UNIVERSITY OF CALICUT

(Abstract)
Scheme and syllabus of M.Sc Zoology (I Semester) of affiliated colleges under Credit Semester System, Calicut University (CUCSS-PG-2010) implemented with effect from 2010 admission-orders issued.

GENERAL & ACADEMIC BRANCH-IV ‘J’ SECTION

No. GA IV/J1/4279/10 Dated, Calicut University PO, 26.07.2010

2. Minutes of the meeting of the Board of Studies in Zoology (PG) of 09.06.2010, Item No.1
3. Orders of the Vice-Chancellor, in the file of even number dated 29.06.2010.
4. Item No.III a.30 of the minutes of the meeting of the Academic Council, held on 03.07.2010.

ORDER
As per reference cited (1) above, Credit Semester System at Post Graduate level in affiliated colleges(CUCSS PG-2010) has been implemented from the academic year 2010, onwards.

The Board of Studies at its meeting, vide reference cited (2) above, discussed the scheme and syllabus of PG (Zoology) of affiliated colleges and has forwarded the scheme and syllabus of Ist Semester to the University.

The Vice-Chancellor, in view of exigency, has approved the minutes of the meeting of the Board, subject to ratification by the Academic Council.

The Academic Council, vide paper read as 4th above, ratified the action of the Vice Chancellor in having approved the minutes of the meeting of the Board of Studies in Zoology.

Sanction has therefore been accorded to implement the scheme and syllabus of MSc Zoology of affiliated colleges under Credit Semester System with effect from 2010 admission.

Orders are issued accordingly. Scheme and syllabus appended.

Sd/-
REGISTRAR

To
1. The Principals of all affiliated Colleges offering M.Sc Zoology
2. Self financing centres of the University of Calicut offering Zoology(PG)

Copy to:
PS to VC/PA to Registrar/CE/ Digital wing (with a request to upload in the University website)/Enquiry/Information Centres/DR III Exams/EG-I/DR
PG/Tabulation/GAI’F’ ‘A’ Sections/GAI/GAIII/DDLFA/SF/FC

Forwarded/By Order
Sd/-
SECTION OFFICER.
CURRICULUM AND SYLLABI FOR
M.Sc. ZOOLOGY Course under
Choice Based Credit Semester System
(C C S S)

FIRST SEMESTER

Theory Courses

<table>
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<tr>
<th>Code No. &amp; Title of the Course</th>
<th>Credits</th>
<th>External marks</th>
<th>Internal marks</th>
<th>Total</th>
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<tbody>
<tr>
<td>ZO ICT 01- Biochemistry</td>
<td>4</td>
<td>75</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>ZO ICT-02-Biophysics and Biostatistics</td>
<td>4</td>
<td>75</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>ZO ICT-03-Systematics and Evolution</td>
<td>4</td>
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<td>25</td>
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<tr>
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<td>225</td>
<td>75</td>
<td>300</td>
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Practical Courses

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<th>External marks</th>
<th>Internal marks</th>
<th>Total</th>
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</thead>
<tbody>
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<td>ZO ICP 01- Biochemistry</td>
<td>2</td>
<td>75</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>ZOICP-02-Biophysics Biostatistics and Systematics</td>
<td>2</td>
<td>75</td>
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<tr>
<td><strong>Total</strong></td>
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ZO - Zoology  
I - 1 semester  
CT - Course Theory  
CP - Course Practical
THEORY
ZO-1CT-01 - BIOCHEMISTRY
(90 hours)

Unit - I – Chemistry and functions of Biomolecules

1. **Introduction** (2 hr)
   1.1. Macromolecules and their subunits
   1.2. Chemical bonds of biomolecules

2. **Carbohydrates** (12 hr)
   2.1. Monosaccharides
      2.1.1. Classification with examples—
      2.1.2. Structure of glucose, fructose, galactose, mannose and ribose
      2.1.3. Methods of representation of sugars (Ball and stick, projection formula and perspective formula)
      2.1.4. Isomerism – Structural isomerism (functional group isomerism) and stereo isomerism (optical isomerism) - mention epimer, anomer and enantiomer with examples
      2.1.5. Mutarotation
      2.1.6. Reactions – Oxidation (by acids, metal hydroxides and H₂O₂), dehydration (by acid) and reduction (by alkali), reactions with alanine and phenyl hydrazine
      2.1.7. Derivatives – ascorbic acid, acetal and hemiacetal, ketal and hemiketal, glycosides – glycosidic bond and deoxyribose
      2.1.8. Biological roles of monosaccharides
   2.2. Disaccharides
      2.2.1. Structure and biological roles of Maltose, Sucrose, Lactose, Cellobiose and Trehalose
      2.2.2. Biosynthesis of trehalose and lactose
   2.3. Polysaccharides
      2.3.1. Homopolysaccharides – Structure and biological roles of cellulose, starch, glycogen, inulin and chitin
      2.3.2. Mode of action of amylase on homopolysaccharides (starch and glycogen)
      2.3.3. Heteropolysaccharide - Structure and biological roles of hyaluronic acid, chondroitin, chondroitin sulphate, keratan sulphate, heparin and agar-agar

3. **Proteins** (9 hr)
   3.1. Amino acids
      3.1.1. Classification: (a) on the basis of number of amino and carboxyl group (b) on the basis of the chemical composition of side chain (c) based on the polarity of side chain (R)
      3.1.2. Amphoteric properties of amino acids
      3.1.3. pK value and isoelectric point (pI) of amino acids
      3.1.4. Peptide bond and peptides (di, tri, tetra, oligo and polypeptide)
   3.2. Structure of protein
      3.2.1. Primary structure, Secondary structure (α-helix –parallel & antiparallel and β pleated sheet), random coil conformation, Tertiary structure, Quarternary structure.
3.2.2. Brief note on protein domains, motifs, folds and Ramachandran plot.
3.2.3. Biological roles of proteins

4. **Lipids** *(8 hr)*
   4.1. Classification of lipids - Simple lipids (fats, oils and waxes), compound lipids (phospholipids, glycolipids, lipoproteins and sulpholipids) and derived lipids.
   4.2. Brief account of the chemistry of sterols, terpenes and carotenoids.
   4.3. Acid number, saponification number, Iodine number, Polenske number and Reichert-Meissl number of lipids.
   4.4. Biological roles of lipids – as food reserves (storage lipids), structural lipids in membrane, as signals, as co-factors, as pigments, as insulators, as vitamin carriers etc.
   4.5. Prostaglandins – Chemical nature and functions.
   4.6. Fatty acids – definition; essential fatty acids.
   4.7. Classification with examples– Saturated, unsaturated, hydroxyl and cyclic fatty acids.

5. **Nucleic acids** *(5 hr)*
   5.1. Structure of nitrogen bases and nucleotides.
   5.2. Structural organization of DNA (Watson –Crick model).
   5.3. Characteristic features of A-, B- C- and Z-DNA.
   5.4. Structural organization of t-RNA; brief note on micro-RNA.
   5.5. Biological roles of nucleotides and nucleic acids.

**Unit - II – Enzymes** *(15 hr)*

1. Classification- (I.U.B. system)
2. Specificity of enzyme action
4. Enzyme kinetics - Michaelis-Menten equation – derivation; significance of $K_m$ and $V_{max}$ Values.
5. Lineweaver-Burk equation and double reciprocal plot of enzyme reaction.
6. Enzyme inhibition – Competitive, non-competitive and uncompetitive inhibition (distinguish kinetically), suicide inhibition and feedback inhibition
7. Allosteric enzymes – positive and negative modulators
8. Iso-enzyme and ribozyme
9. Vitamins as coenzymes
10. Factors influencing enzyme action

**Unit - III – Bioenergetics** *(5 hr)*

1. Laws of thermodynamics and biological system, Enthalpy, Entropy, Free energy concept
2. Energy of activation, Standard free energy change
3. Role of ATP as a free energy carrier in the biological system
Unit - IV – Metabolism and biosynthesis of biomolecules

1. Carbohydrate metabolism (15 hr)
   1.1. Glycolysis – (PFK as pacemaker – Hexokinase conformation and change by glucose), Fate of pyruvic acid
   1.2. Metabolism of 2, 3 DPG as regulator of oxygen transport
   1.3. Citric acid cycle; Pyruvate dehydrogenase complex and ketoglutarate dehydrogenase complex
   1.4. Electron transport system and oxidative phosphorylation; Redox potential, Chemiosmotic hypothesis; inhibitors of electron transport chain
   1.5. Gluconeogenesis, Glycogenesis, Glycogenolysis; regulation of glycogen synthesis and breakdown
   1.6. Pentosephosphate pathway (HMP pathway)

2. Amino acid metabolism (5 hr)
   2.1. Biosynthesis and degradation of amino acids – glutamic acid, phenyl alanine, methionine, tryptophan, isoleucine, histidine

3. Lipid metabolism (8 hr)
   3.1. Oxidation of fatty acids
   3.2. Biosynthesis of fatty acids
   3.3. Biosynthesis of cholesterol

4. Nucleic acid metabolism (6 hr)
   4.1. Biosynthesis and degradation of purines and pyrimidines

References:
9. Zubay, G (latest.), Biochemistry, Maxwell Macmillan International
Section-A-Biophysics

1- Matter and mechanics of cells
   1--Colloids, properties of colloids, forms of colloids,
   Brownian movement and Tyndall phenomena

2- Diffusion and Osmosis
   2.1- Fick’s law and diffusion coefficient.
   2.3- Gibb’s Donnan equilibrium
   2.4- Application of diffusion processes in biology: haemolysis.
   2.5 -Vant Hoff’s laws
   2.6-Osmotic concentration, Osmotic pressure and osmotic gradient
   2.7- Electrosmosis.
   2.8 -Electrolytic and ionic balance in biological fluid

3 –pH
   3.1. Dissociation of water
   3.2. Dissociation of a weak acid
   3.3. Henderson Hasselbalch equation
   3.4. Buffers, pH meter
   3.5. pH value calculation.

4 – Bioacoustics
   4.1-Characteristics of sound
   4.2-Physical basis of hearing
   4.3-Physical organization of ear
   4.4- Physical aspects of sound transmission in the ear.
   4.5-Audible sound frequency
   4.6-Pitch reception and theories
   4.7-Infrasonic and ultrasonic sounds
   4.8 Echolocation; receiving and analyzing echoes

5 -Radiation Biology
   5.1-, Properties of different types of radio isotopes normally used in biology, their detection and measurement incorporation of radioisotopes in biological tissues and cells.
   5.2- Molecular imaging of radioactive material, safety guidelines.
   5.3-Biological effects of radiations
   5.4- Radiation protection and therapy, Nuclear medicine.
5.5-Applications of tracer techniques: Radiation dosimetry, Radioactive isotopes, Ionizing radiations, Radiation Detectors (GM Counter, Liquid Scintillation Counter)

5.6- Autoradiography

6 - Biophysical methods (Brief account) 5 hr
6.1-Analysis of biomolecules—using UV / visible fluorescence, circular dichroism
6.2- NMR and Electron Spin Resonance (ESR) spectroscopy
6.3- Structure determination using X-ray diffraction and NMR; analysis using light scattering.
6.4-Different types of mass spectrometry and surface plasma resonance methods

7- Electrophysiological methods (Brief) 3 hr
7.1-Single neuron recording,
7.2-Patch clamp recording,
7.3-ECG,
7.4-Brain activity recording
7.5-Lesion and stimulation of brain
7.6-Pharmacological testing,
7.7-PET (Positron Emission Tomography), MRI, f MRI, CAT.

8 - Principles and applications of 8 hr
8.1-Microscopy (Fluorescent, Interference, confocal -scanning and transmission electron microscopes
8.2-Resolving powers of different microscopes
8.3-Different fixation and staining techniques for EM, (freeze-etch and freeze fracture methods for EM-image processing methods in microscopy)
8.4- Laser and its applications in Biology

9 - Separation Techniques 10 hr
9.1- Chromatography (Adsorption, Partition, and ion-exchange chromatography, Column, Paper, Thin-layer, Gel-filtration, Gas chromatography, Affinity, HPLC)
9.2-Electrophoresis-(Paper, Disc, PAGE, Two dimensional PAGE, High voltage and Immunelectrophoresis.
9.3. Isoelectric focusing.
9.4-Flow cytometry

10. Influence of gravity 3 hr
10.1-Human body posture in the gravitational field
10.2- Influence of G force
10.3- Force of centrifugal acceleration – importance of aviation and space travel
10.4- Effect of positive G. Force & negative G. Forces
10.5- Protection against G. Force
10.6- Influence of linear acceleration on the body

11- Nanotechnology  

11.1- Definition
11.2- Nanotechnology and its applications in the field of health care.
11.3- Roles of nanotechnology in environmental management.

**Section –B –BIOSTATISTICS (35 Hours)**

1. Introduction 2 hr

1.1 Biostatistics: Definition, Terms, Applications, Role of biostatistics in modern research.

2. Data collection 7 hr

2.1 Types of data:
- Primary, secondary, qualitative, quantitative
2.2 Methods of data collection and classification:
- Types of sampling method-
  - Advantages and disadvantages of census and sampling method,
  - Classification of data, Tabulation
  - Methods of classification
  - Class intervals- exclusive and inclusive method
2.3 Diagrammatic and graphical presentation of data
  - Bar diagram – (types), Pie diagram, Histograms, Frequency polygon
  - Frequency curve (types. skewness, kurtosis, ogive)

3. Statistical Methods: Measures of central tendency and dispersal 8 hr

3.1. Mean, median, mode, quartile
3.2 Range, Mean deviation, Quartiles deviation, variance, Standard deviation, Standard error, degree of freedom

4. Probability distributions 4 hr

4.1. Basic concepts and definition:
4.2. Laws of probability
4.3. Probability distribution: -
  - Binomial, Poisson and Normal

5. Statistical inference 7 hr

5.1. Difference between parametric and non-parametric statistics;
5.2. Testing of hypothesis
5.3. Errors
5.4. Confidence interval; levels of significance, Critical region;
5.5. Normality test
5.6. t-test, chi-square test, F-test, ANOVA
5.7. Kruskal-Wallis, Mann-Whitney

6. **Correlation and Regression**

6.1. Types of correlation
6.2. Methods to measure correlation
   - Scatter diagram
   - Karlpearson’s coefficient of correlation
   - Spearman’s correlation
6.3. Types of regression analysis
6.4. Regression equations
6.5. Difference between regression and correlation analysis

**REFERENCES**

**BIOPHYSICS**

BIOSTATISTICS

ZO-1CT-03 - SYSTEMATICS AND EVOLUTION

(90 hours)

Section A. Systematics (45 hours)

1. Definition and basic concepts in Systematics and Taxonomy 4Hr
   Historical resume of systematics
   1.1 Levels of Taxonomy
       Alpha, beta, gamma taxonomy
   1.2 Place, importance and applications of taxonomy
   1.3 Goals of taxonomy

2. Classification 4Hr
   2.1 Practise of classification- purpose of classification
   2.2 Use of classification- storage of data, recovery of data
   2.3 Theories of biological classification- hierarchy of categories
   2.4 Types of classification—evolutionary & phylogenetic classification – typological classification, phonetic classification, omnispective classification, horizontal and vertical classification
   2.5 Components of classification

3. Taxonomic procedure 8 Hr
   3.1. Taxonomic collections- types of collections, value of collections
   3.2. Curation- preservation of collection in field and laboratory
   3.3. Recording of field data, storage of collection, labelling and cataloguing of collections
   3.4. Identification- methods of identification
3.4.1. Use of keys- kinds of keys, their merits and demerits
3.5. Taxonomic descriptions: presentation of findings
3.6. Kinds of taxonomic publications
3.6.1. Taxonomic and ecological publication and their difference

4. **Species concepts**  
4.1. Species category- different species concepts: typological, Nominalistic, biological, evolutionary, recognition, ontological (theoretical) and operational (epistemological species concepts)
4.2. Taxonomic diversity with in species, different kinds of species, sub species and other infra specific categories, hybrids.

5. **Taxonomic characters**  
5.1 Different kinds of taxonomic characters
5.2 Functions of taxonomic characters.
5.3 Taxonomic characters and classification
5.4 Taxonomic characters and evolution

6. **Zoological nomenclature**  
6.1 International Code of Zoological Nomenclature, development of Code of Zoological Nomenclature: its operative principles, interpretation and application of important rules in the formation of scientific names of various taxa.
6.2 Principle of priority
   6.2.1 Homonymy and Synonymy
6.3 Type method and its significance
6.3.1 Different kinds of types in descriptive taxonomy

7. **Newer trends in systematics**  
7.1 Chemo and serotaxonomy
7.2 Cytotaxonomy
7.3 Numerical taxonomy
7.4 Cladistics
7.5. Molecular systematics
7.6 DNA bar coding vs traditional taxonomy

8. **Ethics in taxonomy**  
8.1 Ethics related to collections
   8.1.1 credit
   8.1.2 Lending and borrowing of specimens
   8.1.3 Loan of material
   8.1.4 Exchange of materials
8.1.5 Collaboration and co-operation with co-workers
8.1.6 Use of language

8.2 Ethics related to taxonomic publications
   8.2.1 Authorship of taxonomic papers
   8.2.2 Correspondence
   8.2.3 Suppression of data
   8.2.4 Undesirable features of taxonomic papers

8.3 Taxonomists and user communities

9. Taxonomic impediments
   9.1 Impediments to build up taxonomic collections and maintenance
   9.2 Shortage of man power
   9.3 Lack of funding for taxonomic research
   9.4 Lack of training in taxonomy
   9.5 Lack of Library facilities
   9.6 Impediments in publishing taxonomic work
   9.7 Solutions to overcome the impediments
      9.7.1 International co-operation
      9.7.2 Development of Taxonomic centres
   9.8 Need for efficient international networking
   9.9 The desired end product

Section B. Evolution (45 hrs)

Unit 1. Natural Selection: 7 hr
   1. Mechanism of natural selection - directional, disruptive and stabilizing selection
   2. Natural selection in Islands.

Unit 2. The Mechanisms: 10 hr
   2. Isolating mechanisms- Prezygotic and Postzygotic isolating mechanisms; speciation-allopatric-peripatric-parapatric-heteropatric- sympatric speciation; ecotypes.
Unit 3. **Tempo of evolution**  
1. Gradualism Vs punctuated equilibrium.  
2. Anagenesis Vs Cladogenesis.

Unit 4. **Molecular evolution**:  
1. Neutral theory of molecular evolution; molecular divergence; molecular drive.  
3. Phylogenetic relationships - Homology; Homologous sequences of proteins and DNA - orthologous and paralogous; parsimony analysis; nucleotide sequence analysis; DNA bar coding vs traditional taxonomy.

Unit 5. **Evolutionary trends**  
3. Communication, speech, language and self awareness in primates.

**References:**

**A. Systematics:**

B: Evolution


PRACTICALS

ZO ICP 01- BIOCHEMISTRY

1. Actual acidity and titrable acidity of a strong and a weak acid.
2. Comparison of the buffering capacities of two buffers of same pH
3. Qualitative tests for carbohydrates
   a) Qualitative tests for monosaccharides (Glucose and fructose)
   b) Qualitative tests for disaccharides (Lactose, Maltose & Sucrose)
   c) Qualitative tests for polysaccharides (Dextrin & Starch)
   d) Identification of unknown carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose, Dextrin & Starch) by suitable tests.
4. Quantitative estimation of carbohydrates
   1.1. Estimation of blood glucose by colorimetric method (Somogy-Nelson method/ O-Toludine method)
   1.2. Estimation of total carbohydrate by phenol-sulphuric acid method
5. Qualitative tests for proteins
   a) Colour reactions with proteins (Albumin, Casein, Peptones & gelatin)
   b) Precipitation reactions with proteins (Albumin, Casein, Peptones & gelatin)
   c) Identification of unknown protein (Albumin, Casein, Peptones & gelatin)
6. Qualitative tests for non-protein nitrogenous substances (urea, uric acid and creatinine)
8. Quantitative estimation of proteins
   a) Estimation of proteins by Biuret method
   b) Isolation of casein from cow’s milk
9. Quantitative estimation of non-protein nitrogenous substances
   a) Quantitation of blood urea by diacetyl monoxine method
   b) Determination of urine creatine by alkaline picrate method
10. Quantitative estimation of lipids
    a) Estimation of total serum cholesterol by Zak’s method
    b) Saponification number of oils – coconut oil & ground nut oil.
    c) Iodine number of fats

References:


ZOICP02-Biophysics, Biostatistics and Systematics

Biophysics
1. pH meter and measurement of pH
3. Gel filtration chromatography (Separation of starch from glucose)
4. Thin layer chromatography of amino acids and sugars.
5. Serum electrophoresis.
6. Determination of absorption coefficient and concentration of unknown solutions by calibration curve using a coloured solution.
7. Absorption spectrum of a coloured solution (KMnO₄)
8. Drawings using camera lucida

Biostatistics
1. Preparation of frequency table with given data
2. Diagrammatic presentation of census data in Kerala in the form of bar diagrams and pie diagrams.
3. Graphic presentation of population distribution in the form of histogram, frequency polygon and frequency curve.
5. Simulation of binomial and poison distributions
6. Estimation of mean number of children per family in the university campus
7. Estimation of population of planktons
8. Designing of an experiment for the comparison of efficacy of a few diets on different types of animals by the method of ANOVA.
9. Regression analysis and correlation analysis of a data of heights and weight of a group of students.
10. Data analysis by SPSS.

**Systematics**
1. Collection, Preservation and curation of specimens
2. Identification of animals (Fishes/insects/any other) up to family/ generic / species level-minimum 15 specimens.
3. Preparation of dichotomous (simple bracket) keys; minimum ten sets from the identified specimens.

**Evolution**
1. Exercises in convergent evolution. 2. Exercises in divergent evolution.

**Reference**