

BHARATHIAR UNIVERSITY: COIMBATORE – 641 046
M. Sc. ZOOLOGY (CBCS – Univ. Dept.)

(For the students admitted for the academic year 2016-2017 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	2	
Total				----	---	----	2250	90	

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	Human Health and Hygiene	2	12	38	50	2
II	GS2	Introduction to Conservation Biology	2	12	38	50	2
III	GS3	Marine Biotechnology	2	12	38	50	2

Course objectives

To enable the learners to

- i. learn the application of Zoological principles to the animal and human biology
- ii. understand the impact of Zoology on basic human needs such as, health care, agriculture, industrial, chemical, energy etc.,
- iii. know the current development in Zoological Sciences
- iv. evaluate the future priorities in Zoology Research
- v. know the practical areas for application of Advanced Zoological Research
- vi. develop skill in the various modern bio-techniques.

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)	4x2½ = 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 - 10x1=10 Marks (Question No. 1 to 10)

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

Section B – 5x5 = 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 – 5x8 = 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 – 5x1=5 Marks (Question No. 1 to 5)

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

Section B – 3x3 = 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 – 4x6 = 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.

Core - I – 13A

FUNCTIONAL MORPHOLOGY OF INVERTEBRATES AND VERTEBRATES

Objectives:

To know the functional aspects of different systems of Invertebrates and Vertebrates in a comparative basis.

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 - Functional systems 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:

Integument: 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.

References:

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. Borradi, 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.

Core - II – 13B

MOLECULAR CELL BIOLOGY

Objectives:

To study the cellular morphology and function, genome organization, experimental basis of current understandings, new experimental methodologies and cell culture techniques.

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, signaling 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:

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

Core - III - 13C

ANIMAL PHYSIOLOGY

Objectives:

To understand the internal physical and chemical functions of animals and their parts this includes digestion and excretion, blood and circulation, respiration, nervous system and sense organs and reproduction.

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.

References:

1. Ganong, H, Review of Medical Physiology, 1989. 14th edition, Appleton & Lange publisher, New York
2. Physiology: A regulatory system approach, Fleur, and Strand, (1978). Macmillan Publishing Company, New York; Collier Macmillan Publishers, London.
3. Shier, D., Butler, J. and Lewis, R., Hole's Human Anatomy and Physiology, (10th edition) 2003. WCB/McGraw Hill, Boston. 2003.
4. Animal Physiology, Eckert, R (5th edition), 2002. W.H.Freeman.
5. Williams S. Hoar (1991) General and Comparative Physiology 3rd edition. Prentice Hall of India- New Delhi.

6. Neilson, K.S. Animal Physiology, 1997. Cambridge University Press, Pergamon Press, Oxford.
7. Prosser, C.L. and Brown-Jr. F.A.: Comparative Animal Physiology, 1961. W.B. Saunders, Philadelphia.
8. Richard w. Hill, Gordon A. Wyse, and Margaret Anderson, 2012. Animal Physiology, Sinauer Associates Inc.,U.S.
9. Christopher D. Moyes and Patricia M. Schulte, 2013. Principles of Animal Physiology, Pearson Education Limited

Core – IV - 13D

ENDOCRINOLOGY

Objectives: The study of hormones and their influence on body metabolisms plays important role in every of medicine. Metabolic processes are involved in formation, maturation and function of body tissues and in pathology of many diseases.

Unit - I

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

Unit - III

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 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

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.

References:

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. Astwood, E. B. 1968. Clinical Endocrinology, Grune and Stratton, New York.
4. Bondy P.K. and Rosenberg L.E. 1974. Duncan's disease of Metabolism – Genetics, Metabolism and Endocrinology. W. B. Saunders Co., Philadelphia, London.
5. Stephen Nussey and Saffron Whitehead. 2001. Endocrinology - An Integrated Approach, Oxford: BIOS Scientific Publishers; 2001.
6. Mac E. Hadley, Endocrinology. 1996, Prentice Hall
7. M.P. Goswami, Endocrinology and Molecular Cell Biology, 2013. Gaurav book centre Pvt Ltd, Delhi.
8. Yadav, Text book of Endocrinology, 2009, Sonali Publications, New Delhi
9. George Griffing, Endocrinology, 2015, Stat Pearls Publishing, USA

Lab Course - I - 13P FUNCTIONAL MORPHOLOGY OF INVERTEBRATE AND VERTEBRATES, MOLECULAR CELL BIOLOGY, ANIMAL PHYSIOLOGY AND ENDOCRINOLOGY

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.

Elective- I - 1EA

NANOBIOTECHNOLOGY AND APPLICATIONS

Objectives: To understand the comprehensive overview of all major aspects of nanobiotechnology and its applications in biology.

Unit -I- Introduction to Nanotechnology`:

Introduction - Importance of nanoscience and nanotechnology in biomedical applications. Types of solid and powder crystals. 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, Nano-Lithography, PVD, CVD, Wet deposition techniques, 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, STM, Atomic and Molecular spectroscopy, Photoacoustic spectroscopy, Fluorescence spectroscopy, Fluorescent resonance energy transfer (FRET), computations, 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:

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.

Elective- I - 1EB

Applied Entomology

Objectives: To understand the insect classification, insect pests, natural enemies, beneficial insects, and current research in applied entomology.

Unit-I

1. Classification of apterygota upto families.
2. Classification of following insect orders (a) orthoptera (b) hemiptera (c) diptera.
3. Classification of following insect order (a) hymenoptera (b) lepidoptera (c) coleoptera
4. Collection and preservation of insects.

Unit-II

1. Insect pest-Management strategies and tools
2. Biological control
3. Genetic control
4. Chemical control

Unit-III

1. Pests of Cotton
2. Pests of sugarcane
3. Pests of paddy
4. Pests of stored food grains
5. Pests of citrus fruits and mango
6. Pests of pulses
7. Households insect pests

Unit-IV

1. Insects in relation to forensic science
2. Insects migration, population fluctuation and factors
3. Insects of medical and veterinary importance
4. Ecological factors affecting the population and development of Insects

Unit-V

1. Mulberry and non mulberry sericulture
2. Apiculture
3. Lac culture
4. Insects as human food for future.

References:

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.

Supportive - I – 1GS

HUMAN HEALTH AND HYGIENE

Objectives: To understand the interaction of nutrients and other substances in food in relation to maintenance, growth, health and disease of human beings.

Unit -I

Introduction to food nutrition and health. Cereals, Rice, Wheat and Millets (Ragi, Maize, Barley and Oats) structure, composition and nutritive value. Recommended dietary allowances for Indian. Role of diet in the development of chronic diseases such as cardiovascular disease, cancer and diabetes.

Unit – II

Fruits and vegetables – Composition, nutritive value, pigments and flavor component. Composition and medicinal value of Garlic, Ginger, Black pepper, Cumin, Coriander and Turmeric.

Unit – III

Human diseases – Factors responsible for the spread of communicable diseases – Mode of transmission of chicken pox, typhoid fever, malaria, leprosy and filariasis.

Unit – IV

Symptoms and management of intestinal diseases – Diarrhea, inflammatory bowel disease, ulcerative colitis, constipation, irritable bowel syndrome.

Unit – V

Herbal cosmetics – advantages and disadvantages – Herbal skin and hair care – Home recipes – Herbal shampoo, hair tonic, face glow, removing dark circles, facial hair control and herbal tooth powder.

References:

1. Diet, Nutrition and Health by M.Garg, 2006, Neha Publishers & Distributors.
2. Food Science and Nutrition by Sunetra Roday, 2012, Oxford University Press
3. Human Diseases by Mark Zelman, 2014, Pearson Publishers.
4. Human Diseases by Marianne Neighbors, Ruth Tannehill-Jones, 2014, Delmar Cengage Learning.
5. Fruits and vegetables by N. P. Singh, Neha Publishers & Distributors

Core - V – 23A

EXPERIMENTAL EMBRYOLOGY

Objectives: Experimental embryology is an experimental science, which provides understanding of the processes of early embryonic development, to analyze the mechanisms of development by experimental manipulation of developing embryos and to review current methodologies for conducting research in the field of embryology. It also emphasizes on current experimental approaches utilized in research of normal and abnormal development of the mammalian embryo.

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.

Recommended Readings:

1. Berril, N.T. : Developmental Biology, 1971. McGraw Hill Co., New York.
2. Berril, N.T., Karp, G. : Development, 1988. Tata McGraw Hill Co., New York
3. Waddington, G.H. : Fundamentals of Embryology, 1949. George Allen and Unwin.
4. Huxley De Beer: The Elements of Experimental Embryology, 1934. Cambridge Univ. Press, Cambridge, Hafher Publishing Co.

5. Rover, C.P. : An Outline of Developmental Physiology (1968). Pergamon Press.
6. Austin, C.R. : Fertilization (1966). Prentice Hall.
7. Austin, C.R. : Ultra structure of Fertilization (1967). Holt Reinhart and Winston.
8. Hay, E.D. : Regeneration (1970). Holt Reinhart and Winston.
9. Nelson, G.F. : The Comparative Embryology of Vertebrates (1979). Blackinton and Co.
10. Balinsky, B.I. : An Introduction to Embryology (1960). W. B. Saunders Co., Philadelphia
11. Bodemer, C. : Modern Embryology (1968). Hold, Rinehart and Winstorn, Inc, New York.
12. Trampush, HAL and Kiotsis, V. : Regeneration and Related Problems (1972). North Holland Publishing Co.,
13. Vorontsova, M.A. and Liosner, L.D. : Asexual Propagation and Regeneration (1960). Pergaman Press.
14. Monray, A. Chemistry and Physiology of Fertilization (1978). Halt Reinhart and Winston.

Core - VI – 23B

IMMUNOLOGY

Objectives: To understand the all areas of immunology, including innate and adaptive immunity, antigens and antibodies, host defense, clinical immunology, immunological disorders, and immunotechnology.

Unit – I

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

Unit-III

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

Unit-IV

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

Unit-V

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

References:

1. Immunology, S.K. Gupta (1999). Narosa Publishing House, New Delhi.
2. Essential Immunology (8th Edition), Ivan Roitt, 1994. Blackwell Scientific Publication. Immunology W.H. Freeman and Company.
3. Abdul .K. Abbas. Andrew .K. Litchmen and Jordan, 1997, Cellular and Molecular Immunology, 3rd Edn. W.B. Saunder Company.
4. Weir, D.M. and Stewart, J., 1997, Immunology, 8th Edn., Churchill Livingston, New York.
5. Eryl Liddell and Ian Weeks., 1995, Antibody Technology, BIOS Scientific Publishers.
6. 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.
7. Immunology, George Pinchuk (2004). Tata McGraw-Hill Publishing Company Limited, New Delhi.

Core - VII – 23C

MOLECULAR GENETICS

Objectives: To understand the structure and function of genes at a molecular level.

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

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. W.H. Freeman & Co.
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 ISBN: 13: 987-0-12-583990-7

Core – VIII – 23D

BIOCHEMISTRY AND BIostatISTICS

Objectives: To study the chemical nature, function, structure and energetics of simple to complex biological and/or cellular molecules. The purpose of Biostatistics is for the proper interpretation of scientific data generated in the biology.

Unit – I

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

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

Types of biological data; frequency distributions; cumulative frequency distributions. Populations; samples from populations; random sampling; parameters and statistics. 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

Probability Distribution: Normal distribution; binomial distribution and poison distribution. Chi-square test for goodness of fit; statistical significance; statistical errors in hypothesis testing.

Unit – V

Simple linear regression; testing the significance of a regression; comparison of two slopes; correlation coefficient – hypothesis testing about correlation coefficients; comparison of two correlation co-efficients; rank correlation; intraclass correlation. Analysis of variance: One-way classification; two-way classification.

References:

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.

**Lab Course – II – 23P EXPERIMENTAL EMBRYOLOGY, IMMUNOLOGY,
MOLECULAR GENETICS AND BIOCHEMISTRY &
BIostatistics**

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 - haemagglutination 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 – frequency distribution etc - graphically represent them - and obtain descriptive measures such as mean, standard deviation, standard error, coefficient of variation etc. for the collected data.
2. Problems relating to probability - genetics - and patterns of distribution (fitting and testing goodness of fit of Binomial, normal distribution).
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.

Elective - II – 2EA

MOLECULAR TAXONOMY

Objectives: To understand the use of molecular genetics to study the evolution of relationships among individuals and species.

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 VectorBase.

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.

References:

1. Darwin, C. 1859. *On the Origin of Species*. London: John Murray (always seek 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

Elective - II – 2EB GLOBAL WARMING – ANIMAL MIGRATION AND BEHAVIOUR

Objectives: To understand the factors responsible for global warming and their impacts on animals particularly the biological responses to climate change

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.

References:

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. Khitoliyan

Supportive – II – 2GS

INTRODUCTION TO CONSERVATION BIOLOGY

Objectives: To understand the species concept, loss of animal diversity, direct implications for the management of species and ecosystems, captive breeding and reintroduction and habitat restoration.

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.

References:

1. R. B. Primack 1993. Essentials of Conservation Biology, Sinauer Associates, USA
2. G. K. Meffe and C. R. Carroll 1994. Principles of Conservation Biology, Sinauer Associates, USA
3. B. Groom bridge 1992. Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.

4. R. A. Mittermeier, N. Meyers, P.R. Gil and C. G. Mittermeier 2000. Hotspots: Earth's
5. T. W. Clark, R. P. Reading and A.L. Clarke 1994. Endangered Species Recovery: Finding the Lessons, Improving the process. Island Press, Washington, DC.
6. W. V. Reid and K.R. Miller 1989. Keeping options Alive. World Resources Institute.
7. Anon. 1997. Wildlife (Protection) Act of India, Nataraj Publishers, Dehradun
8. K.J. Gaston 1996. Biodiversity: Biology of numbers and Difference. Blackwell Science, Oxford.
9. Biologically richest and most endangered Terrestrial Ecoregions. Cemex/Conservation International, USA
10. M.E. Soule 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA. M.Sc. Animal Biotech (Univ. dept) 2010-11 Page 26 of 26
11. M. L. Reaka - Kudla, D. E. Wilson and E. O. Wilson 1997. Biodiversity II: Understanding and Protecting our Biological Resources. Joseph Henry Press, Washington, DC.

Core – IX – 33A

ANIMAL PHYLOGENY AND EVOLUTION

Objectives: To understand the recent progress in the field of animal phylogeny for our understanding of the evolution of development, morphology, genomes, and other characters.

Unit – I

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

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

Unit - IV

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

Unit - V

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:

1. Kotpal, R.L. and N.P. Bali, 1986. 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., 1954. Elementa of Ecology, John Wiley & Sons Inc., New York, London, 534 pp.
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. Leninger, A.L., Nelson, D.L. and Cox, M.M. 1993 – principles of Biochemistry, CBS Publishers and Distributors, New Delhi.

Core - X- 33B

ENVIRONMENTAL BIOLOGY AND TOXICOLOGY

Objectives: Environmental Biology course is designed to provide fundamental ecological principles that provide an in-depth understanding of our natural world, the scientific basis for understanding how environmental systems work, the environmental issues, environmental problems, effects and solutions. This course also provides detailed information about environmental toxicology, which provides a sound basis for understanding and formulating various measures to protect the health and welfare of human population in the world. The course content of this paper is designed to give a basic understanding of various aspects 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.

References:

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.

Core – XI – 33C

ECONOMIC ZOOLOGY

Objectives: To study the application of zoological knowledge for the benefit of mankind.

Unit- I- Agricultural Zoology:

Beneficial insects: spider, mantis, ladybird beetle, damselfly, mealybug 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-nitrogenous 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 - Byproduct 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.

References:

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)

Core – XII – 33D

CONSERVATION BIOLOGY

Objectives: To understand the species concept, loss of animal diversity, direct implications for the management of species and ecosystems, captive breeding and reintroduction and habitat restoration

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 Unit (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.

References:

1. R. B. Primack 1993. Essentials of Conservation Biology, Sinauer Associates, USA.
2. G. K. Meffe and C. R. Carroll 1994. Principles of Conservation Biology, Sinauer Associates, USA
3. B. Groom bridge 1992. Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.
4. R. A. Mittermeier, N. Meyers, P.R. Gil and C. G. Mittermeier 2000. Hotspots: Earth's Biologically richest and most endangered Terrestrial Ecoregions. Cemex/Conservation International, USA.
5. M.E. Soule 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA.
6. M. L. Reaka - Kudla, D. E. Wilson and E. O. Wilson 1997. Biodiversity II: Understanding and Protecting our Biological Resources. Joseph Henry Press, Washington, DC.
7. T. W. Clark, R. P. Reading and A.L. Clarke 1994. Endangered Species Recovery: Finding the Lessons, Improving the process. Island Press, Washington, DC.
8. W. V. Reid and K.R. Miller 1989. Keeping options Alive. World Resources Institute.
9. Anon. 1997. Wildlife (Protection) Act of India, Nataraj Publishers, Dehradun
10. K. J. Gaston 1996. Biodiversity: Biology of numbers and Difference. Blackwell Science, Oxford.

Lab Course – III – 33P ANIMAL PHYLOGENY AND EVOLUTION, ENVIRONMENTAL BIOLOGY AND TOXICOLOGY, ECONOMIC ZOOLOGY AND CONSERVATION BIOLOGY

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 spp.).
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.

Elective - III – 3EA

AQUACULTURE AND FISHERIES

Objectives: To study the breeding, rearing, and harvesting of plants and animals in all types of water environments including ponds, rivers, lakes, and the ocean.

Unit – I

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

Unit – II

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 –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-fish genetics- gynogenesis and androgenesis-Induced polyploidy-fish breeding and hybridization-Role of Ovaprim, Ovotide in induced breeding.

Unit – V

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.

References:

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

Elective - III – 3EB

APPLIED MICROBIOLOGY

Objectives: To study the cultivation and control of microorganism, microbial and food ecology and 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:

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.

Supportive – III – 3GS

MARINE BIOTECHNOLOGY

Objectives: To understand the marine resources of the world that are studied in biotechnology applications.

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.

References:

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

Elective - IV – 4EA

BIOTECHNOLOGY AND BIOETHICS

Objectives: To study the potential of biotechnology demands caution to ensure ethical progress

Unit – I

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

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

Unit – III

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 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 - 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.

References:

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.

Elective - IV – 4EB

INTRODUCTION TO TOXICOLOGY

Objectives: To understand the adverse effects that occurs in living organisms due to chemicals.

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:

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.
5. Foster L. Mayer, Donald J. Versteeg, Michael, J. McKee and Barnett A. Ratlner, 1992, Biomarkers, physiological and non-specific biomarkers. Lewis publishers, London.
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.
