UNIVERSITY OF KERALA
Thiruvananthapuram

M.Sc. Zoology – Semester System

Revised syllabus

(for 2019 admissions onwards)

March 2019

Kup 1065/2018-19

UNIVERSITY OF KERALA

M.Sc. Zoology – Semester System

Revised Syllabus, Course Structure & Mark Distribution

Semester	Paper Code	Title	Distribution of hours / semester	Instructional hours/week L	P	Duration of ESA (Hrs)	Maximum Marks CA	ESA	Total
1	ZO 211	Systematics & Evolutionary Biology	100	5	-	3	25	75	100
	ZO 212	Biochemistry	100	5	-	3	25	75	100
	ZO 213	Biophysics, Instrumentati & Computer Science	100	5	-	3	25	75	100
	ZO 214	Practical	120	-	10	4	25	75	100
	Total for S 1		**450***	**15**	**10**	-	**100**	**300**	**400**
2	ZO 221	Advanced Physiology & Functional Anatomy	100	5	-	3	25	75	100
	ZO 222	Genetics, Quantitative Analysis & Research Methodology	100	5	-	3	25	75	100
	ZO 223	Cell Biology, Molecular Biology Bioinformatics	100	5	-	3	25	75	100
	ZO 224	Practical	120	-	10	4	25	75	100
	Total for S 2		**450***	**15**	**10**	-	**100**	**300**	**400**
3	ZO 231	Microbiology & Biotechnology	100	5	-	3	25	75	100
	ZO 232	Ecology, Ethology & Biodiversity Conservation	100	5	-	3	25	75	100
	ZO 233	Immunology & Developmental Biology	100	5	-	3	25	75	100
	ZO 234	Practical	120	-	10	4	25	75	100
	Total for S 3		**450***	**15**	**10**	-	**100**	**300**	**400**
4	ZO 241	Special Paper 1	100	8	-	3	25	75	100
	ZO 242	Special Paper 2	100	7	-	3	25	75	100
	ZO 243	Special Paper Practical 1	100	-	5	3	25	75	100
	ZO 244	Special Paper Practical 2	120	-	5	4	25	75	100
	Total for S 4		**450***	**15**	**10**	-	**100**	**300**	**400**
	ZO 201	Project	-	-	-	-	25 marks	75 marks	100
	ZO 202	Comprehensive *Viva Voce*					-	100	100
	Grand Total		-	-	-	-	**400**	**1400**	**1800**

L – Lecture, P – Practical; T – Tutorial; CA Continuous Assessment; ESA – End Semester Assessment;

*** Tutorial 30 hours per week**

UNIVERSITY OF KERALA
M.Sc. Zoology – Semester System
Revised syllabus (2019)

Semester I
ZO 211 Systematics and Evolutionary Biology
Total 100 hours (50+50 hrs)

Systematics **(50hrs)**

Module 1. Definition and basic concepts of systematics and taxonomy **(5 hrs)**

1.1. Historical resume of systematics
1.2. Importance and applications of systematics in biology
1.3. Material basis of systematics

Module 2. Taxonomic tools and techniques **(15 hrs)**

2.1. Taxonomic Procedures-collection, preservation, curetting and process of identification.
2.2. Taxonomic characters of different kinds-quantitative and qualitative analysis of variation, Process of typification, different zoological types (holotype, paratype etc) and their significance.
2.3. Taxonomic keys-different kinds of taxonomic keys, their merits and demerits
2.4. Systematic publications- preparation of taxonomic publications
2.5. International code of zoological nomenclature, its operative principles, Implication and application of important rules
2.6. Zoological nomenclature – formation of scientific names of various taxa (Homonymy and Synonymy)

Module 3. Taxonomic characters and dimensions of speciation **(15 hrs)**

3.1. Taxonomic characters- different kinds, origin of reproductive isolation, biological mechanism genetic incompactibility
3.2. Dimentins of speciation-types of lineage changes. Production of additional lineage.
3.3. Species concept- species category, different species concepts, sub species, deme and other intra specific categories, hierarchy of categories

Module 4. Trends in systematic **(15 hrs)**

4.1. Chemotaxonomy
4.2. Cytotaxonomy
4.3. Molecular systematics
  4.3.1. Recent trends based on proteomics and genomis
  4.3.2. DNA bar coding and Barcoding of life
  4.3.3. Phylogenetic trees

Evolutionary Biology **(50 hrs)**

Module. 5. Cosmic evolution and the Origin of life **(5 hrs)**

5.1. Cosmic evolution: Origin of the Universe, matter-time-space continuum. Theory of oscillating universe. Origin of galaxies, stellar systems, planets – earth

5.2. Origin of Life- Physical basis of life, extra terrestrial life.

Module. 6. Molecular Evolution **(15 hrs)**

6.1. Gene evolution

6.2. Evolution of gene families, molecular drive

6.3. Amino acid sequence divergence in proteins

6.4. Nucleotide sequence divergence in DNA

6.5. Molecular clocks

6.6. Ancient DNA

Module. 7. Biochemical and genomic evolution **(15 hrs)**

7.1. The evolutionary history of proteins and concept of molecular clock

7.2. Outline of origin of prokaryotic and eukaryotic genomes

7.3. The "C-Value paradox".

7.4. Evolutionary history of neural integration

7.5. Evolution of the endocrine systems, Hormones and evolution.

Module. 8. Origin of Higher Categories **(15 hrs)**

8.1. Origin of Metazoa, theories of origin

8.2. Origin, Evolution and extinction of Trilobites

8.3. Origin and evolution of vertebrate groups- Pisces, Amphibia, Reptilia, Aves and mammals

8.4. Phylogenetic gradualism and punctuated equilibrium

8.5. Micro and Macro evolution

8.6. Stages in Primate Evolution- Prosimii, Anthropoidea and Hominids. Factors in human origin-Hominid fossils.

8.7. Cytogenetic and Molecular basis of origin of man-African origin of modern man-Mitochondrial Eve, Y chromosomal Adam, - early migration, hunter-gatherer societies.

8.8. Evolution of human brain-communication, speech and language. Evolution of culture.

References

1. Alfred J.R.B and Ramakrishna.2004. Collection, Preservation and Identification of Animals. Zoological Survey of India Publications.
2. Benton,M.J.2005 93rd edn.). Vertebrate Paleontology, Blackwell Publishing Com. Oxford, Uk
3. Campbell, N.A and J.B.Reece.2009. Biology (8th edn). Benjamin Cummings Publ.NY,USA
4. David,M.H, Craig Moritz and K.M. Barbara. 1996. Molecular Systematics. Sinauer Associates, Inc.

5. Hick,am Jr,Cleveland, Lary Roberts, Susan Keen, Allan Larson, David Eisenhour. 2011. Animal Diversity. McGraw-Hill Companies, Inc.NY
6. Kapoor, V.C. 1991. Theory and Practice of Animal Taxonomy. Oxford and IBH Publishing Co., Pvt Ktd. New Delhi.
7. Margulis, Lynn and M.J. Capman (4th edn.). Kingdoms and Domains: An Illustrated Guide to the Phyla of Life on Earth. W.H. Freeman & Company, USA
8. Mayr, E. 1969. Principles of Systematic Zoology. McGraw Hill Book Company, Inc., NY.
9. Mayr, E.1997. this is Biology: The Science of Living world. Universitites Press Ltd.
10. Narendran, T.C. 2008. An introduction to Taxonomy. Zoological survey of India.
11. Pat Willmer. 1996. Invertebrate Relationships-patterns in animal evolution. Cambridge University Press
12. Rupert E.Edward., R.S.Fox and R.D.Barnes. 2006. Invertebrate Zoology:
13. A Functional Evolutionary Approach. Thomson/Cole, Singapore Simpon:
14. Waterman, A.J.1971. Chordate Structure and Function. Macmillan Co. London
15. Winston, J.E.2000. Describing species: Practical taxonomic procedure for biologists. Columbia University Press, Columbia
16. Young, J.Z.1950. Life of Vertebrates. Clarendon Press, Oxford, UK
17. Arthur, W.2011. Evolution – A Developmental Approach, Wiley-Blackwell, Oxford, UK
18. Benton, M.J.2005(3rd edn). Vertebrate Paleontology. Blaxkwell Publishing Com. Oxford, Uk
19. Camilo J.Cela – Conde and Franncisco J. Ayala. 2007. Human Evolution-Trails from the Past. Oxford University Press. Oxford, UK
20. Campbell.B.G.2009. Human Evolution. Transaction Publishers, NJ, USA
21. Charles W. Fox and Janson B.Wolf. 2006. Evolutionary Genetics-Concepts and Case Studies. Oxford University Press, NY. USA
22. Carroll, SB.2005. Endless Forms Most Beautiful: the New Science of Evo-Devo. WE Norton, New York
23. Cleveland P. Hickman, Jr., Larry S. Roberts and Allan Larson. 2001. Integrated Principles of Zoology. (11th edn). McGraw-Hill, NY, USA
24. Darwin, C.D.1859. On the Origin of Species by Means of Natural Selection. John Murray, London.
25. Dan, G. and Li,W.H.2000. Fundamentals of Molecular Evolution. (2nd edn). Sinauer Associates Inc. MA, USA
26. Elliott, Sober.2008. Evidences and Evolution. The logic behind the science. Cambridge University Press, UK
27. Futuyma, D.J. 1986. Evolutionary Biology)2nd edn0. Sinauer Associates Inc. MA, USA
28. Gould, S.J, 2002. The Structure of Evolutionary Theory. Harvard University Press, MA, USA
29. Hall, B.K and Hallgrimsson, B. 2008. Strickberger's Evolution (4th edn). Jones and Bartlett Pub.London, UK
30. Hall, B.K. and Olsen, W.M., (Ed). 2007. Keywords and Concepts in Evolutionary Developmental Biology. Discovery publishing Hourse, New Delhi,
31. Hall, B.K., Pearson, R. and Mullae, G.B.2003. Environment, Evolution and Development: Toward a Synthesis. MIT Press, Cambridge MA, USA

32. Kimura, M. 1983. The neutral theory of molecular evolution. Cambridge University Press
33. Margulis, L and Michael J.C. 1998. Kingdons&Domains: An Illuystrated Guide to the Phyla of Life on Earth (4th edn). W.H. Freeman and Company, USA
34. Niles Eldredge. 2000.Life on earth: an encyclopedia of biodiversity, ecology and evolution (Vol.1 &11).ABC=CLIO,Inc.CA,USA
35. Rupert E.Edward., R.S.Fox and R.D.Barnes. 2006. Invertebrate Zoology:
36. A functional Evolutionary Approach. Thomson/Cole,Singapore
37. Stearns c.S. 1987. The evolution of sex and its consequences. Birakhauser, Basel, Switzerland
38. Strickberger, M.W. 2005. Evolution. Jones and Bartett Publishers, London.
39. West-Eberhard M.J. 2003. Developmental Plasticity and Evolution. Oxford University Press, oxford, UK
40. Web Resources
41. http://www.talkorigins.org
42. http://www.ucmp.berkely.edu
43. http://www.academicearth.org

ZO 212 BIOCHEMISTRY (100 hrs)

Module I Introduction (6hrs)

1.1. Atoms and molecules, intermolecular and intramolecular interactions Bonds-covalent and electrovalent bonds, ionic bond, hydrogen bond.

1.2. Water: Biological importance, pH and Acid – base balance. Buffers: Biological importance.

1.3. Unique solvent properties; electrolytic dissociation into cations and anions, Henderson – Hasselbalch equation.

Module 2 Carbohydrates (12 hrs)

2.1. Classification and nomenclature

2.1.1. Monodsccharides: Biological importance, Structural representations of sugars-Acetal and hemiacetal, ketal and hemiketal linkages, Glucose, fructose, galactose, mannose and ribose. Isomerism – Structural isomerism and stereoisomerism, optical isomerism, Epimerism and Anomerism.

2.1.2. Reactions of monosaccharides: Oxidation, reductionester formation, Osazone formation. Glycosidic bond.

2.1.3. Disaccharides: Sucrose, Lactose, Maltose, Isomaltose, Cellobiose and Trehalose.

2.1.4. Polysacchacides – Homopolysaccharides – Starch, glucogen, cellulose,Chitin, Dextrans, Inulin, Pectin. Heteropolysaccharides- Hyaluronic acid, Heparin, Chondroitin sulphate, Keratan sulphate, Dermatan sulphate and Agar-agar. Glycoproteins and Mucoproteins.

Module 3 Proteins **(10 hrs)**

3.1.1. Amino acids: Structure, classification and properties of amino acids. pK value and iso-electric point of amino acids. Peptide and peptide synthesis. Reactions (due to carboxyl group, amino group and side chains). Colour reactions of amino acids and proteins.

3.2.1. Proteins–structure and classification-primary structure of protein (eg. Insulin).

3.2.2. Secondary structure- Alpha helix, Collagen helix, Beta pleated sheet, Ramachandran angles and Ramachandran map.

3.2.3. Fibrous proteins-examples (Keratin Collagen, Elastin, Resilin, Fibrous muscle proteins). Chaperons.

3.2.4. Tertiary structure-Clobular protein- eg Myoglobin.

3.2.5. Quaternary structure- eg Haemoglobin

3.2.6. Tissue protein in health and diseases, -collagen, structure and synthesis, abnormal collalgens, elastin, keratins, muscle proteins, lens proteins and cataract.

Module 4 Lipids **(10 hrs)**

4.1.1 Classification of lipids: Simple, compound and derived lipids. Biological importance of lipids.

4.1.2. Fatty acids: classification, nomenclature.

4.1.3. Simple fats: Triacylglycerol (Triglycerides) – Physical properties. Reactions – Hydrolysis, Saponification, Rancidity. Acid number, Saponification number, Iodine number oxidation, Ketosis, Reichert- Meissl-Wollny value

4.1.4. Compound lipids: Phospholipids- Lecithin, Phosphatidyl inositol, Cephalins, plasmologens,Glycolipids, Sphingolipids

4.1.5. Steroids: Biologically important steroids-cholesterol, Vitamin D, Bile acids, Ergosterol, Terpenes. Prostaglandins- Structure, types, synthesis and functions.

4.1.6. Lipoproteins.

Module 5 Nucleic Acids **(8 hrs)**

5.1.1 Structure of nucleic acids and nucleotides: Structural organization of DNA(Watson-Crick model) Characteristic features of A,B,C and Z DNA. Structural organization of tRNA and micro RNA stability of proteins and nucleic acids.

5.1.2. Protein-nucleic acid interactions. Electrostatic interaction, hydrogen bonding stacking interactions.

5.1.3. DNA binding proteins-DNA regulatory proteins, folding motifs, finger motifs, Zipper motifs, conformation flexibilities.

5.1.4. Bioloogical roles of nucleotides and nucleic acids.

Module 6 Enzymes **(10 hrs)**

6.1.1. Classification- (I.U.B.system) co-enzymes, iso-enzymes, ribozyme.

6.1.2. Enzyme specificity.

6.1.3. Mechanism of action of enzymes. Formation of enzyme substrate complex. Various theories.

6.1.4. Enzyme kinetics: Michaelis-Menten equation. Km value and its significance. Enzyme velocity and factors influencing enzyme velocity.Enzyme inhibition-suicide inhibition and feedback inhibition.

6.1.5. Enzyme regulation: Types of regulation, Allosteric regulations-Key enzymes, Covalent modification.

Module 7 Carbohydrate Metabolism (8 hrs)

7.1.1. Major metabolic pathways: Glycolysis – Fate of pyuvate.Citric acid cycle and its significance; Oxidative & substrate level phosphorylation. Pentose phosphate pathway (self study).

7.1.2. Gluconeogenesis, Cori cycle

7.1.3. Glucogen metabolism: Clllycogenesis, Glycogenolysis, adenylate cascadesystem Ca^{+2}Calmodulin-sensitive phosphorylase kinase. Regulation of glycogen synthesis

7.1.4. Inborn errors associated with carbohydrate metabolism. Glycogen storage disease, Lactose intolerance, Galactosuria

7.1.5. Factors maintaining blood glucose, Normal plasma glucose level, OGT T oral glucose tolerance test

Module 8 Metabolism of Proteins, Amino acids and nucleic acids (10 hrs)

8.1.1. Amino acid metabolism: Deamination, Transamination and Trans-deamination, decarboxylation

8.1.2. Formation and disposal of ammonia. Urea cycle.

8.1.3. Fate of carbon sleltons of aminoacids: glucogenic, ketogenic, partly glucogenic and ketogenic with examples.

8.1.4. Synthesis of biologically significant compounds from different aminoacids with special reference to glycine, glutamic acid, phenylalanine, tyrosine and tryptophan.

8.1.5. Catabolism of purines and pyrimidines

8.1.6. Heme synthesis and break down – Structure, biosynthesis, porphyrins, bilirubin metabolism, plasma bilirubin, jaundice

Module 9 Metabolism of Lipids (6 hrs)

9.1.1. Beta oxidation, alpha oxidation and omega oxidation of fatty acids.

9.1.2. Formation of ketone bodies, ketosis and keto acidosis

9.1.3. De novo synthesis of fatty acids and fatty acid metabolism

9.1.4. Biosynthesis and regulation of cholesterol, Metabolism of cholesterol.

9.1.5. Metabolism of Triglycerides.

Module 10 Energy Metabolism (8 hrs)

10.1. Energy rich compounds and their biological significance

10.2. Biological oxidation- Mitochondrial electron transport, oxidative phosphorylation, ATP synthesis, Chemi-osmotic theory

Module 11 **Detoxification** **(3 hrs)**

11.1. Formation of toxic compounds in the body

11.2. Detoxification- oxidation, reduction, hydrolysis and conjugation

Module 12 **Free radicals and anti oxidants** **(3 hrs)**

12.1. Free radicals and antioxidants, Generation of free radicals. Reactive oxygen species. Damage produced by free radicals, Free radical scavenger systems.

12.2. Lipid peroxidation. Preventive antioxidants.

Module 13 **Biochemistry of aging** **(3 hrs)**

13.1. Cellular aging

13.2. Diseases associated with aging – e.g. Alzheimer's.

13.3. Prions, Apoptosis

Module 14 **Clinical biochemistry** **(3 hrs)**

14.1. Introduction to clinical biochemistry

14.2. Analysis of diseases (Diabletes etc)

References:

1. Creighton, T.E, Protein Structure and Molecular Properties. W.. Freeman & Co.Ny
2. Deb,A.C.2004. fundamentals of Biochemistry. New Central Book Agency (p) ltd. NewDelhi
3. Elliott, W.H.&C. Elliot. 2003. Biochemistry & Molecular Biology. Oxford University Press, UK
4. Eric E. Conn, Paul K. Stumpf,George Bruening, Roy H. Doi.2007. Outlines of Biochemistry . (5^{th} edn.) John Wiley & Sons, Inc.
5. Garret, R.H. and C.M. Grisham. 1995, Biochemistry. (5^{th} edn).CBS publishers & distruibutors, Delhi
6. Hanes, B.D. and N.M. Hoopar. 1998. Instant notes: Biochemistry, University of Leeds, UK
7. Horton, H.R., Morson, L.A., Scrimgeour, K.G., Perry, M.D and J.D. Rawn. 2006. Principles of Biochemistry. Pearson Educations, International, New Delhi.
8. Jermy M. Berg, John L Tymoczko, Lubert Stryer, 2012, Biochemistry. W.H. Freeman
9. Keith Wilson and John Walker. 2008. Principles and Techniques of Biochemistry and Molecular biology (6^{th} edn). Cambridge University Press, UK.
10. Murray, K., Granner, D.K., Maynes, P.A and V.W.Rodwell. 2006. Harper's Biochemisty. (25^{th} edn). McGraw Hill, New York
11. Oser, B.L.1965. Hawk's Physiological Biochemistry. Mc Graw Hill Book Co.
12. Palmer Trevor. 2001. Enzymes: Biochemistry, Biotechnology & Clinical chemistry.
13. Horwood Publ.com., England
14. Rama Rao, A.V.S.S.1986. Text Book of Biochemistry. L.K.& S Publishers
15. Stayer, L. (latest) Biochemistry. 11 edition, W.H. Freeman & Co.NY
16. Vasudevan, D.M. and S. Sreekumar. 2000. Text of Biochemistry for Medical Students. Jaypee
17. Brothers, Medical Publishers (P) Ltd. New Delhi

18. Voet, D. and J.G. Voet. 2004. Biochemistry. John Wiley & Sons., NY.
19. Zubay,G.1989. Biochemistry. McMillan Publishing Co., New York.

ZO 213 Biophysics, Instrumentation and Computer Science (100 hours)

Biophysics (25 hrs)

Module 1 Thermodynamics (5 hrs)

1.1. Introducation-Concept of energy and laws of Thermodynamics
1.2. Matter and energy-Life as an anergy system-order, disorder, Entropy, Enthalpy.
1.3. Photo bioenergetics: Photosynthesis – light and dark reactions, Redox couple and redox potential
1.4. Chemo-bioenergetics: electron transport and oxidative phosphorylation, Chemi-osmotic theory and binding change mechanism of ATP synthesis.
1.5. Life as an autocatalytic system

Module 2 Electromagnetic spectrum (8 hrs)

2.1. Cosmic radiation – Gamma radiation, X-rays, UV – radiation, visible spectrum, infrared rays, microwaves and radiowaves.
2.2. Biological applications

Module 3 Radiation Biophysics (8 hrs)

3.1. Radioactivity; Detection and measurement of radiation
3.2. Radio-labelling methods,- detection and measurement of different types of radioisotopes and their applications I biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material and safety guide lines
3.3. Ionizing radiation and induced mutations
3.4. Fluorescence.
3.5. Nuclear medicine-Internally administered radioisotopes. Radioiodine in thyroid function analysis. Renal, liver and lung function analysis.

Module 4 Nanotechnology (4 hrs)

4.1. Introduction to Nanobiology
4.2. Nanosensors and Nanomedicines

Instrumentation (50 hrs)

Module 5 Methodology and working of microscopes (15 hrs)

5.1. Phase contrast microscope
5.2. Fluorescent microscope
5.3. Electron microscopes – TEM and SEM, different fixation techniques for Em, Freeze etch and freeze fracture methods for EM,
5.4. Laser scan confocal microscope
5.5. Environmental scanning electron microscope

Module 6 **Centrifugation** **(8hrs)**

6.1. Ordinary, high speed centrifuge
6.2. Density gradient centrifugation.
6.3. Ultracentrifugation

Module 7 **Electrophoresis** **(7 hrs)**

7.1. Principle
7.2. Gel electrophoresis – SDS PAGE, Agarose Gel Electrophoresis
7.3. High voltage electrophoresis
7.4. Immuno electrophoresis- principle and application

Module 8 **Chromatography** **(5 hrs)**

8.1. Principle
8.2. Column chromatography, Ion exchange chromatography, HPLC, Gas chromatography

Module 9 **Biophysical methods** **(15 hrs)**

9.1. Colorimeter, spectrophotometer, flame photometer
9.2. Atomic absorption spectrophotometer, florescent spectrometer
9.3. Infrared spectrophotometry, NMR and EMR spectrophotometry, Different types of Mass spectrometry and surface plasma resonance methods.
9.4. Molecular snalysis using UV/ visible light, fluorescence, circular dichroism
9.5. Molecular structure determination using X ray diffraction
9.6. Electrophysiological methods-simple neuron recording, patch clamp recording, ECG, Brain activity recording, Lesions and stikulation of brain, pharmacological testing, PET (Positron emission tomography), MRI, FMRI, CAT scanning methods

Computer Science **(25 hrs)**

Module 10 **Introduction to computers** **(self study)**

10.1. Characteristics of computers
10.2. Hardware –input out put devises, processor Modules, storing, controlling
10.3. Characteristics of computers

Module 11 **Computer generations** **(8 hrs)**

11.1. Classification- first to 5^{th} generation
11.2. Notebook, laptops, PCs, workstations, mainframe system, supercomputers, client and server computers, hand held computers, - tablet pc, PDA, pocket PC, smart phone.
11.2.1. Artificial intelligence
11.3. Number systems binary, octan, hexadecimal

Module 12 **Soft ware** **(4 hrs)**

12.1. Relationship between hard ware&soft ware, system soft ware & application soft ware

12.2. Acquiring soft ware – buying pre written soft ware, ordering customized soft ware, developing customized software, down loading public domain soft ware, software development steps- firmware, and middle ware

Module 13 **Operating systems** **(4 hrs)**

13.1. Windows, DOS, Linux (self study)

13.2. Concept of free software

Module 14 **Computer Programming** **(4 hrs)**

14.1. Low level languages

14.2. High level languages

14.2.1. Programming language C++

Module 15 **Computer and Communications** **(5 hrs)**

15.1. LAN (local area net work) WAN (wide area network, MAN (Metropolitan area network)

15.2. Internet, email, www, social network groups etc.

REFERENCES

1. Ackerman, E. 1962. Biophysical Science. Prentice hall Inc.
2. Alonso, A., and Arrondo, J.L.R.2006. Advanced Techniques in Biophysica.Springer
3. Arora, M.P.2007. Biophysica. Himalaya Publishing House
4. Baker, E.J. and Silverton R.E. 1978. Interoduction to Medical Laboratory Technology. ELBS.
5. Das,D.1991. Biophysics and Biophysical Chemistry. Academic Press, NY
6. Ernster, L. (Ed).1985. Bioenergetics. Elsivier, New York
7. Ghatak K.L. 2011. Techniques and Methods in Biology. PHI Learning Pvt. Ltd. New Delhi
8. Gupta A.2009. Instrumentation and Bio-Analytical Techniques. Pragati Prakashan, Meerut.
9. Hoope, W. et al., 1983. Biophysics. Springer Verlag, Berlin.
10. Lehninger, A.L.1971. Bioenergetics. W.A. Benjamin, London
11. Narayanan, P.2000. Essentials of Biophysics. New Age International (p) Ltd. Publishers, New Delhi.
12. Nicholls, D.G. And Ferguson S.J (1992) Bioenergetics Academic Press New York
13. Pradeep T. 2007. NANO: The essentials. Understanding Nanoscience and Nanotechnology. Tata
14. McGrawHill Education Pvt.Ltd., New Delhi
15. Roy, R.N. 1996. A Textbook of Biophysics. New Central Book Agency (P)Ltd. Calcutta
16. Sandhu,G.S.1990. Research Techniques in Biological Sciences. Anmol Publications, New Delhi

17. Srivastava P.K. 2006. Elementary Biophysics.An Introduction. Narosa Publishing Delhi Varghese,T and Balakrishna, K.M.2012. Nanotechnology-An Introduction to synthesis, Properties and Applications of Nanomaterials. Atlantic Publishers and distributors.
18. Weesner, f.M. 1960. General Zoological Microtechniques. The Williams& andwilkins Co., Baltimor.

Semester II

ZO 221 ADVANCED PHYSIOLOGY and FUNCTIONAL ANATOMY (100 hrs)

(self study)

Module 1 Introduction

1.1. Introduction to Physiology and Anatomy
1.2. A brief history of Physiology and Anatony
1.3. Cell as a living Module of the body
1.4. Fluids in the cell environment
1.5. Resistance of the cell to acidity and alkalinity.

Module 2 Support and Movement **(10 hrs)**

2.1. Cellular movements, Cytoskeleton, Hydrostatic skeleton
2.2. Terrestrial, aquatic and aerial locomotion
2.3. Musculo skeletal system – Bones and muscles – structure and its role in locomotion with reference to humans
2.4. Theories of molecular basis of muscle contration
2.5. Catch muscle and Fibrillar muscle
2.6. Clinical implications

Module 3 Nutrition **(10 hrs)**

3.1. Feeding mechanism in animals (self study)
3.2. General principles of Gastro-intestinal function
3.3. Factors that regulate quantity of food
3.4. Secretory function of the alimentary canal-hormones and enzymes
3.5. Absorption mechanism of digested nutrients
3.6. Obesity-causes and consequences
3.7. Gastro- intestinal disorders

Module 4 Circulation **(12 hrs)**

4.1. Body fluids in invertebrates and vertebrates
4.2. types of heart, anatomy of heart (human) and Haemopoiesis
4.3. Coronary circulation, Heart valves and Heart sounds
4.4. Circulatory Shock, Cardiac failute
4.5. Control of blood pressure and blood flow

Module 5 Respiration **(10 hrs)**

5.1. Respiratory organs of invertebrates and vertebrates and its functions
5.2. Mechanism of Pulmonary ventilation

5.3. Respiration of unusual environment – Aviation, High altitude, Deep sea diving, Foetal respiration
5.4. Regulation of respiration
5.5. Respiratory disturbance: Oxygen therapy, Artificial respiration

Module 6 **Excretion and Osmoreguation** **(10 hrs)**

6.1. Types of Excretion, Structure of kidney, Basic renal process 9self study)
6.2. Osmo regulation in fresh water, marine and terrestrial animals
6.3. Regulation of sodium and water balance, Primary sodium re absorption, Urine concentration
6.4. Diuretics and kidney diseases. Creatine clearance – Plasma creatine
6.5. Haemodialysis, Peritonial dialysis and transplantation
6.6. Regulation of acid-base balance, blood volume and extra cellular volume
6.7. Respiratory regulation of acid base balance

Module 7 **Nervous Co ordination** **(10 hrs)**

7.1. Neurons,Types of Neurons, transmission of Nerve impulse **(self study)**
7.2. Giant nerve fibres in invertebrates
7.3. Development of neurons and neuronal functionality
7.4. Factors leading to neuronal death
7.5. Neuro transmitters, neuro modulators and mechanism of neuro transmitter release
7.6. Neuronal disorders-strokes, exicotoxicity and NMDA receptors

Module 8 **Endocrinology** **(10 hrs)**

8.1. Invertebrate and Vertebrate endocrine system (self study)
8.2. Classification of Hormones and nature of hormonal action
8.3. Structure and function of different hormones
8.4. Neuro-endocrine feedback and response to various stimuli
8.5. Measurement of Hormone concentration in blood

Module 9 **Somatic and Special senses** **(10 hrs)**

9.1. Structure of Invertebrate andVertebrate eye
9.2. Tactile, Position, Pain,Thermal and taste Senses
9.3. Visual pathways organization of visual cortex. Analysis of visual information, detection of colour
9.4. Auditory pathways – Functions of cerebral cortex in hearting
9.5. Neuronal mechanism of sound detection and direction

Module 10 **Reproduction** **(10 hrs)**

10.1 Male reproductive system- Anatomy Spermatogenesis and transport of sperm (self study)
10.2. Hormonal control of male reproductive function
10.3. Female reproductive system – Anatomy, Ovarian function (self study)

10.4. Control of ovarian function. Uterine changes in menstrual cycle, effects of estrogen and progesterone. Androgen in women
10.5. Preganancy – Ovum transport, sperm activation, implantation and placentation
10.6. Hormonal and other changes during pregnancy – Parturition, Lactation
10.7. Birth control measures Pre-natal diagnostic tests.
10.8. Adjustments of the infants to extra uterine life

Module 11 Physiological adaptation and Stress **(5 hrs)**

11.1. Physiological adaptation, acclimation, acclimatization.
11.2. Concept of stress- definition, stressor, stress response, eustress, distress, acute and chronic stress, stress acclimation.
11.3. Concept of ease, recovery response, stress hormones, neuroendocrine control of stress response, role of hypothalamo-pituitary-adrenal axis.

Module 12 Sports Physiology **(3 hrs)**

12.1. Muscles in exercise, cardiac reserve, cardiovascular fitness, fascia training, neurobiological effects of physical exercise, physical fitness and its components.
12.2. Dope test, drugs and athletes
12.3. Fitness test. Bio energetic fuel for muscle work

References

1. Clarke, R.K.2010. Anatomy and Physiology. Jones and Bactlett publishers, London.
2. Franklyn, F. and Bolander. 2004. Molecular Endocrinology. Academic press.
3. Ganong,W.f.2003. Review of Medical Physiology. Mc Graw Hill Co.
4. Ghas, C.L.2007. A Text Book of Practical Physiology. Medical Publishers Ltd, New Delhi.
5. Guyton,A.C. and Hall,J.E.2007. Text Book of Medical Physiology. Elsevier.
6. Hadley,M.E.2005.endocrinology, Pearson Education
7. Hill,W.R., Wyse, G.E. and Anderson, m.2007, Animal Physiology, Sinauer Associates, Inc.U.S.A
8. Hoar.W.r.2004. General and comparative physiology, Pearson Education.
9. Nagabhushanam, Kudarkar and Sarojini, 2002. Text Book of Animal Physiology, Oxford IBH Publishing Co.Pvt.Ltd.
10. Professor, C.L.Comparative Animal Physiology,Saunder College, Philadelphia.
11. Ranganathan.T.S.2008. A Text Book of Human Anatomy,S.Chand and Co.
12. Singh,D.P.2003. Stress Physiology, New Age International Publishers.
13. Tortora,G.J. and Derickson, B.2007. Principles of Anatomy and Physiology. John wiley & Sons inc.
14. Tortora, G.J and S.R. Grabowski.1996.Principles of Anatomy and Physiology.
15. JohnWiley & Sons inc.
16. Tortora, G.J and S.R. Grabowski.1996. Principles of Anatomy and Physiology. Harper Collins College Publishers.

17. M.C.S. Peter (2013). Understanding the adaptive response in vertebrates: The phenomenon of ease and ease response during post-stress acclimation *Gen. Comp. Endocrinol.* 181, 59-64 IF 3.45

Zo 222 Genetics, Quantitative Analysis and Research Methodology **(100 Hrs)**

Genetics **(70 hrs)**

Module 1 **Introduction** **(5 hrs)**

1.1. Genetics and modern agriculture
1.2. Genetics and medicine
1.3. Legal and ethical issues in genetics

Module 2 **Mendelian Genetics and its Application** **(15 hrs)**

2.1. Gene mapping
2.2. Recombination frequency
2.3. Chromosome banding
2.4. Genetics in animal breeding
2.5. General effects of inbreeding and out breeding; hybrid vigour.
2.6. Expressivity, penetrance
2.7. Modern concept of Mendelism

Module 3 **Population Genetics** **(15 hrs)**

3.1. Genetic variations
3.2. Polymorphism
3.3. Gene pool
3.4. Gene frequency
3.5. Distribution patterns
3.6. Hardy Weinberg equilibrium
3.7. Disequilibrium
3.8. Factors disrupting gene equilibrium

Module 4 **Human Genetics** **(15 hrs)**

4.1. Pedigree analysis – Karyotype analysis
4.2. X-Chrmosome dosage
4.3. Lyon hypothesis and mosaicism
4.4. Genetics of ABO system
4.5. Rh disease and its inheritance
4.6. Sickle haemoglobin and inheritance; thalassemias
4.7. Genetic disorders – Patau, Edwards, Cri-du-chat syndromes, Philadelphia chromosome.

Module 5 **Microbial Genetics** **(12 hrs)**

5.1. Retrovirus
5.2. Viral genome and multiplication – HIV genome and multiplication

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5.3. Reproductive cycle of RNA viruses
5.4. Plasmids – Vector DNA – Insert DNA
5.5. Lambda Phages
5.6. Microbes in genetic engineering

Module 6 **Genetics in Medicine and Forensics** **(8 hrs)**

6.1. Human Genome Project:
6.2. Human gene therapy
6.3. DNA fingerprinting:
6.3.1 Applications in forensic science
6.3.2. Applications in paternity testing

Quantitative Analysis **(15 hrs)**

Module 1 Introduction **(2 hrs)**

1.1. Definition, history, scope of biostatistics and application of statistics in biology (self study)
1.2. Descriptive an dinferentail statistics
1.3. Preliminary concepts – populaiton and sample, statistic and parameter, variables, sampling (self study)
1.4. Collection of data – primary and secondary data, methods. Use of software in statistics.

Module 11 **Descriptive Statistics** **(2 hrs)**

2.1 Processing and classification of data, presentation of data-tabulation and graphical and diagrammatic representation (self study)
2.2. Measures of Central Tendency, problems (self study)
2.3. Measures of Dispersion-problems, Skewness and Kurtosis
2.4. Correlation and Regression, problems (self study)

Module 111 **Probability Distribution** **(3 hrs)**

3.1. Definition, important terms and concepts
3.2. Theorems in probability
3.3. Important theoretical distributions- Binomial, Poisson, and Normal probability distributions.

Module 1V **Parametric test** **(4 hrs)**

4.1. Basic idea – Hypothesis testing, types of errors
4.2. Tests of significance for large and small samples- Z-test,Chi-Square Test, Student's 't' test, F-test – problems – and ANOVA

Module V **Non-parametric test** **(2 hrs)**

5.1. Characteristics, advantages and disadvantages
5.2. Types (Brief account only)

Module V1 **Vital statistics** **(2 hrs)**

6.1. Introduction,uses, methods of collections
6.2. Measures of vital Statistics, life tables

Research Methodology **(15 Hrs)**

Module 1 **Introduction** **(2 hrs)**

1.1. Definition, meaning, objectives, and significance of research, research methods vs Methodology
1.2. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs Qualitative, Conceptual vs Empirical.
1.3. Characteristics of good research, steps of working of research

Module 11 **Research Formulation** **(2 hrs)**

2.1. Formulation and defining a research problem, techniques involved
2.2. Literature survey-Journals, conference proceedings, books, government reports, etc,
2.3. Problem selection, formulation of working hypothesis

Module 111 **Research design** **(2 hrs)**

3.1. Meaning, need and features a good research design
3.2. Different types of research design (exploratory, descriptive, diagnostic and hypothesis-testing research studies)
3.3. Developing a research plan.

Module 1V **Execution of research plan** **(2 hrs)**

4.1. Data collection methods-primary and secondary, sampling design (self study), measurements etc. LC 50 & Dose Response.
4.2. Analysis of data (self study)
4.3. Interpretations-advantages and techniques-and generalizations of the findings

Module V **Scientific documentation** **(3 hrs)**

5.1. Significance of report writing, types of reports
5.2. Research report writing (thesis, dissertations, research articles, etc) – characteristics and format
5.3. Writing and preparation of articles for publication and for oral and poster presentation
5.4. Project proposal and report writing.

Module V1 **Research, extension and ethics** **(4 hrs)**

6.1. Publications-abstracting and indexing journals, books, conference/seminar proceedings, periodicals, reference sources, reviews, monographs. Extension tools, impact factor, citation.

6.2. Online libraries, e-journals, e-books, e-encyclopedia, institutional websites, TED Talk.
6.3. Intellectual property Rights-copy right, patents, trademarks, geographical indications, industrial design.
6.4. Research misconduct: fabrication, falsification and plagiarism
6.5. Precaution – ESO standards for safety, lab protocols, lab animal uses, IACUC, control of hazards
6.6. Ethical norms, codes and policies for research ethic, laws in India

REFERENCES

Genetics

1. Daniel Fairbanks and W.R Anderson (2000) Genetics – The Continuity of Life. Brooks/Cole Publishing Co., N.Y.
2. J. Herbert Tayleor, Molecular Genetics Part I & II:
3. Eldon. J., Gardner Principles of Genetics.
4. Sinnot, Dunn, Dobzhansky, Principles of Genetics: TMH Edn.
5. John D Hawkins, Gene Structure and Expression. Cambridge University Press – Edinberg Buildings – Cambridge CBZ/ZRU UK
6. PKU Nair and K. Prabhakar Achar, A Text Book of Genetics and Evolution: Konark publishers.
7. Robert M Horton and Robert C. Tait, Genetics Engineering with PCR: Horizon Scientific Press, Wymondham Norfolk NR 19 – OEH – UK
8. R. World and S.B. Primrose, Principles of Gene Manipulation: Black Well Scientific Publishers, Melbourne, Paris.
9. Samuel Karlin Eviatar Nevo, Population Genetics and Ecology, Academic Press New York.
10. A Franklin Shull, Heredity. Mc.Graw Hill Book Co, London.
11. George W Burns, the Science of Genetics, Mae Millan C0 New York.
12. A Gib De Busk, Molecular Genetics, Mae Millan C0 New York.
13. Edgar Altenberg, Genetics, Oxford and IBH Publisher, New Delhi.
14. Janeway, Travens, (1996) Immunobiology Current Biology Ltd., Middle Sex House-34-42 Cleveland Street, London.
15. Gunther S. Stent & Richard Calender Molecular Genetics, CMS Publishers, 485 Jain Bhawan, Bholanath Nagar, Shahdra, Newdeli
16. Benjamin Lewin, Genes V Oxford University Press, New York.
17. James D. Watson, Tania.A.Baker, Stephen.P.Bell, Alexander Gann, Michael Levine,
18. Richard Losick, (2004) Molecular Biology& Genes, Pearson Education.
19. Strickberger, M.W. Genetics, Macmillan Publishing Co., Inc., New York.
20. J.M. Walker and R. Rapley, (2002), Molecular Biology and Biotechnology, Purnima Publishing Corporation, New Delhi.

Quantitative Analysis

1. Fisher.R.A., Statistical Methods for Research
2. Biometrical Genetics – Dover Publication, New York

3. Ostle B, Statistics in Research.
4. Agarwal, B.L. (1996) Basis Statistics. New Age International (P) Ltd. Publishers, New Delhi.
5. Bailey, N.T.J (1981). Statistical Methods in Biology. Hodder and Stongtton, London.
6. Finney, D.J. (1980). Statistics for Biologists. Chapman and Hall, London.
7. Caswell, F. (1982). Success in Statistics. John Murray Publishers Ltd., London.
8. Gupta, S.P. (1996). Statistical Methods. Sultan Chand & Sons Publishers, New Delhi.
9. Arora, P.N. and P.K. Malhan. 1996. Biostatistics Himalaya Pub.House
10. Bailey, N.T.J.1994. Statistical Methods in Biology (3rd edn).Cambridge University Press, London
11. Danial, W. 2006. Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc., New York.
12. Dharmapalan, B. 2012.. Scientific Research Methodoly. Narosa Publishing House, New Delhi.
13. Finney, D.J. 1980. Statistics for Biologists. Chamman and Hall, London
14. Kothari C.R., 2009. Research Methodology: Methods and Techniwues. New Age Interntional Publishers, New Delhi.
15. Oliver, P.2005. Writing Your thesis. Vistar Publications. New Delhi.

Zo223 Cell Biology, Molecular Biology and Bioinformatics **(100 hrs)**

Module 1 **Membrane structure, models and membrane transport** **(10 hrs)**

1.1. Diffusion of small molecules across phospholipids bilayer
1.2. Uniporter – catalysed transport
1.3. Membrane potential
1.4. Active transport by ATP powered pumps
1.5. Co-transport by symporters and antiporters

Module 2 **Cell-cell signalling** **(5 hrs)**

2.1. Cell surface receptors
2.2. Signal transduction pathways (cyclic AMP, cyclic GMP, Ras, Raf and MAP kinase pathways)
2.3. Second messenger system

Module 3 **Cell cycle** **(6 hrs)**

3.1. Cyclin and cyclin – dependent kinases
3.2. Regulation of CDK – cyclin activity
3.3. Check points in the cell cycle
3.4. Regulation of cell cycle in malignant cells

Module 4 **Chromatin structure** **(6 hrs)**

4.1. Types of Chromatin
4.2. Detailed structure of nucleosome; higher order structure of chromatin and the role of histones HI, scaffold proteins, and radial loop model

Module 5 **Topology of Nucleic Acids** (5 hrs)

5.1. Liking number and writhing number

5.2. DNA Super coiling

5.2.1 Super coiling in prokaryotes

5.2.2 Super coiling in eukaryotes

5.2.3 Role of topoisomerases

Module 6 **Organization of the eukaryotic genome** (12 hrs)

6.1. Genomic size and genetic content

6.2. Complexity of eukaryotic genome:

6.2.1 Intragenic sequences -exons, introns; split gene organization; regulatory sequences

6.2.2 Intergenic sequences

6.2.2.1 Unique sequences

6.2.2.2 Repetitive sequences: Highly repeated sequences – satellite, minisatellite and microsatellite DNAs Moderately repeated sequences (e.g. SINEs and LINEs).

6.3. DNA denaturation-renaturation kinetics and genome complexity; in situ hybridization.

6.4. Organelle genomes-mitochondrial and plastid DNAs

Module 7 **DNA Replication, repair and recombination** (14 hrs)

7.1. Prokaryotic and Eukaryotic DNA replication

7.2. DNA replication machinery.

7.3. Enzymes and accessory proteins involved in replication

7.4. DNA damage and repair

Direct reversal: photo reactivation, adaptive response

Excision repair

Mismatch repair

SOS repair and mutagenesis

ERecombination repair; Rec A and other recombinases

7.5. Damage signaling and checkpoints

7.6. DNA repair-associated disorders

Module 8 **Transcription and RNA processing** (8 hrs)

8.1 Prokaryotic and eukaryotic transcription

8.2 Binding the transcription complex-promoters, factors and RNA polymerases.

8.3 Regulation of transcription

8.4 Sigma factor and its role in prokaryotic transcription.

8.5 Post-transcriptional processing of RNA precursors, spliceosomes.

Module 9 **Translation-gene expression** (15 hrs)

9.1. Prokaryotic and Eukaryotic translation

9.2. The translation machinery

9.3. Mechanism of initiation, elongation and termination
9.4. Co-and post translational modifications of proteins.
9.5. Hormonal regulation of protein synthesis.

Module 10 Gene Regulation Mechanisms (7 hrs)

10.1. Gene regulation in eukaryotes at various levels.
10.2. Transcription factors and DNA-binding domains (Zinc-finger motif and Helix-loop-helix motif)
10.3. Transcription signals – TATA Box, CAAT BOX., Enhancers.

Module 11 Bioinformatics (12 hrs)

11.1. Introduction to bioinformatics, brief history and its role and importance in modern biology, internet, internet, portals, servers and search engines.
11.2. Biological databases, their purpose, primary, secondary, curated and ncurated databases types of databases (DNA, protein, RNA, functional and structural databases),
11.3. Uploading and downloading of data, FASTA format, data retrieval from databases, analyses tools and soft wares and their applications, pair wise and multiple sequence analyses.
11.4. Construction of rooted and un-rooted phylogenetic trees, their interpretation and use in analyzing evolutionary trends, steps in phylogenetic analyses
11.5. Brief overview of computational biology, computation, prediction and modulation of biological pathways, (ex. Kegg pathways) e-cell, computational analyses of genomes and proteomes

References

1. Harvey Lodish, Arnold Berk, Sipursky, Matsudaria, David Baltomore and Darnell, (2002) Molecular Cell Biology, W.W. Freman and Company.
2. Gerald Karp (2005) Cell and Molecular Biology, John Wiley and Sons, Inc. USA
3. Richard Lodivk, (2004) Molecular Biology & Genes, Pearson Education.
4. B.Albert's, D. Bray, J. Lewis, M. Raff, K, Roberts and J.D. Waston, (2004) Molecular Biology of the Cell- Garland Publishing in New York.
5. Devlin, T.M. (2002) Text book if Biochemistry, John-Wiley and Sons, Inc., Publication.
6. Becker W.M, Kleinsmith L.J and Hardin J (2003) The World of the Cell. Pearson Education, Singapore.
7. John Ringo (2004) Fundamental Genetics. Cambridge University Press, UK.
8. Herbert Taylor, Molecular Genetics, Part 1 & II.
9. Daniel Fairbanks and W R Anderson (2000) Genetics – The Continuity of Life. Brooks/Cole Publishing Co., N.Y.
10. Snustad, D.P. and Simmons, M.J. (2002) Principles of T Genetics John Wiley and Sons, Inc. New York.
11. 11. Elliot, H.E. and Elliott, D.C. (2001). Biochemistry and Molecular Biology, Oxford University Press.

12. John D Hawkins. Gene Structure and Expression. Cambridge University Press – Edinberg Building – Cambridge CBZ/ZRU UK.
13. PKU Nair and K. Prabhakar Achar, A Text Book of Genetics and Evolution, Konark Publishers.
14. A Franklin Shull (2000) Heredity. Mc. Graw Hill Book Co, London.
15. George W Burns (1999) The Science of Genetics, Mac Millian Co, New York.
16. A Gib De Busk (2000) Molecular Genetics, Mac Millan Co. New York.
17. Gunther S. Stnet and Richard Calender (2000) Molecular Genetics, CMS Publishers, 485 Jain Bhawan, Bholanath Nagar, Shahdara, Newdeli.
18. Benjamin Lewin, (2006) Genes IX – Oxford University Press
19. James D Watson, Tania A Baker, Stephen P Bell, Alexander Gann, Michael Levine, Richard Losick, (2004) Molecular Biology of Genes, Pearson Education.
20. Strickberger, M.W (2000) Genetics, Macmillan Publishing Co., Inc., New York.
21. J.M. Walker and R. Rapley, (2002), Molecular Biology and Biotechnology, Purnima Publishing Corporation, New Delhi.
22. David E Sadava (2004) Cell Biology. Panima Publishing Corporation, New Delhi.
23. Pollard T D and Earnshaw W.C (2002) Cell biology. Elsevier Science, USA.
24. Wilson K and Walker J (2006) Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, N.Y
25. Andrew Read and Dian Donnai. (2007) New Clinical Genetics. Scion Publishing Ltd.,

Zo214 Practical 1

A Systematics and Evolutionary Biology

1. Collection and identification of the following using standard keys:
   - A. Insects (5 nos)
   - B. Prawn (2 nos)
   - C. Crab (2 nos)
   - D. Fishes (5 nos)
2. Study of preservation media and tools and materials for txidemy
3. Comparative study of prokaryotic and eukaryotic cells by staining and mounting (evolutionary significance).

B. Biochemistry

1. Titration curve of acetic acid.Titration of a measured volume of acetic acid with sodium hydroxide (NaOH) to determine the amount of acid in the given solution and pKa of acetic acid.
2. Determination of the isoelectric pH of the given amino acid by titration method.
3. Estimation of DNA/RNA
4. Quantitative estimation of glycogen of a tissue.
5. Quantitative estimation of blood glucose.
6. Quantitative estimation of serum protein.
7. Determination of acid value of the given fat.
8. Determination of saponification value of the given fact.
9. Estimation of serum cholesterol using a standard protocol
10. Determination of the Michaelis constant (Km value) for the digestion of case in by trypsin.

11. Estimation of serum cholesterol using a standard protocol.
12. Estimation of acetylcholine content in tissue sample.

C. Biophysics, Instrumentation and Computer Application

1. Micrometry: Measurement of microscopic objects using micrometer.
2. Seperation of haemolymph of serum protein by gel electrophoresis.
3. Sketching of biological specimens using a camera Lucia.
4. Quantification estimation of Na, K,Ca of the given sample with the help of flame photometer/ spectrophotometer preparing standard curve.
5. Preparation of tables and bar diagrams using suitable softwares, from the data provided.
6. Statistical Analysis (Chi-square, t-test, correlation, regression, standard deviation and standard error) of the given data using suitable software. E.g. PH Stat.

References

1. Hardd Varley- Practical clinical Biochemistry
2. Ranjana Chawla – Practicla Clinical Biochemistry – Methods and interpretations.
3. Hawk's Practical Physiological Chemistry
4. Jayaraman, Practical Biochemistry.

Practical 11

Zo 224 Advanced Physiology and Functional Anatomy

Please use software such as **Physio Ex.9.0** where ever applicable

1. Effect of salivary amylase on starch (colorimetric)
   a) Influence of temperature and calculation of Q10
   b) Influence of pH
2. Transport of glucose through intestinal wall (everted gut sac) of a suitable animal
3. Recording of heart beat and the effect of drugs (acetylcholine and adrenaline) in fowl.
4. Effect pH different concentrations of NaCl (0.1% to 2%) on the diameter of RBCs using micrometery.
5. Estimation of RBCs and WBCs in vertebrate blood
6. Blood histology of earthworm/cockroach/fish and chick.
7. Studies on feeding-Mounting of mouth parts of housefly, honey bee and mosquito in relation to food and feeding.
8. Observation of mitochondria in yeast cells.

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