

Sacred Heart College (Autonomous)

Department of Zoology

Master of Science [Zoology]

Course plan

Academic Year: 2014 – 15

Semester I

COURSE PLAN: PG ZOOLOGY SEMSTER 1
BIOSYSTEMATICS AND ANIMAL DIVERSITY

72 Hours (4 hrs/week) Credit – 4

Objectives:

To give a thorough understanding in the principles and practice of systematics
To help students acquire an in-depth knowledge on the diversity and relationships in animal world
To develop an holistic appreciation on the phylogeny and adaptations in animals

Course Teachers: 2

Faculty 1

Sessions	Topic	Method	Remarks
	Module I. Concepts in Biosystematics		
1	Systematics and Taxonomy. Levels of Taxonomy - alpha, beta and gamma taxonomy	ICT Enabled (ppt & images); discussion	
2	Microtaxonomy – phenon, taxon, category	ICT Enabled (ppt & images); discussion	
3	Macrotaxonomy; Importance of Taxonomy.	ICT Enabled (ppt & images); discussion	
4	Three Domain Concept in Systematics, two, five and six kingdom classification.	ICT Enabled (ppt & images); discussion	
5	Hierarchy of categories and higher taxa – Linnaean Hierarchy. Higher categories – Genus, family, order, class and phylum (brief account only)	ICT Enabled (ppt & images); discussion	
6	Concept of species - Typological, Nominalistic, Biological and Evolutionary	ICT Enabled (ppt & images); discussion	
7	Intraspecific Categories; Variety, Subspecies, Race, Cline.	ICT Enabled (ppt & images); discussion	
	CIA 1	1 Hr	
	Module II. Methods of Biosystematics		
8	Typological, Phenetics, Evolutionary, Phylogenetic, Different kinds of taxonomic characters.	ICT Enabled (ppt & images); discussion	
	Module III. Practice of Taxonomy		
9	Taxonomic Procedures - collection, different types of taxonomic collections, preservation, curation and identification	ICT Enabled (ppt & images); discussion	
10	Taxonomic Keys as tool of identification, different types of keys, merits and demerits.	ICT Enabled (ppt & images); discussion	

11	Process of typification, different zoological types and their significance.	ICT Enabled (ppt & images); discussion	
12	Use of computer softwares in taxonomic identification.	ICT Enabled (ppt & images); discussion	
13	Taxonomic nomenclature - International Code of Zoological Nomenclature (ICZN), Rules and formation of scientific names of different taxa.	ICT Enabled (ppt & images); discussion	
14	Importance principles of Zoological Nomenclature - Law of priority, Homonymy and Synonymy.	ICT Enabled (ppt & images); discussion	
15	Taxonomic publications – description of new taxa, synopses and reviews	ICT Enabled (ppt & images); discussion	
	Taxonomic revisions, monographs, atlases, field guides and manuals, catalogs and checklists.	ICT Enabled (ppt & images); discussion	
16	Ethics in taxonomy - authorship, suppression of data, undesirable practices in taxonomy (brief description only).	ICT Enabled (ppt & images); discussion	
	Module IV. Modern systematics	ICT Enabled (ppt & images); discussion	
17	Molecular Taxonomy - use of Proteins, DNA and RNA. Molecular Phylogeny, Phylogenetic trees, Phylocode,	ICT Enabled (ppt & images); discussion	
18	Tree of Life. Cladistic analysis and cladograms. Bar-coding of Life – merits and demerits	ICT Enabled (ppt & images); discussion	
	CIA 2	2 Hrs	

	Animal Diversity		
	Module I. Studies on Indian Fauna – from the past		
19.	Contributions from British period	Lecture	
20.	Organizations - Bombay Natural History Society, The Asiatic Society of Bengal	Lecture	
21.	Publication - <i>The Fauna of British India, Including Ceylon and Burma</i>	Lecture	
22.	Contributors to the research on Indian Fauna - Patrick Russell, Sir Francis Day, Ferdinand Stoliczka, Jim Corbet	Lecture	
23.	Contributors to the research on Indian Fauna- Salim Ali, Sunder Lal Hora, Wynter-Blyth, Romulus Whitaker.	Lecture	
	Module III. Diversity of Palaeofauna		
24.	Fossil records of prokaryotes, fossil protists, Edicaran and Burgess Shale fauna. Cambrian explosion- causes and consequences	ICT Enabled (ppt & images); discussion	
25.	Fossil arthropods - Trilobites, Extinct molluscs, Fossil Echinoderms, Fossil records of Fishes,	ICT Enabled (ppt & images); discussion	
26.	Mesozoic world of reptiles and their extinction. Fossil record of birds,	ICT Enabled (ppt & images); discussion	

	Mammalian ancestral forms, Animal fossil records from India.		
27.	Revision & Evaluation of the course	ICT Enabled (ppt); discussion	

Faculty 2

Sessions	Topic	Method	Remarks
	Animal Diversity		
	Module II Indian Fauna-Present status		
1	An overview of Animal Diversity in India	ICT Enabled (ppt) Seminar	
2	Corals of India, Earthworm diversity of India	ICT Enabled (ppt) Seminar	
3	Commercial Shrimps and Prawns of India	ICT Enabled (ppt) Seminar	
4	Insect fauna of India, Butterflies of India, Indian Arachnids.	ICT Enabled (ppt) Seminar	
5	Indian molluscs, Echinoderms of India	ICT Enabled (ppt) Seminar	
6	Major fishes of India, Amphibian diversity of India	ICT Enabled (ppt) Seminar	
7	Indian snakes, Survey of Indian Bird fauna	ICT Enabled (ppt) Seminar	

	Indian mammals, Diversity of domesticated animals of India,	ICT Enabled (ppt) Seminar	
	Endangered animals of India, Endemic animals of Kerala.	ICT Enabled (ppt) Seminar	
8	Western Ghats – Geography, Faunal diversity, endemism	Lecture and Assignment	
9.	Zoological Survey of India and the role in the conservation of Indian Fauna.	Lecture and assignment	
	Module IV Animal architecture		
10	Animal complexity – acellular/unicellular grade, cellular grade, tissue grade, organ grade and organ system grade. Animal body plans.	ICT Enabled (ppt) Lecture	
11.	Symmetry and its embryonic origin, body cavities, metamerism, cephalisation, complexity and body size.	ICT Enabled (ppt) Lecture	
12.	Module V. Animal Diversity – Invertebrates	ICT Enabled (ppt) Lecture	
13.	Diversity of protists with reference to body structure, nutrition, reproduction and life history.	ICT Enabled (ppt) Lecture	
14.	Recent trends in the classification of protists.	ICT Enabled (ppt) Lecture	
	CIA I	1 hr.	

15.	Body architecture of sponges, Diversity of Porifera with reference to body structure.	ICT Enabled (ppt) Lecture	
16.	Diversity of Cnidaria with reference to body organization and morphology. Ctenophoran diversity.	ICT Enabled (ppt) Lecture	
17.	Acoelomata	ICT Enabled (ppt) Lecture	
18.	Pseudocoelomata;	ICT Enabled (ppt) Lecture	
19.	Phylogeny of Arthropod - Monophyly and Polyphyly, Reasons for the success of Arthropods.	ICT Enabled (ppt) Lecture	
20.	Diversity of arthropod larvae; Adaptive Radiation in Molluscs	ICT Enabled (ppt) Lecture	
21.	Larval forms of Molluscs	ICT Enabled (ppt) Lecture	
22.	Lesser Protostomes (Brief account only) - Sipuncula, Echiura, Phoronida	ICT Enabled (ppt) Lecture	
23.	Brachipoda, Onychophora and Chaetognatha	ICT Enabled (ppt) Lecture	
24.	Echinoderms - Adaptive radiation, Larval forms of Echinoderms.	ICT Enabled (ppt) Lecture	
25.	Hemichordates – Taxonomic position	ICT Enabled (ppt) Lecture	

	Module III. Animal Diversity – Vertebrates	ICT Enabled (ppt) Lecture	
26.	Lower Chordates	ICT Enabled (ppt) Lecture	
27.	Chondrichthyes and Osteichthyes	ICT Enabled (ppt) Lecture	
	CIA -II	2 hrs	
28.	Modern Amphibians, diversity, distribution, status and threats	ICT Enabled (ppt) Lecture	
29.	Reptiles – origin and adaptive radiation	ICT Enabled (ppt) Lecture	
30.	Birds - Structural and functional modifications for aerial life	ICT Enabled (ppt) Lecture	
31.	Adaptive radiation in mammals	ICT Enabled (ppt) Lecture	

ASSIGNMENTS

	Date of submission/completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	Session 10	Individual assignments

Seminar

	Date of completion	Topic of Seminar & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	Sessions 10	Individual Seminar

Additional Reading List

1. Alfred, J.R.B and Ramakrishna. 2004. Collection, Preservation and Identification of Animals. Zoological Survey of India Publications, Kolkata, India.
2. Anderson, T.A. 2001. Invertebrate Zoology (2nd edn). Oxford University Press, New Delhi.
3. Barnes, R. D. 1982. Invertebrate Zoology (6th edn). Toppan International Co., NY
4. Barrington, E. J. W. 1969. Invertebrate Structure and Functions. English Language Book Society.
5. Benton, M.J. 2005. Vertebrate Paleontology Blackwell Publishing Com. Oxford, UK.

6. David, M. H, Craig Moritz and K.M. Barbara.1996. Molecular Systematics. Sinauer Associates, Inc.
7. Fauna of India (Formerly Fauna of British India). Zoological Survey of India (ZSI) Publications, Kolkata, India.
8. Hickman Jr., Cleveland, Larry Roberts, Susan Keen, Allan Larson, and David Eisenhour .2011. Animal Diversity. McGraw-Hill Companies, Inc. NY
9. Hyman, L. H. 1940 –1967. The Invertebrates (6 vols). McGraw-Hill Companies Inc. NY
10. K.A.Subramanian and K.G.Sivaramakrishnan Aquatic Insects of India-A fieldguide Ashoka Trust for Research in Ecology and the Environment, Bengaluru, India.
11. Kapoor, V.C. 1991.Theory and Practice of Animal Taxonomy. Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.
12. Margulis,Lynn and M.J.Chapman 2001. Kingdoms and Domains: An Illustrated Guide to the Phyla of Life on Earth(4th edn.). W.H.Freeman &Company,USA
13. Mayr, E .1969. Principles of Systematic Zoology. McGraw Hill Book Company, Inc., NY.
14. Mayr, E and Ashlock P.D. 1991. Principles of Systematic Zoology. McGraw Hill Book Company, Inc., NY.
15. Niles, E. 2000.Life on earth: an Encyclopedia of Biodiversity, Ecology and Evolution (Vol.1&II).ABCCLIO, Inc.CA,USA
16. Priyadarsanan D. R., S. Devy, Aravind N. A., Subramanian, K. A., and S. Narayanan 2012. Invertebrate diversity and conservation in the Western Ghats Ashoka Trust for Research in Ecology and the Environment, Bengaluru, India.
17. Romer, A.S. and T.S. Parsons. 1985. The Vertebrate Body. (6th edn.) Saunders, Philadelphia.
18. State Fauna Series - Zoological Survey of India (ZSI) Publications, Kolkata, India.
19. T.K. PAL. R.VENKATACHALAPATHY. B. BARAIK. Animal Fossils of Nagaland. OCCASIONAL PAPER NO. 338. Records of the Zoological Survey of India..
20. Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. 2009. *Molecular Biology of the Gene*. Pearson.

COURSE PLAN: EVOLUTIONARY BIOLOGY AND ETHOLOGY

72 Hours (4 hrs/week)

Credit – 4

COURSE Objectives:

- To provide an understanding on the process and theories in evolutionary biology
- To help students develop an interest in the debates and discussion taking place in the field of evolutionary biology
- To equip the learners to critically evaluate the debates and take a stand based on science and reason
- To expose students to the basics and advances in ethology, and generate an interest in the subject in order to understand the complexities of both animal and human behavior

TEACHER I			
Sessions	Topic	Method	Remarks/Reference
	EVOLUTIONARY BIOLOGY		
	Module I. Concepts in Evolution		
1	Concepts of variation, adaptation, struggle, fitness and natural selection-spontaneity of mutation and the evolutionary synthesis.	ICT enabled with ppt and related videos	
2	Contributions of Margulis, Eldredge and Gould (Punctuated equilibrium)	ICT enabled with ppt and related videos	
3	Rose Mary and Peter Grant (Molecular evolution in Darwinian finches).	ICT enabled with ppt and related videos	
	Module II. Origin and Evolution of Life		
4	The RNA world. Idea of Panspermia. The First Cell	ICT enabled with ppt and related videos	
5	Evolution of Prokaryotes-	ICT enabled with ppt and related videos	
6	Origin of eukaryotic cells- evolution of unicellular eukaryotes	ICT enabled with ppt and related videos	
7	Genome evolution. Anaerobic metabolism	ICT enabled with ppt and related videos	
8	Origin of photosynthesis and aerobic metabolism	ICT enabled with ppt and related videos	
	Module V. Developmental and Evolutionary Genetics		
9	The idea of Evo-Devo, Heterochrony	ICT enabled with ppt and related videos	
10	Heterotopy, Heterometry and Heterotypy	ICT enabled with ppt and related videos	
11	Developmental genes	ICT enabled with ppt and related videos	

12	Gene co-option	ICT enabled with ppt and related videos	
13	Evolution of plasticity	ICT enabled with ppt and related videos	
14	Evolution of complexity. Evolution of sex.	ICT enabled with ppt and related videos	
15	I CIA		
16	Module VI. Primate Evolution and Human Origins		
17	Stages in Primate evolution- Prosimii, Anthroidea and Hominids	ICT enabled with ppt and related videos	
18	Factors in human origin, hominid fossils	ICT enabled with ppt and related videos	
19	Cytogenetic and molecular basis of origin of man	ICT enabled with ppt and related videos	
20	African origin of modern man - Mitochondrial Eve, Y chromosomal Adam	ICT enabled with ppt and related videos	
21	Evolution of human brain- communication, speech and language.	ICT enabled with ppt and related videos	
	ETHOLOGY		
	Module VII. Complex Behaviour		
22	Orientation, Navigation	ICT enabled with ppt and related videos	
23	Migration (Fishes and birds), Navigation cues	ICT enabled with ppt and related videos	
24	Biological rhythms - Circadian	ICT enabled with ppt and related videos	
25	Biological rhythms - Circannual, Lunar periodicity	ICT enabled with ppt and related videos	
26	Biological rhythms - Tidal rhythms	ICT enabled with ppt and related videos	

27	Genetics of biological rhythms.	ICT enabled with ppt and related videos	
	Module VIII. Social Behaviour		
28	Sociobiology (Brief account only) Aggregations - schooling in fishes	ICT enabled with ppt and related videos	
29	Herding in mammals, Group selection	ICT enabled with ppt and related videos	
30	Kin selection, altruism, reciprocal altruism	ICT enabled with ppt and related videos	
32	Inclusive fitness, co-operation, territoriality, alarm call	ICT enabled with ppt and related videos	
33	Social organization in insects and primates	ICT enabled with ppt and related videos	
	Module IX. Stress and Behaviour		
34	Adaptations to stress- basic concept of environmental stress	ICT enabled with ppt and related videos	
35	Acclimation, acclimatization, avoidance and tolerance.	ICT enabled with ppt and related videos	
	II CIA		
36	Revision and Evaluation		
TEACHER II			
1	Module III. Evidences of Evolution Evidences from morphology and comparative anatomy - homologous structures, vestigial organs	Lecture	
2	Analogous structures, adaptive radiation, atavism, connecting links.	Lecture with interaction	
3	Evidences from embryology – egg and developmental stages	Lecture	
4	Similarity of embryos, Baer’s law, recapitulation theory.	Lecture and	

		interaction	
5	Physiological and biochemical evidences – protoplasm, chromosomes, DNA, enzymes, hormones	Lecture	
6	Blood groups, excretory products, biochemical recapitulation, comparative serology.	Lecture and interaction	
7	Palaentological evidences – fossils and fossil formation, conditions essential for fossil formation	Lecture	
8	Types of fossils, dating of fossils, significance of fossils, geological time scale.	Lecture and interaction	
	Module IV. Population Genetics	Lecture	
9	Gene pool		
10	Gene frequency	Lecture	
11	Hardy-Weinberg Law	Lecture	
12	Hardy-Weinberg Equation with Example	Lecture and interaction	
13	Factors affecting Hardy-Weinberg Equilibrium	„	
14	Rate of change in gene frequency through natural selection	„	
15	Migration and random genetic drift.	„	
16	Founder effect. Isolating mechanisms	Lecture and interaction	
17	Speciation. Micro and Macro Evolution	„	
18	Mega evolution. Co-evolution.	„	
TEACHER III			
	ETHOLOGY		
	MODULE I- Introduction		
1	Historical background, Stimulus-Response, Causal factors,	Lecture with Power	

	Quantitative aspects - Duration, interval frequency. Behaviour bouts.	Point Presentation and Video show	
2	Scope of ethology.	Lecture with Power Point Presentation and Video show	
	MODULE II- Neurophysiological Aspects of Behaviour		
3	Reflex action, Kinesis, Taxes	Lecture with Power Point Presentation	
	Sherrington's neuro-physiological concepts in behavior - Latency, summation, fatigue.	Lecture with Power Point Presentation	
4	Fixed action patterns.	Lecture with Power Point Presentation	
	I CIA		
	MODULE III- Motivation		
5	Definition- Goal oriented drive, internal causal factor, Homeostatic and Non-homeostatic drives.	Lecture with Power Point Presentation	
6	Hormones and behavior, Psycho-hydrologic model of motivation.	Lecture with Power Point Presentation	
	MODULE IV- Learning		
7	Short and long term memory, Habituation	Lecture with Power Point Presentation	
8	Classical conditioning (Pavlov's experiments), Instrumental	Lecture with Power	

	conditioning,	Point Presentation	
9	Latent learning, Trial and error learning, Instinct, Imprinting.	Lecture with Power Point Presentation	
	MODULE V- Communication		
10	Evolution of communication	Lecture with Power Point Presentation	
11	Sensory mechanisms: Electrical	Lecture with Power Point Presentation and Video show	
12	Sensory Mechanisms: Chemical, Olfactory	Lecture with Power Point Presentation	
13	Sensory Mechanisms: Auditory and Visual.	Lecture with Power Point Presentation and Video show	
14	Dance language of honey bees, Pheromonal communication (Ants and mammals).	Lecture with Power Point Presentation and Video show	
	II CIA		
	MODULE VI- Reproduction and Behaviour 4 hrs.		
15	Reproductive strategies and Mating systems	Lecture with Power Point Presentation	
16	Courtship behaviour	Lecture with Power Point Presentation	

		and Video show	
17	Sexual selection- patterns	Lecture with Power Point Presentation	
18	Parental care and investment.	Lecture with Power Point Presentation and Video show	

ASSIGNMENTS

	Submission/completion	Topic of Assignment& Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	8 th Session	Individual assignment
2	12 th Session	Individual assignment

References

- Arthur,W. 2011. Evolution - A Developmental Approach. Wiley-Blackwell, Oxford,UK Camilo J.Cela - Conde and Francisco J. Ayala. 2007. Human Evolution-Trails from the Past. Oxford University Press.Oxford ,UK
- Campbell.B.G.2009. Human Evolution. Transaction Publishers, NJ, USA.
- Charles W. Fox and Janson B.Wolf . 2006. Evolutionary Genetics-Concepts and Case Studies. Oxford University Press, NY. USA.
- Carroll, SB. 2005. Endless Forms Most Beautiful: The New Science of Evo-Devo. WW Norton, New York
- Cleveland P.Hickman, Jr., Larry S. Roberts and Allan Larson. 2011. Integrated Principles of Zoology. (11th edn.). McGraw- Hill, NY, USA.

- Darwin, C.D. 1859. On the Origin of Species by Means of Natural Selection. John Murray, London.
- Dan, G. and Li, W.H. 2000. Fundamentals of Molecular Evolution. (2nd edn.). Sinauer Associates Inc. MA, USA
- Elliott, Sober. 2008. Evidences and Evolution: The Logic Behind the Science. Cambridge University Press, UK.
- Futuyma, D.J. 1986. Evolutionary Biology. (2nd edn.). Sinauer Associates Inc. MA, USA.
- Gould, S.J. 2002. The Structure of Evolutionary Theory. Harvard University Press, MA, USA.
- Hall, B.K and Hallgrímsson, B. 2008. Strickberger's Evolution (4th edn). Jones and Bartlett Pub. London, UK
- Hall, B.K. and Olsen, W. M., (Ed). 2007. Keywords and Concepts in Evolutionary Developmental Biology. Discovery Publishing House, New Delhi,
- Hall, B.K., Pearson, R. and Muller, G.B. 2003. Environment, Evolution and Development: Toward a Synthesis. MIT Press, Cambridge MA, USA.
- Kimura, M. 1983. The neutral theory of molecular evolution. Cambridge University Press. Margulis, L and Michael J. C. 1998. Kingdoms & Domains: An Illustrated Guide to the Phyla of Life on Earth (4th edn.). W. H. Freeman and Company, USA.
- Richard E. M and Levin, R B. 1988. The Evolution of Sex: An Examination of Current Ideas. Sinauer Associates Inc. MA, USA.
- Stearns C.S. 1987. The Evolution of Sex and its Consequences. Birkhauser, Basel, Switzerland.
- West- Eberhard M.J. 2003. Developmental Plasticity and Evolution. Oxford University Press, Oxford, UK..

ETHOLOGY

- Alcock John. 2009. Animal Behaviour: An Evolutionary Approach (8th edn). Sinauer Associates Inc. Sunderland, Massachusetts.
- Aubrey Manning and Mariam Stamp Dawkins. 2000. An Introduction to Animal Behaviour (5th Edn). Cambridge University Press, U.K.
- Eibl - Ebesfeldt, I. Hol. 1970. Ethology: The Biology of Behaviour. Reinhart & Winston. New York.
- Fatik Baran Mandal .2009. A Textbook of Animal Behaviour. PHI Learning Private Limited, New Delhi.
- Hauser, M. 1998. The Evolution of Communication. MIT Press, Cambridge, Mass. USA.
- Jeffrey C. Hall. 2003. Genetics and Molecular Biology of Rhythms in Drosophila and other Insects. Elsevier Science, USA.
- Judith Goodenough, Betty McGuire .2010. Perspectives of Animal Behaviour. John Wiley & Sons Inc. USA,
- Krebs, J. R. and N.B. Davis. 2000. An Introduction to Behavioral Ecology. Blackwell Scientific Publications, Oxford.

- Lee Alan Dugatkin .2009. Principles of Animal behaviour (2nd edn). W.W. Norton and Company.
- Lee C. Drickamer, Stephen H. Vessey, Elizabeth Jakob.2002. Animal Behaviour -Mechanisms, Ecology, Evolution (5th edn).McGraw-Hill Publishing Company, New York.
- Macfarland, D1998. Animal Behaviour - Psychobiology, Ethology and Evolution. Pitman publication Ltd. London.
- Scott,Graham.2005. Essential animal behavior. Blackwell Publications Company, Oxford ,UK
- Thorpe, W.H. 1979. The origins and rise of Ethology. Heinmann Educational Books, London.university press, U.K.
- Wilson, E.O.2000. Sociobiology: The new synthesis. Harvard Univ. Press, Cambridge, Mass. USA.

COURSE PLAN FOR MASTER OF SCIENCE PROGRAMME IN ZOOLOGY
SACRED HEART COLLEGE(AUTONOMOUS), THEVARA

DEPARTMENT OF ZOOLOGY

COURSE PLAN: BIOCHEMISTRY

COURSE OBJECTIVES

- To understand the chemical nature of life and life process
- To provide an idea on structure and functioning of biologically important molecules
- To generate an interest in the subject and help students explore the new developments in biochemistry

Teacher I ; 36 hr

Sessions	Topic	Method	Remarks/Reference
	Module I. Carbohydrates		
1	Reactions of monosaccharides: Oxidation, reduction, ester formation, osazone formation. Glycosidic bond.	ICT Enabled (ppt & images, video clippings)	
2	Disaccharides: Sucrose, Lactose, Maltose, Isomaltose, Cellobiose and Trehalose.	ICT Enabled (ppt & images, charts, video clippings)	
3	Polysaccharides: Homopolysaccharides- Starch, Glycogen, Cellulose, Chitin, Dextrans, Inulin, Pectin.	ICT Enabled (ppt & images, video clippings)	
4	Heteropolysaccharides- Hyaluronic acid, Heparin, Chondroitin sulphate, Keratan sulphate, Dermatan sulphate and Agar-agar.	ICT Enabled (ppt & animations, images, video clippings)	
5	Glycoproteins and Mucoproteins.	ICT Enabled (ppt & animations, images, video clippings)	
	Module II. Proteins		
6	Structure, classification and properties of amino acids.	ICT Enabled (ppt & images, video clippings)	

7	Amphoteric properties of amino acids, pK value and iso-electric point of amino acids. Peptide bond formation and peptides.	ICT Enabled (ppt & images, video clippings)	
8	Reactions (due to carboxyl group, amino group and side chains).	ICT Enabled (ppt & images, video clippings)	
9	Colour reactions of amino acids and proteins.	ICT Enabled (ppt & images, video clippings)	
10	Primary structure of protein (e.g. insulin). Classification and properties of proteins. Conformation of proteins- chemical bonds involved,	ICT Enabled (ppt & images, video clippings)	
11	Secondary structure- Alpha helix, Collagen helix, Beta pleated sheet, Ramachandran angles and Ramachandran map.	ICT Enabled (ppt & images, video clippings)	
12	Fibrous proteins- examples (Keratin, Collagen, Elastin, Resilin, Fibrous muscle proteins). Chaperons.	ICT Enabled (ppt & images, video clippings)	
13	Tertiary structure- e.g. Myoglobin. Quaternary structure - e.g. Haemoglobin	ICT Enabled (ppt & images, video clippings)	
14	CIA I	1 hr; descriptive answers only	
	Module III. Lipids		
15	Classification of lipids: simple, compound and derived lipids. Biological importance of lipids.	ICT Enabled (ppt & images, charts, video clippings)	
16	Fatty acids: classification, nomenclature. Simple fats: Triacylglycerol (Triglycerides) - Physical properties.	ICT Enabled (ppt & images, video clippings)	
17	Reactions-Hydrolysis, Saponification, Rancidity. Acid number, Saponification number, Iodine number, Polenske number and Reichert-Meissl number of lipids. Waxes.	ICT Enabled (ppt & images, video clippings)	
18	Compound lipids: Phospholipids- Lecithin, Phosphatidyl inositol, Cephalins, Plasmalogens.	ICT Enabled (ppt & images, video clippings)	

19	Glycolipids, Sphingolipids. Derived Lipids	ICT Enabled (ppt & images, charts, video clippings)	
20	Steroids: Biologically important steroids-cholesterol, Vitamin D, Bile acids,	ICT Enabled (ppt & images, video clippings)	
21	Ergosterol, Terpenes, Lipoproteins.	ICT Enabled (ppt & images, video clippings)	
22	Prostaglandins- structure, types, synthesis and functions	ICT Enabled (ppt, images, animations & video clippings)	
23	Toxicants of biological origin - Afflatotoxin, Botulinum toxin	ICT Enabled (ppt & images, charts, video clippings)	
	Module IV. Nucleic Acids		
24	Structural organization of DNA (Watson - Crick Model)	ICT Enabled (ppt & images, charts, video clippings)	
25	Characteristic features of A, B, C and Z DNA.	ICT Enabled (ppt & images, video clippings)	
26	Structural organization of tRNA;	ICT Enabled (ppt & images, video clippings)	
27	Protein-nucleic acid interaction. DNA regulatory proteins,	ICT Enabled (ppt & images, video clippings)	
28	folding motifs, conformation flexibilities,	ICT Enabled (ppt & images, video clippings)	
29	denaturation, renaturation,	ICT Enabled (ppt & images, video clippings)	
30	DNA polymerases,	ICT Enabled (ppt & images, video clippings)	
31	Restriction endonucleases.	ICT Enabled (ppt & images, video clippings)	
32	CIA- II	2 hrs	
33	Biological roles of nucleotides and nucleic acids.	ICT Enabled (ppt & images, video clippings)	
34	Biological roles of nucleic acids.	ICT Enabled (ppt & images, video clippings)	
35	Revision		
36	Evaluation of the course		

Teacher: II 18 hrs

Topic	Method	Remarks/Reference
Module V: Enzymes		

1	Co-enzymes,Iso-enzymes,Ribozymes. Enzyme specificity	ICT Enabled (ppt & images, video clippings)	
2	Mode of action of enzymes.Formation of enzyme substrate complex. Lowering of activation energy, various theories, active site.	ICT Enabled (ppt & images, charts, video clippings)	
3	Enzyme kinetics: Michaelis-Menten equation. Km value and its significance	ICT Enabled (ppt & images, video clippings)	
4	Enzyme velocity and factors influencing enzyme velocity.	Lecture	
5	Kinetics of enzyme inhibition, suicide inhibition and feedback inhibition	ICT Enabled (ppt & images, video clippings)	
		1 hr; descriptive answers only	
6	Enzyme regulation: Allosteric regulations – Key enzymes, Covalent modifications. Enzyme engineering.	ICT Enabled (ppt & images, video clippings)	
	Module VI: Carbohydrates Metabolism		
1	Glycogen metabolism- Glycogenesis, Glycogenolysis.	ICT Enabled (ppt & images, charts, video clippings)	
2	Adenylate cascade system	ICT Enabled (ppt & images, video clippings)	
3	Ca ²⁺ Calmodulin –sensitive phosphorylase kinase. Regulation of glycogen synthesis.	ICT Enabled (ppt, images, animations & video clippings)	
4	Minor metabolic pathways of carbohydrates: Pentose Phosphate pathway, Glucuronic acid metabolism.	ICT Enabled (ppt, images, animations & video clippings)	
5	Galactose metabolism	ICT Enabled (ppt & images, charts, video clippings)	
6	Inborn errors associated with carbohydrate metabolism.	ICT Enabled (ppt & images, video clippings)	
7	Glycogen storage diseases	Lecture	
8	Lactose intolerance, Galactosuria	ICT Enabled (ppt & images, charts, video clippings)	
	Module VII. Metabolism of Proteins		
1	Fate of carbon skeletons of aminoacids: glucogenic	ICT Enabled (ppt, images, animations & video clippings)	

2	Ketogenic	ICT Enabled (ppt, images, animations & video clippings)	
3	Partly glucogenic and examples	ICT Enabled (ppt, images, animations & video clippings)	
4	Partly ketogenic with examples	ICT Enabled (ppt, images, animations & video clippings)	

Teacher: III 18 hrs

Topic	Method	Remarks/Reference
Module VII: Metabolism of proteins		
1	Synthesis of biologically significant compounds from different aminoacids with special reference to glycine,	ICT Enabled (ppt & images, video clippings)
2	glutamic acid and phenylalanine,	ICT Enabled (ppt & images, charts, video clippings)
3	tyrosine and tryptophan.	ICT Enabled (ppt & images, video clippings)
Module VIII: Metabolism of Lipids		
4	Alpha oxidation and omega oxidation of fatty acids.	ICT Enabled (ppt & images, video clippings)
5	De novo synthesis of fatty acids.	ICT Enabled (ppt & images, video clippings)
6	Metabolism of cholesterol, synthesis and its regulation.	ICT Enabled (ppt & images, video clippings)
7	Biosynthesis of triglycerides.	ICT Enabled (ppt & images, charts, video clippings)
8	Metabolism of ketone bodies - Ketogenesis, Ketolysis, Ketosis.	ICT Enabled (ppt & images, video clippings)
Module IX: Metabolism of Nucleic acids		
9	Catabolism of purines and pyrimidines.	ICT Enabled (ppt, images, animations & video clippings)
10	Major and minor nutrients. Role of Calcium, Phosphorus,	ICT Enabled (ppt, images, animations & video clippings)
11	Magnesium, Sodium	ICT Enabled (ppt & images, charts, video clippings)
12	, Potassium, Chloride,	ICT Enabled (ppt & images, video clippings)
13	Sulphur and Iron.	ICT Enabled (ppt & images, video clippings)
14	Free radicals and	ICT Enabled (ppt & images, video

	antioxidants, Generation of free radicals. Reactive oxygen species.	clippings)	
15	CIA II	2hrs	
16	Free radical scavenger systems. Lipid peroxidation.	ICT Enabled (ppt, images, animations & video clippings)	
17	Preventive antioxidants.	ICT Enabled (ppt, images, animations & video clippings)	
18	Revision and Evaluation	ICT Enabled (ppt, images, animations & video clippings)	

ASSIGNMENTS

	Date of submission/completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	Session 10	Individual assignment

Additional Reading List

- Lenhninger, A.L. 2008. Principles of Biochemistry. (5th edn). CBS Publishers and Distributors, New Delhi.
- Stayer, L. 2011. Biochemistry. (7th edn). W.H. Freeman & Co. NY.
- Voet, D. and J.G. Voet. 2004. Biochemistry. John Wiley & Sons., NY.

**COURSE PLAN: BIOSTATISTICS, COMPUTER
APPLICATION
AND RESEARCH METHODOLOGY**

COURSE OBJECTIVES:

To impart concepts, generate enthusiasm and make awareness about the tools/gadgets and accessories of biological research

- To equip the learner to carry out original research in biology
- To help the students to improve analytical and critical thinking skills through problem solving
- To provide hands on training in the use of various tools and techniques suggested in the course.

Basic Reference:

Ahuja, V.K. 2010. Law of Copy Rights and Neighbouring Rights : National and International

Perspectives..Lexis Nexis- Butterworths Wadhwa, Nagpur

Ahuja, V.K. 2007. Law Relating to Intellectual Property Rights. Lexis Nexis- Butterworths Wadhwa, Nagpur.

Anitha Goel.2010. Computer Fundamentals. Pearson Education India.

Bailey, N.T.J. 1994. Statistical Methods in Biology (3rdedn). Cambridge University Press.

Bright Wilson. 1990. An Introduction to Scientific Research. Dover Publications. NY.

Chap T.Le.2003.Introductory Biostatistics. John Wiley & Sons, NJ, USA.

Clough, P. and C. Nutbrown. 2002. A Student's Guide to Methodology: Justifying Enquiry. Sage, London.

Daniel, W.W. 2006. Biostatistics: A Foundation for Analysis in the Health Sciences (7th edn). John Wiley & Sons, New York.

Dharmapalan, Biju. 2012. Scientific Research Methodology. Narosa Publishing House, New Delhi

Finney, D.J. 1980. Statistics for Biologists. Chapman and Hall, London

Frank, Harry and Steven C. Althoen, 1995. Statistics: Concepts and Applications. Cambridge University Press

Glenn McGee. 2003. Pragmatic Bioethics. The MIT Press, MA, USA

Jeremy R. Garret.2012. The Ethics of Animal Research. The MIT Press, MA. USA
 Kothari C.R., 2009. Research Methodology: Methods and Techniques (2ndedn.).
 NewAge International Publishers, New Delhi.

Pagano, M and K.Gauvreau. 2000. Principles of Biostatistics. Brooks/Cole,
 CA, USA

Session	Topic	Method	Remarks
1	Steps in Statistical Investigation, Data and Variable (Collection, Types, Sources).	Lecture	
2	Population, Sample, Sampling Methods (Random, Cluster, Stratified and Geographical) and Sampling Errors/Bias.	Lecture	
3	Organization of Data - Editing, Classification, Tabulation (forming a frequency distribution from raw data and types and characteristics of a Frequency table).	Lecture	
4	Presentation of Data - Types and Characteristics of Tables and Visual aids – Graphs, Charts, Diagrams, Flow charts, Cartographs.	Lecture	
5	Statistical Analysis Tools - Parametric and Non-Parametric	Lecture	
6	Bivariate and Multivariate Analysis.	Lecture	

	Interpretation and Forecasting		
7	Introduction, Characteristics	Lecture	
8	Merits and Demerits of Mean	Lecture	
9	Merits and Demerits of Median	Lecture	
10	Merits and Demerits of Mode	Lecture	
11	Calculations/Problems for different data (raw, frequency table).	Lecture	
12	Geometric Mean	Lecture	
13	Introduction, Characteristics	Lecture	
14	Merits and Demerits of Range	Lecture	
15	Merits and Demerits of Quartile deviation	Lecture	
16	Merits and Demerits of Mean deviation	Lecture	
17	Merits and Demerits of standard deviation	Lecture	
19	Calculations/Problems for frequency table.	Lecture	
20	Standard Error and Relative Measures of Dispersion, Skewness and Kurtosis	Lecture	
21	Correlation - types and methods of correlation analysis	Lecture	

22	Problems for Karl Pearson's correlation coefficient	Lecture	
23	Spearman's rank correlation	Lecture	
24	Regression and Line of Best Fit	Lecture	
25	Types and methods of regression analysis.	Lecture	
26	Graphic Methods (Scatter method, Curve fitting).	Lecture	
27	Algebraic method (Fitting of straight line through regression Equation)	Lecture	
28	Probit Analysis (Brief account only)	Lecture	
29	Mathematical Models in Biology (Brief account only).	Lecture	
30	Length - Weight Relationship. Von-Bertalanffy's Growth (VBG) Model.	Lecture	
31	Measures of Probability and Theorems in Probability	Lecture	
32	Theorems in Probability	Lecture	
33	Probability distributions	Lecture	

34	Binomial distribution	Lecture	
35	Poisson distribution	Lecture	
36	Normal distribution	Lecture	
37	Hypothesis and types	Lecture	
38	Confidence Interval	Lecture	
39	Sampling, Methods and Errors	Lecture	
40	Tests of significance (For large and small samples – Critical Ratio and P value). Z Test (Problem for small Samples)	Lecture	
41	Chi- Square Test	Lecture	
42	Student's 't' test (Problem for small samples comparing mean of two variable)	Lecture	
43	F-test and Analysis of Variance (ANOVA - One way)	Lecture	
44	Non-parametric tests: Mc Nemar and Mann Whitney U test	Lecture	
45	Introduction, uses, records and system of classification of vital statistics.	Lecture	
46	Sample registration system, Sample design, Survey of causes of death and Age classification	Lecture	
47	Measures of Vital	Lecture	

	Statistics and Measures of Population		
48	Life tables (Brief account only).	Lecture	

49	Scientific temper, Empiricism, Rationalism	ICT Enabled (ppt); discussion	
	Module II. Concepts of Research		
50	Basic concepts of research -Meaning, Objectives, Motivation and Approaches.	ICT Enabled (ppt); discussion	
51	Types of Research (Descriptive/Analytical, Applied/ Fundamental, Quantitative/Qualitative, Conceptual/ Empirical	ICT Enabled (ppt); discussion	
53	Research methods versus Methodology, Research and scientific method. Research Process.	ICT Enabled (ppt); discussion	
54	CIA I	1 Hr.	
	Module III. Research Formulation		
55	Research formulation - Observation and Facts, Prediction and explanation, Induction, Deduction	ICT Enabled (ppt); discussion	
56	Defining and formulating the research problem, Selecting the problem and necessity of defining the problem.,	ICT Enabled (ppt); discussion	
57	Literature review - Importance of literature reviewing in defining a problem, Critical literature review, Identifying gap areas from literature review	ICT Enabled (ppt); discussion	
58	Hypothesis -Null and alternate hypothesis and testing of hypothesis	ICT Enabled (ppt); discussion	
	Module IV. Research Designs		

59	Research Design -Basic principles, Meaning, Need and features of good design, Important concepts. Types of research designs.	ICT Enabled (ppt); discussion	
60	Development of a research plan -Exploration, Description, Diagnosis, Experimentation, determining experimental and sample designs.	ICT Enabled (ppt); discussion	
61	Data collection techniques.	ICT Enabled (ppt); discussion	
	Module V. Scientific Documentation and Communication		
62	Project proposal writing, Research report writing (Thesis and dissertations, Research articles, Oral communications).	ICT Enabled (ppt); discussion	
63	CIA II	2 Hrs	
64	Impact factor, Citation index,H- index Presentation techniques - Assignment, Seminar, Debate, Workshop, Colloquium, Conference.	ICT Enabled (ppt); discussion	
	Module VI. Information Science, Extension and Ethics		
65	Sources of Information -Primary and secondary sources. Library - books, journals, periodicals, reference sources, abstracting and indexing sources, Reviews, Treatise, Monographs, Patents. Internet -Search engines	ICT Enabled (ppt); discussion	

	and software, Online libraries, digital libraries, e-Books, e-Encyclopedia, TED Talk, Institutional Websites.		
66	Intellectual Property Rights - Copy right, Designs, Patents, Trademarks, Geographical indications. Safety and precaution - ISO standards for safety, Lab protocols, Lab animal use, care and welfare, animal houses, radiation hazards	ICT Enabled (ppt); discussion	
67	Extension: Lab to Field, Extension communication, Extension tools. Bioethics: Laws in India, Working with man and animals, Consent, Animal Ethical Committees and Constitution. Revision & Evaluation of the course	ICT Enabled (ppt); discussion	

68	Generations of computers, Organization of computers,	ICT Enabled (ppt & images, video clippings)	
69	Binary Number System and Digital Computers. Hardware – examples,	ICT Enabled (ppt & images, charts, video clippings)	
70	Software - System Software, Operating System – functions, DOS, Windows,	ICT Enabled (ppt & images, video clippings)	
71	Linux and UNIX	ICT Enabled (ppt & animations, images, video clippings)	
72	Application Softwares, Firmware, Virus and Antivirus	ICT Enabled (ppt & images, video clippings)	
73	Types of modern computing: Cluster computing, Grid computing, cloud	ICT Enabled (ppt & images, video clippings)	

	computing		
74	CIA I	1 hr; descriptive answers only	
	Module II. Computer Language and Programming		
75	Computer languages - Classification and types, HTML,	ICT Enabled (ppt & images, video clippings)	
76	C and Java	ICT Enabled (ppt & images, video clippings)	
77	Programming concepts -Algorithm, Codes	ICT Enabled (ppt & images, charts, video clippings)	
	Module III. Information Technology and Biology		
78	Computer Networking – structure, topology, types (PAN, LAN, WAN, MAN) Wireless communication – Bluetooth /Wifi).	ICT Enabled (ppt & images, video clippings)	
79	INFLIBNET – Library networking Internet and Internet Services -World Wide Web, Uploading, Downloading, Hosting, Portal, Search Engines, Firewall.	ICT Enabled (ppt, images, animations & video clippings)	
80	Biological Databases – Category, role in biological research, BIOSIS, Medline and Medlars, AGRIS;	ICT Enabled (ppt & images, charts, video clippings)	
81	CIA- II	2 hrs	
82	E Journals and E Books Publishing.	ICT Enabled (ppt & images, video clippings)	
83	Cyber Crime and Cyber Laws	ICT Enabled (ppt & images, video clippings)	

84	Revision		
	Evaluation of the course		