

ZY1CT01BIOSYSTEMATICS AND ANIMAL DIVERSITY

90 Hours (25+65) 5 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

BIOSYSTEMATICS

25 hrs

Module I. Biological Classification

5 hrs.

Hierarchy of categories and higher taxa. Taxonomic Procedures-collection, preservation, curation and process of identification. Taxonomic characters of different kinds- quantitative and qualitative analysis of variation, Process of typification, different zoological types and their significance.

Prerequisite: Fundamentals of Systematics

Module II. Methods of Biosystematics

5 hrs.

Classical and modern methods-Typological, Phenetics, Evolutionary, Phylogenetic, Cladistics and Molecular Taxonomy. Phylocode, Tree of Life and Bar-coding of Life.

Module III. Taxonomic Publications

5 hrs.

Keys, types, use of keys, merits and demerits. International Code of Zoological Nomenclature(ICZN), Rules and formation of Scientific names of different taxa. Homonymy and Synonymy. Ethics in taxonomy- authorship, suppression of data, undesirable practices in taxonomy.

Module IV. Concepts and Techniques in Systematics

10 hrs.

Three Domain Concept in Systematics, two, five and six kingdom classification. Concept of species-taxonomic diversity within species.

Molecular Phylogeny-use of Proteins, DNA and RNA. Phylogenetic trees.

ANIMAL DIVERSITY

65 hrs.

Module I. Introduction

3 hrs.

Origin of Protists. Prokaryotes and Eukaryotes. Levels of organization in animal kingdom.

Module II. Multi-cellularity

8 hrs.

Edicaran and Burgess Shale fauna. Cambrian explosion- causes and consequences. Cropping and Red Queen principle. Possible theories of metazoan origin.

Symmetry, Coelom and Metamerism-evolutionary advantages.

Module III. Lower Metazoans

6 hrs.

Porifera, Cnidaria-Polymorphism, Ctenophora, Acoelomata, Placozoa, Mesozoa and Pseudocoelomata-evolutionary relationships and adaptive modifications only.

Module IV. Protostomes and Deuterostomes

10 hrs.

Phylogenetic position of Molluscs, Adaptive Radiation in Molluscs and Annelids. Phylogeny of Arthropod-Monophyly and Polyphyly, Reasons for the success of Arthropods. Major classes under Arthropoda and adaptive radiation.

Module V. Lesser Protostomes **4 hrs.**

Sipuncula, Echiura, Phoronida, Brachipoda, Onychophora and Chaetognatha- Phylogeny only.

Module VI. Echinoderms **3 hrs.**

Classification and adaptive radiation.

Pre-requisite: Larval forms of Annelids, Molluscs, Arthropods and Echinoderms. Impact of sedentary life on the organization of invertebrates.

Module VII. Hemichordates **2 hrs.**

Position in the animal kingdom, phylogeny and evolutionary significance

Module VIII. Ancestry of Chordates **9 hrs.**

Cephalochordates and Urochordates. Vertebrate Phylogeny-Agnatha, Ostracoderms and Gnathostomes-Placoderms, Acanthodians, Chondrichthyes and Osteichthyes. Structural and Functional adaptations of fishes.

Module IX. Terrestrial Vertebrates **8 hrs.**

Tetrapod phylogeny - modern Amphibians, diversity, distribution, status and threats.

Reptiles – origin and adaptive radiation. Skull of reptiles and its importance in biosystematics. Mesozoic world of reptiles and extinction.

Module X. Birds and Mammals **12 hrs.**

Origin of birds and mammals. Structural and functional modifications for aerial life. Orders under class Aves.

Class Mammalia: Prototheria, Metatheria and Eutheria. Phylogeny of Mammalian orders. Adaptive radiation in mammals.

Prerequisite : Classification and characteristics of Mammalia.

REFERENCES

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- Anderson, T.A. 2001. *Invertebrate Zoology* (2nd edn). Oxford University Press, New Delhi.
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- Hyman, L. H. 1940 –1967. *The Invertebrates* (6 vols). McGraw-Hill Companies Inc. NY
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- Romer, A.S. and T.S. Parsons. 1985. *The Vertebrate Body*. (6th edn.) Saunders, Philadelphia.
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- Waterman, A.J. 1971. *Chordate Structure and Function*. Macmillan Co. London
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- Young, J.Z. 1950. *Life of Vertebrates*. Clarendon Press, Oxford, UK.

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ZY1CT02 EVOLUTIONARY BIOLOGY AND ETHOLOGY**90 Hours (55+35)****Credit- 4****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

EVOLUTIONARY BIOLOGY**55 hrs.****Module I. Concepts in Evolution****10 hrs.**

Pre-Darwanian, Lamarck, Darwin and Wallace and Post Darwanian. Concepts of variation, adaptation, struggle, fitness and natural selection-spontaneity of mutation and the evolutionary synthesis. Neutral Evolution, Molecular Evolution. Neutralist versus Selectionist. Contributions of Margulis (Endosymbiotic theory), Eldredge and Gould (Punctuated equilibrium), Rose Mary and Peter Grant (Molecular evolution in Darwinian finches). Debates in evolutionary biology.

Prerequisite: Biography of Lamarck, Darwin and Wallace

Module II. Origin and Evolution of Life**13 hrs.**

Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers, concept of Oparin - Haldane, Miller-Urey Experiments. The RNA world. Idea of Panspermia. The First Cell. Evolution of Prokaryotes- origin of eukaryotic cells- evolution of unicellular eukaryotes, genome evolution. Anaerobic metabolism- origin of photosynthesis and aerobic metabolism.

Module III. Geological Timescale**7 hrs.**

Major events in evolutionary timescale. Anthropocene. Tools and techniques in estimating evolutionary time scale. Mass extinction and its consequences. Fossils- fossilization and its significance.

Prerequisite: Geological time scale - eras, periods and epochs

Module IV. Population Genetics**10 hrs.**

Gene pool, gene frequency, Hardy-Weinberg Law. Rate of change in gene frequency through natural selection, migration and random genetic drift. Founder effect. Isolating mechanisms and speciation. Micro Macro and Mega evolution. Co-evolution.

Module V. Developmental and Evolutionary Genetics**5 hrs.**

The idea of Evo-Devo, Heterochrony, Heterotopy, Heterometry and Heterotypy. Developmental genes and gene co-option. Evolution of plasticity and complexity. Evolution of sex.

Module VI. Primate Evolution and Human Origins**10 hrs.**

Stages in Primate evolution- Prosimii, Anthropoidea and Hominids. Factors in human origin, hominid fossils. Cytogenetic and molecular basis of origin of man-African origin of modern man- Mitochondrial Eve, Y chromosomal Adam,- early migration, hunter- gatherer societies. Evolution of human brain-communication, speech and language. Evolution of culture.

ETHOLOGY	35 hrs.
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- Module 1. Introduction** **3 hrs.**
 Historical background, Stimulus-Response, Causal factors, Quantitative aspects – Duration, interval frequency. Behaviour bouts. Darwinian Perspective on Animal behaviour, Scope of ethology, Genetic basis of behaviour.
- Module II. Neurophysiological Aspects of Behaviour** **3 hrs.**
 Reflex action, Kinesis, Taxes, Fixed action patterns. Sherrington’s neuro-physiological concepts in behaviour – Latency, summation, fatigue.
- Module III. Motivation** **4 hrs.**
 Goal oriented drive, internal causal factor, Homeostatic and Non-homeostatic drives. Hormones and behaviour, Psycho-hydrologic model of motivation.
- Module IV. Learning** **4 hrs.**
 Short and long term memory, Habituation, Classical conditioning (Pavlov’s experiments), Instrumental conditioning, Latent learning, Trial and error learning, Instinct, Imprinting.
- Module V. Communication** **5 hrs.**
 Evolution of communication, Sensory mechanisms: Electrical, Chemical, Olfactory, Auditory and Visual. Dance language of honey bees, Pheromonal communication (Ants and mammals).
- Module VI. Reproduction and Behaviour** **4 hrs.**
 Reproductive strategies, Mating systems, Courtship, Sexual selection- patterns, parental care and investment.
- Module VII. Complex Behaviour** **5 hrs.**
 Orientation, Navigation, Migration (Fishes and birds), Navigation cues. Biological rhythms – Circadian, Circannual, Lunar periodicity, Tidal rhythms. Genetics of biological rhythms.
- Module VIII. Social Behaviour** **5 hrs.**
 Sociobiology (Brief account only)
 Aggregations – schooling in fishes, herding in mammals, Group selection, Kin selection, altruism, reciprocal altruism, inclusive fitness, co-operation, territoriality, alarm call, social organization in insects and primates.
- Module IX. Stress and Behaviour** **2 hrs.**
 Adaptations to stress- basic concept of environmental stress, acclimation, acclimatization, avoidance and tolerance.

REFERENCES

Evolutionary Biology

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Web Resources

- <http://www.talkorigins.org>
<http://www.ucmp.berkeley.edu>
<http://www.academicearth.org>

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Web Resources

www.animalbehavioronline.com/modestable.html

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ZY1CT03 BIOCHEMISTRY**90 Hours (5hrs/week)****Credit- 4****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

Module I. Introduction**2 hrs.**

Atoms, molecules and chemical bonds. Water: biological importance, pH and acid - base balance. Buffers - biological importance.

Module II. Carbohydrates**10 hrs.**

Monosaccharides: Classification and nomenclature, 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. Mutarotation and inversion of sugars.

Reactions of monosaccharides: Oxidation, reduction, ester formation, osazone formation. Glycosidic bond.

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

Polysaccharides: Homopolysaccharides- Starch, Glycogen, Cellulose, Chitin, Dextran, Inulin, Pectin. Heteropolysaccharides- Hyaluronic acid, Heparin, Chondroitin sulphate, Keratan sulphate, Dermatan sulphate and Agar-agar. Glycoproteins and Mucoproteins.

Module III. Proteins**10 hrs.**

Structure, classification and properties of amino acids. Amphoteric properties of amino acids, pK value and iso-electric point of amino acids. Peptide bond formation and peptides. Reactions (due to carboxyl group, amino group and side chains). Colour reactions of amino acids and proteins.

Primary structure of protein (*e.g.* insulin).

Classification and properties of proteins. Conformation of proteins- chemical bonds involved, Secondary structure- Alpha helix, Collagen helix, Beta pleated sheet, Ramachandran angles and Ramachandran map. Fibrous proteins- examples (Keratin, Collagen, Elastin, Resilin, Fibrous muscle proteins). Chaperons. Tertiary structure- *e.g.* Myoglobin. Quaternary structure – *e.g.* Haemoglobin.

Module IV. Lipids**10 hrs.**

Classification of lipids: simple, compound and derived lipids. Biological importance of lipids. Fatty acids: classification, nomenclature.

Simple fats: Triacylglycerol (Triglycerides) - Physical properties. Reactions-Hydrolysis, Saponification, Rancidity. Acid number, Saponification number, Iodine number, Polenske number and Reichert-Meissl number of lipids. Waxes.

Compound lipids: Phospholipids- Lecithin, Phosphatidyl inositol, Cephalins, Plasmalogens.

Glycolipids, Sphingolipids. Derived Lipids, Steroids: Biologically important steroids-cholesterol, Vitamin D, Bile acids, Ergosterol, Terpenes, Lipoproteins.

Prostaglandins- structure, types, synthesis and functions.

Module V. Nucleic Acids**10 hrs.**

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; Protein-nucleic acid

interaction. DNA regulatory proteins, folding motifs, conformation flexibilities, denaturation, renaturation, DNA polymerases, Restriction endonucleases. Biological roles of nucleotides and nucleic acids.

Module VI. Enzymes

10 hrs.

Classification- (I.U.B.system), co-enzymes, iso-enzymes, ribozyme. Enzyme specificity. Mode of action of enzymes. Formation of enzyme substrate complex. Lowering of activation energy, Various theories, Active site.

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

Enzyme regulation: Allosteric regulations- Key enzymes, Covalent modification. Enzyme engineering.

Module VII. Carbohydrate Metabolism

12 hrs.

Major metabolic pathways- Glycolysis – Fate of pyruvate. Citric acid cycle and its significance; Central role of citric acid cycle. Oxidative and substrate level phosphorylation. Gluconeogenesis, Cori cycle. Glycogen metabolism- Glycogenesis, Glycogenolysis, Adenylate cascade system, Ca⁺² Calmodulin-sensitive phosphorylase kinase. Regulation of glycogen synthesis .

Minor metabolic pathways of carbohydrates: Pentose Phosphate pathway, Glucuronic acid metabolism, Galactose metabolism. Inborn errors associated with carbohydrate metabolism. Glycogen storage diseases, Lactose intolerance, Galactosuria.

Module VIII. Metabolism of Proteins

10 hrs.

Amino acid metabolism-Deamination, Transamination and Trans-deamination. Formation and disposal of ammonia. Urea cycle. Fate of carbon skeletons of aminoacids: glucogenic, ketogenic, partly glucogenic and ketogenic with examples. Synthesis of biologically significant compounds from different aminoacids with special reference to glycine, glutamic acid, phenylalanine, tyrosine and tryptophan.

Module IX. Metabolism of Lipids

8 hrs.

Beta oxidation, alpha oxidation and omega oxidation of fatty acids. *De novo* synthesis of fatty acids. Metabolism of cholesterol, synthesis and its regulation. Biosynthesis of triglycerides. Metabolism of ketone bodies - Ketogenesis, Ketolysis, Ketosis.

Module X. Nucleic Acid and Mineral Metabolism

8hrs.

Catabolism of purines and pyrimidines.

Major and minor nutrients. Role of Calcium, Phosphorus, Magnesium, Sodium, Potassium, Chloride, Sulphur and Iron.

Free radicals and antioxidants, Generation of free radicals. Reactive oxygen species. Free radical scavenger systems. Lipid peroxidation. Preventive antioxidants.

REFERENCES

Creighton, T.E. *Protein Structure and Molecular Properties*. 1993. W.H. Freeman & Co, NY.

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ZY1CT04 BIostatistics, Computer Application AND RESEARCH METHODOLOGY

90 Hours (40+30+20)

Credit-4

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

BIostatistics

40 hrs.

Module 1. Basics of Biostatistics

6 hrs.

Steps in Statistical Investigation, Data and Variable (Collection, Types, Sources).

Population, Sample, Sampling Methods (Random, Cluster, Stratified and Geographical) and Sampling Errors/Bias.

Organization of Data - Editing, Classification, Tabulation (forming a frequency distribution from raw data and types and characteristics of a Frequency table).

Presentation of Data - Types and Characteristics of Tables and Visual aids – Graphs, Charts, Diagrams, Flow charts, Cartographs.

Statistical Analysis Tools - Parametric and Non-Parametric; Bivariate and Multivariate Analysis. Interpretation and Forecasting.

Prerequisite: Statistics and Biostatistics – scope and significance.

Module II. Measures of Central Tendency

4 hrs.

Introduction, Characteristics, Merits and Demerits of Mean, Median and Mode.

Calculations/Problems for different data (raw, frequency table).

Harmonic and Geometric Mean (Brief account only).

Module III. Measures of Dispersion

5 hrs.

Introduction, Characteristics, Merits and Demerits of Range, Quartile Deviation, Mean Deviation and Standard Deviation. Calculations/Problems for frequency table.

Standard Error and Relative Measures of Dispersion, Skewness and Kurtosis (Brief account only).

Module IV. Correlation Analysis

3 hrs.

Correlation - types and methods of correlation analysis, Problems for Karl Pearson's correlation coefficient and Spearman's rank correlation.

Module V. Regression Analysis

7 hrs.

Regression and Line of Best Fit, Types and methods of regression analysis.

Graphic Methods (Scatter method, Curve fitting). Algebraic method (Fitting of straight line through regression equation).

Probit Analysis (Brief account only), Mathematical Models in Biology (Brief account only). Length - Weight Relationship. Von-Bertalanffy's Growth (VBG) Model.

Module VI. Theory of Probability**4 hrs.**

Measures of Probability and Theorems in Probability. Probability distributions – Binomial, Poisson and Normal (Brief Account only).

Module VII. Testing of Hypothesis**7 hrs.**

Hypothesis and types, Confidence Interval, Sampling, Methods and Errors.

Tests of significance (For large and small samples – Critical Ratio and P value). Z Test (Problem for small samples), Chi- Square Test (Problem for 2×2 table only).

Student's 't' test (Problem for small samples comparing mean of two variable).

F-test and Analysis of Variance (ANOVA - One way) (Brief account only).

Non-parametric tests: Mc Nemar and Mann Whitney U test (Brief account only).

Module VIII. Vital Statistics**4 hrs.**

Introduction, uses, records and system of classification of vital statistics.

Sample registration system, Sample design, Survey of causes of death and Age classification.

Measures of Vital Statistics and Measures of Population (Mortality rates, Fertility rates).

Life tables (Brief account only).

COMPUTER APPLICATIONS**30 hrs.****Module I. Basics of Computers****6 hrs.**

Types of Computers. Binary Number System, Digital and Analog systems.

Hardware/Software/Firmware. Basics of Computer Functioning- Booting; Formatting;

File, File Extensions; Temporary Files; Folder; GUI, Icon; Installation of Programs, Commands, Bios-setup, Date and Time, Memory Partitions, Registry, Default Operations; Defragmentation (Brief account only).

Prerequisite: Basics of Computers (Characteristics, History and Generations, Components and Organization).

Module II. Hardware Basics**7 hrs.**

Memory -Classification and Types of memory; memory devices; Units.

Input Devices -Types, working and functions. Output Devices –Types, working and functions.

CPU components - Processors, Mother boards, SMPS, Accessory Cards – Graphic /Sound/ Networking/ Bluetooth/Wifi (Brief account only).

New Generation Computers - Servers, Laptop; Palmtop; Cyborgs; Robotics, Zoobotics (Brief account only).

Module III. Software Basics**7 hrs.**

System Software/Operating System -System Files; Working of OS; DOS, Windows, Linux and UNIX (Brief account only).

Application Software -Programs and Packages, Calculator, MS Paint, MS Word, MS Excel, MS PowerPoint, Publisher, Acrobat Reader, E Book Reader, Explorer, Photoshop.

Virus and Antivirus (Brief account only).

Statistical Software (MS Excel, PH Stat, SPSS).

Databases -MS Access (Brief account only).

Module IV. Computer Language and Programming**5 hrs.**

Computer language -Classification and types, HTML, C and Java

Programming concepts -Algorithm, Codes (Brief account only).

Module V. Networking, Internet and Information Technology **5 hrs.**
 Computer Communication -Network Topology, Media of networking, Networking Protocols, PAN, LAN, WAN, MAN, INFLIBNET, Modem and Gateway.
 Internet and Internet Services -World Wide Web, Uploading, Downloading, Hosting, Portal, Search Engines, Firewall.
 Global Information System -BIOSIS, Medline and Medlars, AGRIS; E Journals and E Books Publishing. Cyber Crime and Cyber Laws (Brief account only).

RESEARCH METHODOLOGY **20 hrs.**

Module I. Science and Life Sciences **2 hrs.**
 Basic concepts - Knowledge, Information and Data - Science, Pseudoscience.
 Life Science - Definition, Laws, Characteristics.
 Scientific temper, Empiricism, Rationalism and Units of measurements.

Module II. Concepts of Research **4 hrs.**
 Basic concepts of research -Meaning, Objectives, Motivation and Approaches.
 Types of Research (Descriptive/Analytical, Applied/ Fundamental, Quantitative/Qualitative, Conceptual/ Empirical).
 Research methods versus Methodology, Research and scientific method. Research Process.

Module III. Research Formulation **4 hrs.**
 Research formulation -Observation and Facts, Prediction and explanation, Induction, Deduction.
 Defining and formulating the research problem, Selecting the problem and necessity of defining the problem. Literature review -Importance of literature reviewing in defining a problem, Critical literature review, Identifying gap areas from literature review.
 Hypothesis -Null and alternate hypothesis and testing of hypothesis -Theory, Principle, Law and Canon.

Module IV. Research Designs **4 hrs.**
 Research Design -Basic principles, Meaning, Need and features of good design, Important concepts. Types of research designs.
 Development of a research plan -Exploration, Description, Diagnosis, Experimentation, determining experimental and sample designs.
 Data collection techniques.

Module V. Scientific Documentation and Communication **3 hrs.**
 Project proposal writing, Research report writing (Thesis and dissertations, Research articles, Oral communications).
 Presentation techniques - Assignment, Seminar, Debate, Workshop, Colloquium, Conference.

Module VI. Information Science, Extension and Ethics **3 hrs.**
 Sources of Information -Primary and secondary sources.
 Library - books, journals, periodicals, reference sources, abstracting and indexing sources, Reviews, Treatise, Monographs, Patents.
 Internet -Search engines and software, Online libraries, e-Books, e-Encyclopedia, TED Talk, Institutional Websites.
 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.
 Extension: Lab to Field, Extension communication, Extension tools.
 Bioethics: Laws in India, Working with man and animals, Consent, Animal Ethical Committees and Constitution.

REFERENCES

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**ZY1CP05 PRACTICAL 1: BIOSYSTEMATICS AND ANIMAL DIVERSITY,
EVOLUTIONARY BIOLOGY AND ETHOLOGY, BIOCHEMISTRY, BIOSTATISTICS,
COMPUTER APPLICATION AND RESEARCH METHODOLOGY**

90 Hours (5hrs./week)

Credit-3

Biosystematics and Animal Diversity, Evolutionary Biology and Ethology

Study of museum specimens - 70 invertebrates and 30 vertebrates (List the studied items with brief descriptions. Diagrams not necessary).

Larval forms – any 10 larvae from different taxa

Study of the skull of vertebrates - Varanus, Crocodile, Bird, Dog, Rabbit/ Rat

Preparation of dichotomous key of 4 specimens up to family (insects/spiders/ fishes/ snakes of any three taxa).

Preparation of Cladogram based on the specimens provided (at least five museum specimen).

Calculating gene frequencies and genotype frequencies in the light of Hardy-Weinberg Law in human/ other populations.

Study of fish in response to three temperatures (Normal and + 5⁰C) of water in a microenvironment and preparation of an ethogram

Study of the grooming behaviour in insects/bird

Biochemistry

Quantitative estimation of blood glucose by Folin-Wu/Anthrone /DNS/O-Toluidine/Enzymatic method Estimation of proteins by Biuret/ Lowry *et al.* method

Quantitative estimation of blood urea/ creatine/ uric acid Quantitative estimation of cholesterol in the blood Estimation of alkaline and acid phosphatases

Biostatistics

(Problems can be solved using scientific calculator).

These exercises can be done as assignments of the theory sessions

Calculation of mean, median and mode from grouped data

Calculation of mean deviation and standard deviation from grouped data Calculation of Pearson correlation coefficient.

Calculation of regression coefficient and regression equation ('x' on 'y' only) Calculation of length-weight relationship

Calculation of 'Z' value (small sample only)

Calculation of Chi square value (2×2 table only)

Calculation of 't' value (for small sample comparing two variable)

Draw line graph, vertical bar diagram, horizontal bar diagram, histogram, frequency polygon, frequency curve, pie diagram and ogives on graph paper for simple grouped data.

Computer Applications

MS Excel: Preparation of table

MS Excel: Preparation of graphs (bar, pie and ogives)

MS Excel: Formula writing (Addition, Subtraction, Multiplication, Division, Power and Root) MS Excel: Correlation Analysis

MS Power Point: Preparation of a presentation with minimum 5 slides based on First Semester theory topics

M.Sc ZOOLOGY SYLLABUS 2012

PH Stat: Basic statistics (mean, median, mode, standard deviation) PH

Stat: Chi square test

PH Stat: Students t test PH Stat :

Regression