- To know laws and regulations adopted for animals
- To provide students with a multidisciplinary education in conservation biology

Unit- I- Biodiversity; species concepts; animal diversity:

Components of Biodiversity (Ecosystem, Genetic and Species diversity) - Assigning values to biodiversity - Species concepts - Animal diversity: (Distribution inventory, species richness) - Biodiversity Hotspots (Western Ghats, Indo-Burma region). Biogeography of India - patterns and distribution of ecosystems, ecological succession, biotic and abiotic factors of an ecosystem. Conservation ethics and values of wildlife.

Unit- II - Loss of animal diversity, status of species:

Extinctions: Past rates of Extinctions - Concepts of Island biogeography and extinction rates on Islands - Human induced, Modern and local extinctions - Population reduction-threats to wildlife (examples) - Habitat loss, degradation and fragmentation. Threats to animal diversity in India - Status of species: Rare, endemic and threatened species - Measuring status of species in the wild - IUCN Red list (Assessments and methodologies) - Status of Indian animals.

Unit- III- Conservation tools:

In situ conservation of Indian animals (Case studies). Ex situ: Captive breeding programme - people participation in conservation - Successes and failures of conservation actions in India (Case study) - Tools in Conservation: GIS - remote sensing - Landscape model - PVA - VORTEX. Red listing process: categories and criteria, SIS. Wildlife conservation in India importance of conservation - methods of wildlife conservation.

Unit- IV- Animal laws and policies in India:

Economics of biodiversity conservation: Wildlife (Protection) Act of India (1972) - Protected Area network - forest policy – Prevention of cruelty to Animal Act - Convention on Biological

diversity, International Trade in endangered species - Zoo policy- Laws and their applications in Zoological parks, wildlife sanctuaries and biosphere reserves - Economics of biodiversity conservation. The world Conservation Union (IUCN) - World wildlife fund (WWF) - Indian Board for Wildlife (IBWL).

Unit- V- Conservation education, awareness and implementations:

Wildlife / Animal magazines, Journals- How to write popular and Scientific articles - Magazine and Journal information - Wildlife, nature, environment games (examples) - Role of NGO's and Government organizations in wildlife conservation - Wildlife celebration days in India. Technical writing and reporting of field studies. Public presentation. Field Project/ Report – visit to Zoological parks, wildlife sanctuaries and biosphere reserves.

Reference Books:

1. Anon. 2004. Indian Wildlife Protection Act 1972. Natraj Publishers, Dehra Dun. 104p.
2. Anon. 1992. Convention on Biological Diversity - Text and annexes. World Wide Fund for Nature - India.
3. Anon. 1997. Wildlife (Protection) Act of India, Nataraj Publishers, Dehradun
4. Caughley, G., and A. Gunn. 1995. Conservation Biology in Theory and Practice. Blackwell Publishers.
5. Cody, M.L. and J.M. Diamond 1975. Ecology and Evolution of Communities. Harvard University Press. Cambridge. 545p.
6. Gaston, K. J. 1996. Biodiversity- A Biology of Numbers and Difference. Blackwell Science, Oxford. 396 p.
7. Giles, H. 1984. Wildlife Management Techniques. Natraj Publishers, Dehra Dun.
8. Gopal, R. 1992. Fundamentals of Wildlife Management. Justice Home. Allahabad. 668p.
9. Groom bridge, B.1992.Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.
10. Handa, S.K. 1999. Principles of Pesticide Chemistry. Agrobios Publishers, Jodhpur. 309p.
11. Heyer, W.R. *et al* 1994. Measuring and Monitoring Biological Diversity, Standard methods for Amphibians. Smithsonian Institution Press. Washington. 364p.
12. Huffaker, C.B. and A.P. Gutierrez 1999. Ecological Entomology. John Wiley and Sons, New York. 756p.
13. International Commission of Zoological Nomenclature 1999. International code of zoological nomenclature. 4th Edition. International Trust for Zoological Nomenclature, London. 306p.
14. IUCN, The World Conservation Union. <http://www.iucn.org/.21>
15. Kikkawa, J. and D.J. Anderson 1986. Community Ecology: Pattern and Process. Blackwell Scientific Publications, Oxford. 432p.
16. Meffe, G. K. and C. R. Carroll 1994.Principles of Conservation Biology, Sinauer Associates, USA
17. Michael, P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata Mc Graw Hill Publishing Company Limited, New Delhi. 404 p.
18. Odum, E.P. 1996. Fundamentals of Ecology. Natraj Publishers, Dehra Dun 574p.
19. Primack, R. B. 2006. Essentials of Conservation Biology, Sinauer Associates, USA.

20. Reaka, M.L., Kudla, D. E. Wilson and E. O. Wilson 1997. Biodiversity II: Understanding and Protecting our Biological Resources. Joseph Henry Press, Washington, DC.
21. Rodgers, W.A. and H.S. Panwar 1988. Planning a Protected Area Network in India. Wildlife Institute o India, Dehra Dun.
22. Soule, M. E. 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA.
23. Southwood, T. R.E. and P.A. Henderson 2000. Ecological Methods. Blackwell Science. Oxford.575 p.
24. Sutherland, W. J., 1998. Conservation science and action. Blackwell Science, Oxford, England.
25. William J. Sutherland 1996. Ecological census: techniques, (Cambridge University press.
26. William Morris, Daniel Doak, Martha Groom et al., 1999. A Practical handbook for Population Viability Analysis, The Nature Conservancy.
27. Wilson, E. O., and D. Perlman. 2000. Conserving earth's biodiversity. Island Press, Washington, D.C.

Course Outcomes:

On successful completion of the course, the students will be able to:

- CO1- develop conservation ethics with clear understanding of different biodiversity concepts
- CO2- address the loss of animal diversity and evaluates the role of human impacts for the decline in diversity
- CO3- establish workable methods for preserving species and their biological communities
- CO4- gain knowledge on the working of various International and National animal laws and policies
- CO5- apply this knowledge in addressing local and global issues in securing the world's biological diversity

Course prepared by: Dr. C. Gunasekaran

Course verified by: Dr. M. Ramesh

Title of the Subject - Lab Course - III

ANIMAL PHYLOGENY AND EVOLUTION, ENVIRONMENTAL BIOLOGY AND TOXICOLOGY, ECONOMIC ZOOLOGY AND CONSERVATION BIOLOGY

Code No. : 33P No. of Credits: 4
No. of Teaching hours: 8 hrs/week

Course Objectives :

- Study of identification and study of invertebrate and vertebrate fossils
- Estimate the physic chemical parameters of the water.
- To study the collection, isolation and identification of planktons
- To study the parasitic protozoa and heminthus worms
- To study insect pests, predators and parasites in aquaculture, prawn diseases and their pathology.
- To study the collection and preservations of fauna using various sampling and statistical techniques

Animal phylogeny and evolution

Identification and study of Invertebrate and Vertebrate fossils (slides and specimens)

1. Coelenterate – Coral (Carboniferous)
2. Arthropoda – Trilobite (Silurian)
3. Mollusca – Lamellibranch (Recent)
4. Mollusca – Gastropod (Tertiary)
5. Mollusca – Ammonite (Jurassic)
6. Echinodermata – Crinoid (Carboniferous)
7. Echinodermata – Echinoid (Jurassic)
8. Vertebrata – Shark’s tooth (Miocene)

Environmental biology and toxicology

1. Estimation of Aquatic - Primary productivity - Dark and Light bottle.
2. Estimation of pH, Dissolved oxygen, Carbon di-oxide, Salinity and Carbonates and Bicarbonates in water samples.
3. Analysis of industrial effluent - TDS, TSS, BOD, (COD - Demonstration).
4. Estimation of Earthworm population - Demonstration.
5. Collection, isolation and identification of Plankton.
6. Study of sandy, muddy and rocky shore fauna with special Reference for their adaptation to the environment.
7. Animal Association - parasitism, mutualism and commensalisms.
8. Visit to treatment Plants
 - a) Drinking water treatment plant – Siruvani Dam.
 - b) Effluent Treatment - Tirupur.
 - c) Sewage treatment - Tirupur.

Economic Zoology

1. Parasitic protozoa – Amoeba, Plasmodium and Trypanosoma.

2. Helminthes worms – Liver fluke, Tape worm and Filarial worm.
3. Insect pests – Trips, Nematode, Caterpillar and Rhinoceros beetle.
4. Value added products of dairy, poultry and fishery.
5. Methods for the microbiological examination of water and foods.
6. Predators and parasites in aquaculture.
7. Prawn diseases and their pathology.

Conservation Biology

1. Collection and preservations of fauna (each student should submit at least 3 fauna sps.).
2. Sampling Techniques (Transect and quadrature method).
3. Identification and use of keys – reference specimen.
4. Wildlife photography and documentation.
5. Remote sensing GIS and their modules for conservation.
6. IUCN Red List Exercise, VORTEX and SIS.
7. Statistical analysis – Shannon wiener index, Simpson's index, Species richness and evenness.

Practical records to be submitted to the University Practical Examination.

Reference Books:

1. Robert L Wallace and Walter K Taylor, Invertebrate Zoology: A Laboratory Manual.
2. Lynn, Environmental biology and ecology laboratory manual 4th edition, Kendall Hunt Publishing; 4th edition, 2003.
3. A.K. Jain, Era Upadhyay & Mr Anupam Adhikary, A lab text book on environmental studies.
4. Govind Pandey, Toxicology laboratory manual.
5. Oberdorster Eva, Toxicology Laboratory Lab Manual 1st Edition, Kendall Hunt Publishing; 1 edition, 2009.
6. Dr. P S Verma, A Manual of Practical Zoology: Invertebrates, S. Chand Publishing.
7. Aminul Islam, A Textbook of Economic Zoology, I.K. International Publishing, House.

Course Outcomes:

On successful completion of the course, the students will be able to:

- CO 1 - Develop skill in simple analysis of physico chemical parameters of water
- CO 2 – Understand evolutionary history of animals.
- CO 3 - Understand the diseases, pest, parasites and predators of economic importance
- CO 4 - Understand the study of fossils of different animals
- CO 5 - Understand the process of isolation of microorganisms.

**Course prepared by: Dr. T. Muralisankar
Dr.M.Ramesh
Dr. N. Arul
Dr. C. Gunasekaran
Dr. V. Maruthappan**

Course verified by: Dr. M. Ramesh

Title of the Subject : AQUACULTURE AND FISHERIES

No. of Credits: 4

Code No : 3EA

No of Teaching hours: 4 hrs per week

Course Objectives:

- To study the breeding, rearing, and harvesting of aquatic animals.
- To study the recent techniques and application for the practical aquaculture
- To know the methodology for the construction of hatcheries and farms.
- To understand the feed formulation techniques
- To learn the importance of aquaculture

Unit – I Basics of Aquaculture:

Basics of Aquaculture- Scope and importance of Aquaculture- Indian Fisheries – World Fisheries.

Unit – II Aqua farm engineering:

Aqua farm engineering-selection of site, designing, layout and construction of aqua farms-basic introduction to culture techniques-modern approach of composite fish culture-Integrated fish farming.

Unit – III Feed formulation and Technology:

Feed formulation and Technology –live feeds-ingredients and their selection- formulation and preparation of feeds-addition of probiotics and probiotics in formulate feeds.

Unit – IV Hormonal and genetic approach to modern aquaculture:

Hormonal and genetic approach to modern aquaculture-fish genetics- gynogenesis and androgenesis-Induced polyploidy-fish breeding and hybridization-Role of Ovaprim, Ovotide in induced breeding.

Unit – V Development of new techniques:

Development of new techniques for aquaculture cryopreservation techniques for sperms Application of remote sensing in conservation of management of fish faunal diversity-vaccines for aquaculture-Identification of Bacterial and viral pathogen.

Reference Books:

1. Fisheries and Aquaculture by Lingaraj Patro (2012)
2. A Text Book of Fish Biology & Fisheries by S.S Khanna , H R Singh (2014)
3. Fish and Fisheries by Pandey (2014)
4. Fisheries And Aquaculture by Neelima Gupta (2006)

5. Fisheries research planning and Management in developing countries- V.R.P.Sinha1. International Books and Periodicals services (IBS)-New Delhi.
6. Live feeds in Marine Aquaculture- L.A.McEvoy and J.G.Stottrup-Blackwell publishing company, UK
7. Aquaculture Principles and Practices-T.V.R.Pillay, 2005, Fishing News Books, USA.
8. Fish and fisheries of India-V.G.Jingran-1975, Hindustan Publishing Corporation, Delhi.
9. Biology of finfish and shellfish-SCSC publishers-Howrah.

Course Outcomes:

On successful completion of the course, the students will be able to

- CO 1- Easily get the employment opportunities especially in the Hatchery and Fish farm.
- CO2 - Able to design & construct fish and prawn farm and maintain young ones in the hatchery.
- CO 3 - Boost the immunity in fishes and prawns and enhance the nutrition through live feed culturing.
- CO 4 - Learn the new techniques in aquaculture
- CO 5 - Understand the fish genetics.

Course prepared by: Dr. V. Ramasubramanian

Course verified by: Dr. M. Ramesh

Title of the Subject : APPLIED MICROBIOLOGY

No. of Credits: 4

Code No : 3EB

No of Teaching hours: 4 hrs per week

Course Objectives:

- key features of the structure, functions and classification of bacteria, viruses, fungi and yeast
- knowledge on the Cultivation and control of microorganism
- to understand the distribution of microorganisms
- to learn about the microorganisms and their detection
- to understand the application of microorganisms in microbial technology

Unit – I -Introduction– Scope and History of microbiology:

Classification of bacteria, fungi, yeast and virus. Structure and functions of bacteria and virus. Reproduction in bacteria – Transformation, conjugation, transduction. Mapping in bacterial genomes.

Unit – II -Cultivation and control of microorganism:

Methods of collection of sample – methods of estimation of microorganism in soil, water and air – Isolation and identification of bacteria. Methods of sterilization and disinfection – Microbial control – Physical and chemical –techniques of pure culture – Method of cultivation of bacteria – Phases of growth.

Unit – III -Microbial Ecology:

Distribution of microorganism in soil, water and air –Role of microorganisms in the cycling of nutrients – carbon, nitrogen, phosphorous and sulphur cycle.

Unit – IV-Food Microbiology:

Sources, types incidence of microorganism in vegetables, meats, poultry, seafood and dairy products – spoilage of food, fruits, vegetables, meat, poultry, seafood, caned products – Factors influencing spoilage – Methods of detection of spoilage, principles of food preservation and prevention of food spoilage.

Unit – V -Microbial Technology:

Genetic engineering of food and additives – Single Cell Protein (SCP) production – Production of organic acids (acetic acid), ethanol – Antibiotics – Microbial toxins – Fermentation products.

References Books:

1. Burden, K.L. and R.P. Williams (6th Ed.) 1968. Microbiology. The Macmillan Co., London P. 818.

2. Dawes, E.A. (Ed.) 1986. Energy conservation in bacterial photosynthesis. In: Microbial energetics. Blackie & Son Ltd., Glasgon, 133-144pp.
3. Doelle, H.W. (Ed.) 1969. Fermentation acetic acid bacteria and lactic acid bacteria. In: Bacterial metabolism. Academic Press. New York, London. 256 – 351 pp.
4. Hay, J.M. (Ed.) 1986. Modern Food Microbiology. CBS publishers, Delhi. 622 pp.
5. Reed, G. (4th Ed.) 1983. Prescott & Dunn's Industrial Microbiology. AVI Publishing Co., Inc. Connecticut, 883. pp.
6. Roberts, T.A. and F.A. Skinner (Eds.) 1983. Food Microbiology: Advances and Prospects, Academic Press, Inc. London, 393 pp.
7. Selle, A.J. (Ed.) 1967. Fundamental Principles of Bacteriology. Tata McGra – Hill Publishing Company Ltd., New Delhi, 822 pp.

Course Outcomes:

On successful completion of the course, the students will be able to

CO1 - identify the scope and history of microbiology

CO2 –acquire the knowledge on cultivation and control of microorganisms

CO3 –knowledge on the role of microorganism in cycling of nutrients

CO4 -analyze the different applications of microbiology in food industry

CO5- understand the application of microbial technology in production of organic acids.

Course prepared by: Dr. N. Arul

Course verified by: Dr. M. Ramesh

Title of the Subject : **BIOTECHNOLOGY AND BIOETHICS** No. of Credits: 4

Code No. : 4EA No. of Teaching hours: 4 hrs/week

Course Objectives:

- To acquire knowledge on the Bioethics biotechnology applications
- To study the Regulation framework and Good Laboratory Practices
- Understand the CPCSEA Guidelines
- To learn the Intellectual Property Rights and patent filing.
- To learn the application of biotechnology in various fields

Unit-I Introduction to Bioethics and Biotechnology examples:

Introduction to Bioethics in Biotechnology- Ethics – Bioethics - Biotechnology – Positive effects – Negative effects - Ethics in biotechnology- Biotechnology examples – Rice with Vitamin A - Slow Ripening Fruits- Saving the Banana- Virus Resistant Crops - Building with Silk- Educated Need for Fertilizers- More from the Sun-Toxic Soils- Biological Pest Controls – Fast Growing Trees- Fast Growing fish- The Monarch Butterfly Story- Consumer traits – food safety- Environmental concerns- Economic and Social Concerns.

Unit-II Biotechnology applications:

Production of secondary metabolites/products: Insulin, growth hormones and interferons,). Production of biotechnological products: Food –SCP (algae, yeast, mushroom). Biofertiliser (BGA, VAM) Biopesticides (*Bascillus thuringiensis*).

Unit-III Regulation framework and Good Laboratory Practices:

Regulation framework in– USA- European Union-Canada- Australia- South Africa-India. GLP and Bioethics- Introduction – National Good Laboratory Practice (GLP) Programme- The GLP authority functions- Why follow Good Laboratory Practices?- The Aspiration – Who is responsible? – The IT Way- Role of a Sponsor- What are the quality standards for Clinical Trials?- Why is India a favorite destination for Clinical Trials worldwide?

Unit-IV CPCSEA Guidelines:

CPCSEA Guidelines for Laboratory Animal Facility : Goal-Veterinary care- Animal procurement- Quarantine, Sterilization and separation – Surveillance, diagnosis, treatment and control of disease- Animal care and technical personnel- Personal hygiene- Animal experimentation involving hazardous agent- Multiple surgical procedures on single animal- Duration of experiments- Physical restraint- Physical plant- Physical relationships of animal facilities to laboratories– Functional areas- Physical relationship of animal facilities to laboratories- Functional area- Physical facilities- Environment- Animal husbandry- Activity – Food- Bedding- Water- Sanitation and cleanliness- Assessing the

effectiveness of sanitation – Waste disposal- Pest control- Emergency , weekend and holiday care.

Unit-V Intellectual Property Rights:

Intellectual Property Rights - An introduction- Origin of the Patent Regime- Early patterns Act & Indian Pharmaceutical Industry – History of Indian Patent System- The Present Scenario – Basis of Patentability –Patent Application Procedure in India- Patent Granted Under Convention Agreement- Who can apply for a patent?- Patent Procedure – Opposition to Grant of Patent-Grant and Sealing- Exclusive Rights – Grant of Exclusive Rights- Special Provision for selling or distribution – Suits relating to infringements – Compulsory License- Termination of Compulsory License – Case study- Compulsory Licenses- Relief under TRIPS agreement.

Reference Books:

1. Bioethics, by Shaleesha A. Stanley (2008). Published by Wisdom Educational service Chennai.
2. Dubey, R. C., 2008, A text book of Biotechnology, S. Chand Co., New Delhi
3. Gupta, P.K, 2008, Biotechnology and Genomics, Rastogi Publications, Meerut, India.

Course Outcomes:

On successful completion of the course, the student will be able to

- CO1 -Learn the terminology, vocabulary, and objectives of bioethics and the examples of biotechnology in human welfare.
- CO2- Know the practical use of biotechnology and its applications in medicine, food production and agriculture.
- CO3- Acquire knowledge on the regulatory framework and Good laboratory Practices at the global level
- CO4- Understand the guidelines and established procedures to maintain and handle the animals as per laboratory standards.
- CO5- Familiarise the procedure, types of patent system and application procedure in India and at abroad.

Course prepared by: Dr. P. Sundarraj

Course verified by: Dr. M. Ramesh

Title of the Subject : **INTRODUCTION TO TOXICOLOGY** No. of Credits: 4

Code No. : 4EB No. of Teaching hours: 4 hrs/week

Course Objectives:

- To acquire knowledge on principles of toxicology and governing toxic responses to chemical exposures.
- To learn the presence of toxic substances in the environment and poisonous substances of plant and animal origin
- Introduce students the various procedures in the field of toxicology
- Teach students how toxicants interact with target organs.
- To learn the risk assessment of toxic substances and their applications in various fields.

Unit –I- General principles of toxicology:

Definition – Scope of toxicology – Recent developments – Absorption – distribution – Excretion – Bio-transformation.

Unit – II-Toxic substances found in water soil, water, air and food:

Introduction – Inorganic poisons – organic compounds – Aromatic compounds – Heterocyclic compounds – Poisonous substances of plant and animal origin – detergents – pesticides.

Unit – III-Testing procedures:

Introduction – Bioassay – Acute toxicity, sublethal toxicity – Determination of LC 50, EC 50 and LT 50.

Unit – IV-Target organs:

Gill- Liver – Lung – Skin – Kidney – testing procedures – evaluation – antidotes

Unit – V-Risk assessment and applications of toxicology:

Risk assessment: Introduction – Acceptable daily intake (ADI) – Mathematical model – other procedures. Applications: Forensic – clinical – occupational and regulatory toxicology – toxicology and law.

References Books:

1. Frant C.L.V. 1991, Basic Toxicology II (Eds.), Hemisphere Publishing Corporation, Washington, London.
2. Casarett and Doull's 1980. Toxicology: The Basic Science of Poisons.. II (Eds.) Macmillan publishing co., Inc, New York.

3. Butler, G.C. 198\78, Principles of Ecotoxicology. John Wiley and Sons, Chichester.
4. Fumi Matsumura, 1980. Toxicology of Insecticides. Plenum Press, New York and London.
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6. Sambasiva Rao K.R.S. 1999. Pesticide impact on fish metabolism. (Eds.) Discovery Publishing House, New Delhi.
7. Gupta, P.K. 1985. Modern toxicology Vol. II. Metropolitan Book co. (P) Ltd., New Delhi.
8. Thomas J. Haley and William O. Berndt, 1987. Handbook of toxicology. Hemisphere Publishing Corporation, Washington.
9. Bio-pesticides in Insect Pest Management 1999. S. Ignacimuthu and Alok Sen, Phoenix Publishing House Pvt., Ltd., New Delhi.
10. Water Toxicology V.V. Metelev, Kanaev, N.G. Dzasokhova-Amerind Publishing Co., Pvt., Ltd., New Delhi.

Course Outcomes:

On successful completion of the course, the student will be able to

- CO1 - To explain the processes of absorption, metabolism and elimination of toxicants
- CO2- To explain the environmental toxicants and specific examples
- CO3- Students will develop a broad range of skills in testing procedures of toxic substances in the laboratory.
- CO4- Exhibiting a depth of scientific knowledge on target organs of chemical substances and risk assessment
- CO5- To assist in the preparation of students for employment in the pharmaceutical industry or related area

Course prepared by: Dr. M. Ramesh

Course verified by: Dr. M. Ramesh

Title of the Subject : **PROJECT WORK AND VIVA VOCE** No. of Credits: 6

Code No. : 4PV No. of Teaching hours: 25 hrs/week

Course Objectives: To complete a project work in the field of Toxicology, Crustacean Biology and Reproduction, Aquatic Biotechnology and Live feed Culture, Conservation Biology, Nematology, Disease Proteomics and Aquatic Ecology.

Course Outcomes:

On successful completion of the course, the student will be able to

CO 1- Explain the recent trends in the respective fields

CO 2- To undertake the higher studies

Co 3- To get placement in related industries.

Title of the Subject : **FIELD TRIP AND SKILL DEVELOPMENT** No. of Credits: 2

Code No. : 4FV & 4SD No. of Teaching hours: 7-10 days (minimum)

Course Objectives :

- To visit institution, research labs, and industries
- To acquire a skill programme in recent field of zoological research.

Course Outcomes:

On successful completion of the course, the student will be able to

CO 1- Understand the various research programmes in zoology

CO 2- To get placement in related industries.

Title of the Subject: **LIFESTYLE DISEASES**
Code No. : GS1

No. of Credits: 2
No. of .Teaching hours: 2 hrs/week

Course Objectives:

- To understand basic knowledge on lifestyle changes and their diseases.
- To study the different lifestyle diseases based on various habits of a particular individual.
- To know the frequent diseases arising from IT sector as occupational level.
- To learn the impact an assortment of environmental factors based on an unusual lifestyle.
- To build awareness by diverse management practices.

UNIT -I: Introduction to Lifestyle diseases:

Introduction- Classification of disease - Lifestyle disease (LD) – Non communicable disease as Lifestyle disease – Changes in the lifestyle –Controllable and uncontrollable Risk factors of LD.

UNIT -II: Habitual Lifestyle diseases:

Smoking: Asthma, lung disease, Chronic respiratory disease, **Alcoholism:** alcoholic myopathy, alcoholic cardiomyopathy, **Diet:** Diabetes, osteoporosis, kidney calculus, stroke, and **Childhood disease:**Thumb sucking and nail biting.

UNIT -III: Occupational Lifestyle diseases:

IT Sector- An overview – Dry eye syndrome, Cervical spondylitis, Carpal tunnel syndrome, Psychological stress, Obesity, Hypertension, Cardiovascular diseases, Infertility.

UNIT -IV: Environmental Lifestyle Factors and Their Impact:

Electromagnetic Radiation environment- Electronic Gadgets and their ill effects-Spinal misalignment, Neurodegenerative disease, Cancers in adult and children, Digital dementia and Brain oxidative stress.

UNIT V: Management practices:

Prevention and control of Lifestyle diseases- Nutrition and Dieting- Physical Exercise and its benefits.

Course outcomes: On successful completion of the course, the student will be able to

CO1: Acquire basic knowledge on lifestyle changes and their diseases.

CO2: Learn the the different lifestyle diseases based on various habits of a particular individual.

CO3: Understand the frequent diseases arising from IT sector as occupational level.

CO4: Learn the impact an assortment of environmental factors based on an unusual lifestyle.

CO5: Gain adequate knowledge awareness by diverse management practices.

References:

1. WHO (2017). Noncommunicable diseases. Fact Sheet. (Retrieved from: <http://www.who.int/mediacentre/factsheets/fs355/en/> on: 2/05/2017)
2. WHO (2011). Global status report on noncommunicable diseases 2010. (Retrieved from http://www.who.int/nmh/publications/ncd_report_full_en.pdf on 1/05/2017)
3. WHO/WEF (2008). Preventing noncommunicable diseases in the workplace through diet and physical activity: World Health Organisation/World Economic Forum report of a joint event.
4. C. Carlberg et al. Nutrition and Common Diseases; *Nutrigenomics*, DOI 10.1007/978-3-319-30415-1_1; Springer International Publishing Switzerland 2016.
5. V. Gupta et al., Lifestyle, Stress, and Disorders. *Basic and Applied Aspects of Biotechnology*, DOI 10.1007/978-981-10-0875-7_22; Springer Science+Business Media Singapore 2017.
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8. Linda Rosenstock, Mark R Cullen, Carl Andrew Brodtkin. Textbook of Clinical Occupational and Environmental Medicine; Elsevier Saunders (Second edition); 2005
9. R. Kumar, M. Kumar. Guide to prevention of life style diseases. Deep and Deep publications, 2004.
10. Sebastian L. Johnston, Stephen T. Holgate. Asthma: Critical Debates. John Wiley & Sons. 2008.
11. Kent Pinkerton Richard Harding, The Lung, Development, Aging and the Environment, 2nd Edition, 2014.
12. Richard I. G. Holt, Clive Cockram, Allan Flyvbjerg, Barry J. Goldstein, Textbook of Diabetes, John Wiley & Sons. 5th edition, 2016.
13. David Reid, Handbook of Osteoporosis published by Springer Healthcare Ltd, 2011.
14. David A. Schulsinger, Kidney Stone Disease: Say NO to Stones!, Springer, 2014.
15. Chaudhuri and P.O. Behan, alcoholic myopathy, Proc R Coll Physicians Edinb 1999.
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17. Tanaka, O. M et al., Nailbiting, or onychophagia: A special habit. American Journal of Orthodontics and Dentofacial Orthopedics, 2008 (doi:10.1016/j.ajodo.2006.06.023).
18. B. Maisch, Alcoholic cardiomyopathy, 2016 • 41:484–493 (DOI 10.1007/s00059-016 4469-6).

Course prepared by: Dr. N. Arul

Course verified by: Dr. K. Murugan

Title of the Subject: **INTRODUCTION TO CONSERVATION BIOLOGY**

No. of Credits: 2

Code No. : GS2

No. of Teaching hours: 2 hrs/week

Course Objectives:

- To learn the fundamentals of biodiversity
- To study grounds of habitat loss in animals and ensure species assessments
- To familiarise with tools and techniques employed for studying wildlife, habitat and ecosystem processes
- To know laws and regulations adopted for animals
- To provide students with a multidisciplinary education in conservation biology

Unit –I - Biodiversity; species concepts; animal diversity:

Components of Biodiversity (Ecosystem, Genetic and Species diversity) - Assigning values to biodiversity - Species concepts - inventory survey methods in Animal diversity - Biodiversity Hotspots (Western Ghats, Indo - Burma region).

Unit - II - Loss of animal diversity, status of species:

Extinctions: Past rates of Extinctions - Threats to animal diversity in India - Status of species: Rare, endemic and threatened species - Measuring status of species in the wild - IUCN Red list exercise - Status of Indian animals.

Unit - III - Conservation: tools in animal conservation:

In situ and *Ex situ* conservation of Indian animals (Case studies) - Project Tiger and Elephant - Captive breeding program - Peoples participation in conservation - Tools in Conservation: GIS, Remote sensing – PVA - vortex.

Unit – IV- Animal laws and policies in India; Economics of Biodiversity conservation:

Wildlife (Protection) Act of India (1972) - Protected Area Network - Zoo policy - Laws and their applications in Zoological parks, Wildlife sanctuaries and Biosphere reserves - Economics of biodiversity conservation.

Unit – V- Conservation education and awareness:

Wildlife / Animal magazines, Journals - How to write popular and Scientific articles – Public Presentation - Designing educational resource materials – wildlife, nature, environmental games - Role of NGO's and Government organizations in wildlife conservation - Wildlife documentation.

Reference Books:

1. Anon. 2004. Indian Wildlife Protection Act 1972. Natraj Publishers, Dehra Dun. 104p.

2. Anon. 1992. Convention on Biological Diversity - Text and annexes. World Wide Fund for Nature - India.
3. Anon. 1997. Wildlife (Protection) Act of India, Nataraj Publishers, Dehradun
4. Caughley, G., and A. Gunn. 1995. Conservation Biology in Theory and Practice. Blackwell Publishers.
5. Cody, M.L. and J.M. Diamond 1975. Ecology and Evolution of Communities. Harvard University Press. Cambridge. 545p.
6. Gaston, K. J. 1996. Biodiversity- A Biology of Numbers and Difference. Blackwell Science, Oxford. 396 p.
7. Giles, H. 1984. Wildlife Management Techniques. Natraj Publishers, Dehra Dun.
8. Gopal, R. 1992. Fundamentals of Wildlife Management. Justice Home. Allahabad. 668p.
9. Groom bridge, B.1992.Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.
10. Handa, S.K. 1999. Principles of Pesticide Chemistry. Agrobios Publishers, Jodhpur. 309p.
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12. Huffaker, C.B. and A.P. Gutierrez 1999. Ecological Entomology. John Wiley and Sons, New York. 756p.
13. International Commission of Zoological Nomenclature 1999. International code of zoological nomenclature. 4th Edition. International Trust for Zoological Nomenclature, London. 306p.
14. IUCN, The World Conservation Union. <http://www.iucn.org/.21>
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17. Michael, P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata Mc Graw Hill Publishing Company Limited, New Delhi. 404 p.
18. Odum, E.P. 1996. Fundamentals of Ecology. Natraj Publishers, Dehra Dun 574p.
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21. Rodgers, W.A. and H.S. Panwar 1988. Planning a Protected Area Network in India. Wildlife Institute o India, Dehra Dun.
22. Soule, M. E. 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA.
23. Southwood, T. R.E. and P.A. Henderson 2000. Ecological Methods. Blackwell Science. Oxford.575 p.
24. Sutherland, W. J., 1998. Conservation science and action. Blackwell Science, Oxford, England.
25. William J. Sutherland 1996. Ecological census: techniques, (Cambridge University press.
26. William Morris, Daniel Doak, Martha Groom et al., 1999. A Practical handbook for Population Viability Analysis, The Nature Conservancy.
27. Wilson, E. O., and D. Perlman. 2000. Conserving earth's biodiversity. Island Press, Washington, D.C.

Course Outcomes:

On successful completion of the course, the students will be able to:

- CO1- develop clear understanding of different biodiversity concepts
- CO2- address the loss of animal diversity
- CO3- establish workable methods for preserving species and their biological communities
- CO4- gain knowledge on the working of various International and National animal laws and policies
- CO5- apply this knowledge in addressing local and global issues in securing the world's biological diversity

Course prepared by: Dr. C. Gunasekaran

Course verified by: Dr. M. Ramesh

Title of the Subject: **MARINE BIORESOURCES**

No. of Credits: 2

Code No. : GS3

No. of Teaching hours: 2 hrs/week

Course Objectives:

- ✓ To acquire basic knowledge on Oceanography
- ✓ To study the ecological and economic importance of marine flora and fauna
- ✓ To understand biodiversity and its conservation strategies of marine organisms
- ✓ To know the pharmacological importance of marine organisms
- ✓ To understand the various threats for marine life

Unit-I Oceanography

Marine environment- Physical oceanography: measurements of waves, tides and currents- Chemical oceanography: Nutrient cycle, minerals and trace elements-Biological oceanography: microbes, phytoplankton and zooplankton, finfish and shellfish resources.

Unit-II Marine Organisms

Marine flora: microalgae, saltmarshes, seaweeds, sea grasses and mangroves and their ecological and economic importance; Marine fauna- Zooplankton- characteristics and ecological and economic importance of marine crustaceans, molluscs, and Pisces.

Unit-III Marine Conservation

Conservation of marine life - In situ and ex situ conservation- Conservation of coral reefs- IUCN and its importance- Sea ranching- Marine biosphere reserves of India- Marine parks - Island Biodiversity-Invasive species.

Unit- IV Marine Pharmacology

Bioactive compounds- Sources of bioactive compounds (Bacteria, microalgae, seaweeds, sea grass and invertebrates)-Bioactive compounds for antibacterial, antifungal, antiviral, anti-inflammatory and anticancer activities.

Unit-V Threats of Marine Life

Marine pollution- Types and sources of pollutions- Eutrophication- Ocean Acidification- Heavy metal pollution- Microplastics pollution- Oil pollution.

Course outcomes: On successful completion of the course, the student will be able to

CO1: Acquire basic knowledge on oceanography

CO2: Learn the ecological and economic importance of marine organisms

CO3: Understand the significance of marine biodiversity and its conservation.

CO4: Know the pharmacological significance of marine organisms

CO5: Gain adequate knowledge on marine pollution and its effects on the marine life.

References:

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3. Jeffrey S. Levinton, C.D., 2001. Marine Biology: Function, biodiversity, ecology (515pp) with cd-rom”.
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6. Faulkner, D.J., Antonie Van Leeuwenhoek, 2000. Marine Pharmacology. 77: 135-145pp
7. Moore, B.S., 1999. Biosynthesis of marine natural products: Microorganisms and microalgae. 16: 653- 674.
8. Fusetani, N., 2000. Drug from the sea. Karger Publ. Basel.
9. Carl J. Sindermann, 2005. Coastal pollution: Effects on living resources and humans (Marine Science Series). 271 pp.
10. Clark, R.B., 2001. Marine pollution, Fifth edition. Oxford University press, New York Inc., 231pp
11. Qubiroga, H., 2006. Marine biodiversity, Springer, 353pp.
12. Ruth, 2002. Dynamic modeling for marine conservation. Springer, 446pp.
13. Singh, J.S. Singh, S.P., Gupta, S.R., 2006. Ecology, Environment and Resource conservation. Anamaya Pub., New Delhi, 688 pp.
14. Castro P. Huber, M.E., 2003. Marine Biology, Mc Graw Hill. Pub., 468 pp.
15. Miller, C.B., 2005. Biological oceanography. Blackwell Publsihing, 402pp.
16. Brown, E., and others, 2006. Waves, tides and shallow water processes. The Open University, 227pp.
17. Ikeda, M. and F.W. Dobson, 2005. Oceanographic applications of remote sensing. CRC Press, 492pp.

Course prepared by: Dr. T. Muralisankar
Course verified by: Dr. K. Murugan

Title of the Subject : **MARINE BIOTECHNOLOGY** No. of Credits: 2

Code No : GS4 No of Teaching hours: 2 hrs per week

Course Objectives:

- To understand the Basics of Aquaculture
- To learn about the Marine Fisheries
- To study the Principles of Oceanography and Live feed culture
- To understand the Marine Biotechnology and its Potential
- To know the Biotechnology in aquaculture

Unit – I- Basics of Aquaculture:

Introduction to Marine Biotechnology - scope and its utility in Aquaculture - Indian and World Aquaculture-Role, Status and Importance of Aquaculture.

Unit – II- Marine Fisheries:

Physico-chemical Properties of Marine environmental- Marine Fishery resources of India
Marine ornamental Fishes.

Unit – III- Principles of Oceanography and Live feed culture:

Living resources of Indian sea – Marine food analysis -Live feeds in Marine Aquaculture
Artemia, Rotifers, Microalgae and Copepods.

Unit – IV- Marine Biotechnology and its Potential:

Probiotics bacteria and their importance in aquaculture – Vaccines for aquaculture -PCR and other techniques for identification of bacterial and viral pathogen in aquaculture.

Unit – V- Biotechnology in aquaculture:

Cryo-preservation techniques- Application of cryo preservation in aquaculture - Applied genetics of cultivated fishes –. Application of ocean remote sensing in Aquaculture.

Reference Books

1. Marine Biotechnology - Enabling Solutions for Ocean Productivity and Sustainability by Organization For Economic Cooperation An (2013)
2. Springer Handbook of Marine Biotechnology by Se-Kwon Kim (2015)
3. Marine Biotechnology II (Advances in Biochemical Engineering/Biotechnology) by Yves Le Gal and Roland Ulber (2010)
4. Advances in Marine Biotechnology by Ninawe A. S., Selvin Joseph, Seghal Kiran G.(2013)

5. Biological Oceanography, (1999) Lalli, C.M.
6. Textbook of Marine Ecology (1989) Nair, N.B and Thampis
7. An Introduction to Marine Sciences (1988). Medius, P.S & Campell, J. J.
8. General Oceanography- An introduction (1980) Sielder, G.
9. Recent Advances in Marine Biotechnology. Vol.2 (1998) Nagabhusan.R
10. Biotechnology and Biodegradation (1990), D. Chakaraborthy.
11. Chemical Oceanography (1992). Millero & Saha, M.C.
12. Fish Genetics and Endocrinology (2007) R.Ghosh
13. Live feeds in Marine Aquaculture (2003) Josianne G. Stottrup and Lesley A.McEvoy
14. Marine Biology (2005) S.K.Dubey.

Course Outcomes:

On successful completion of the course, the students will be able to

- CO1- Easily get the employment opportunities especially in the Central Government Aquaculture Institutes such as NIO, NIOT, CIBA and CMFRI.
- CO 2- understand the Aquaculture Practices.
- CO 3- learn Culture Techniques.
- CO 4- study the resources of Aquatic Organism in the Ocean.
- CO 5- know about the Biotechnology in aquaculture.

Course prepared by: Dr. V. Ramasubramanian

Course verified by: Dr. M. Ramesh