

**(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.

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**GENERAL & ACADEMIC BRANCH-IV 'J' SECTION**

No. GA IV/J1/4279/10

Dated, Calicut University PO, 26.07.2010

**Read:** 1. U.O.No. GAIV/J1/1373/08 dated, 23.07.2010.

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 4<sup>th</sup> 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/GAII/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

<b>Code No. &amp; Title of the Course</b>	<b>Credits</b>	<b>External marks</b>	<b>Internal marks</b>	<b>Total</b>
ZO ICT 01- Biochemistry	4	75	25	100
ZO ICT-02-Biophysics and Biostatistics	4	75	25	100
ZO ICT-03-Systematics and Evolution	4	75	25	100
Total	12	225	75	300

Practical Courses

<b>Code No. &amp; Title of the Course</b>	<b>Credits</b>	<b>External marks</b>	<b>Internal marks</b>	<b>Total</b>
ZO ICP 01- Biochemistry	2	75	25	100
ZOICP-02-Biophysics Biostatistics and Systematics	2	75	25	100
Total	4	150	50	200

ZO - Zoology  
I - I 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 H<sub>2</sub>O<sub>2</sub>), 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 ( $\alpha$ -helix –parallel & antiparallel and  $\beta$  pleated sheet), random coil conformation, Tertiary structure, Quaternary 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
- 4.8. Nomenclature of fatty acids – Geneva system

#### 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
3. Mechanism of enzyme action: Formation of enzyme substrate complex- Gibbs free energy of activation; Michaelis-Menten theory, Fischer's template theory and Koshland's induced fit theory. Electrostatic, hydrogen and Van der Waal's bonds in Enzyme-substrate complex.
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 conenzymes
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:**

1. Lehninger, A.L. (2008), Principles of Biochemistry, V<sup>th</sup> edition, CBS publishers and distributors, Delhi
2. Robert Harper's Biochemistry, (1996) 24<sup>th</sup> Edition, K. Murray, Daryl K. Granner, Peter, A. Mayes and Victor, W. Rodwell Appleton and Lange, Prentice Hall of India Private limited, New Delhi,
3. Lubert Stayer,(latest) Biochemistry, II edition, W.H. Freeman & Co. NY
4. Oser, B.L, (1965) Hawk's Physiological Biochemistry, Mc Graw Hill Book Co.
5. Eric E. Conn, Paul K. Stumpf, George Bruening, Roy H. Doi, (latest ) Outlines of Biochemistry, V<sup>th</sup> edition, John Wiley & Sons, Inc, (2007).
6. Deb, A.C.(2004) Fundamentals of biochemistry, New Central Book Agency (P) Ltd.
7. Keith Wilson and John Walker (2008) Principles and techniques of Biochemistry and Molecular biology – 6<sup>th</sup> edn, Cambridge University Press
8. Voet, D. and Voet, J.G. (2004), Biochemistry, John Wiley & Sons
9. Zubay, G (latest .), Biochemistry, Maxwell Macmillan International
10. Devlin,T.M. (2006), A Text of Biochemistry with clinical correlations, John Wiley & Sons

## **Section-A-Biophysics**

**(55 Hours)**

### **1- Matter and mechanics of cells**

**3 hr**

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

### **2- –Diffusion and Osmosis**

**5 hr**

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 –P<sup>H</sup>**

**2 hr**

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**

**5 hr**

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**

**9 hr**

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 Immuno-electrophoresis.

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 2 hr**

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

- 6.1. 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**

1. Ackerman, E. (1962).Biophysical Science. Prentice Hall Inc.
2. Alonso, A and Arrondo, J.L.R (2006) - Advanced techniques in Biophysics, Springer
3. Alok Srivastava and Ipsita Roy-(2009)-Bio-Nano- Geo Sciences- The future challenge-Ane Books Ltd.
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5. Bengt Nolting ( 2006), Methods in modern Biophysics, Springer.
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## **BIOSTATISTICS**

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5. Rostogi, V. B. (2009) Fundamentals of Biostatistics. Ane's Students Edition New Delhi
6. Stephen W,Looney(2008) Methods in Molecular Biology-Biostatistical Methods- Springer International Edition
7. Zar, J.H.(2003) Biostatistical Analysis - Fourth edition. Pearson Education. Delhi.

## **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** **7 Hr**
- 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** **4 Hr**
- 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** **5 Hr**
- 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** **4 Hr**
- 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** **3 Hr**
- 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 **2 Hr**
- 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**

**4 Hr**

- 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.
- 3. Sexual selection; Intrasexual and intersexual selection-[secondary sex characteristics-sexy son hypothesis](#)-good genes hypothesis.

**Unit 2. The Mechanisms:**

10 hr

- 1. Population genetics – populations, gene pool, gene frequency; Hardy-Weinberg law,, founder principle, bottleneck effect and genetic drift as factors in speciation.
- 2. Isolating mechanisms-*Prezygotic* and *Postzygotic isolating mechanisms*; speciation-allopatric-peripatric-parapatric-heteropatric- sympatric speciation;ecotypes.
- 3. Co-evolution; Microevolution, Macroevolution. Convergent (homoplasmy) –divergent-parallel evolution.

**Unit 3. Tempo of evolution**

8 hr

- 1. Gradualism Vs punctuated equilibrium.
- 2. Anagenesis Vs Cladogenesis.

**Unit 4. Molecular evolution :**

10 hr

1. Neutral theory of molecular evolution; molecular divergence; molecular drive.
2. Molecular clocks- genetic equidistance- human mitochondrial molecular clock.
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**

10 hr

1. Biochemical evolution- Collapse of Orthogenesis.
2. Stages in primate evolution including Homo: dry and wet nosed primates, [prosimians](#) and [simians-humans and the African apes](#) - [African origin for modern humans](#). Y-chromosomal Adam- mitochondrial Eve.
3. Communication, speech, language and self awareness in primates.

**References:**

**A. Systematics:**

1. David, M. H, Craig Moritz and Barbara K. M. (1996) Molecular Systematics. Sinauer Associates, Inc.
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**B: Evolution**

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## 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-Toluidine 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)
7. Identification of unknown carbohydrates, protein and non-protein nitrogenous substances from a given solution.
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:**

1. Plummer David, T.( latest) An introduction to practical biochemistry –Tata Mc Graw-Hill, New Delhi
2. Oser, B.L., (1965) Hawk's Physiological Biochemistry, McGraw Hill Book Co.
3. Sadasivan, S. and Manickam, A., (2005), Biochemical methods, New Age International, New Delhi.
4. Keith Wilson and John Walker (2008), Principles and techniques of Biochemistry and Molecular biology – 6<sup>th</sup> edn, Cambridge University Press
5. Jayaraman, J.(latest.) Laboratory Manual in Biochemistry, Wiley Eastern Ltd.

**ZOICP02-Biophysics, Biostatistics and Systematics**

**Biophysics**

1. pH meter and measurement of pH
2. Paper chromatography of amino acids, mixtures, identification of unknown amino acids and sugars.
3. Gel filtration chromatography (Separation of starch from glucose)
4. Thin layer chromatography of amino acids and sugars.
5. Serum electrophoresis.
7. Determination of absorption coefficient and concentration of unknown solutions by calibration curve using a coloured solution.
8. Absorption spectrum of a coloured solution ( $\text{KMnO}_4$ )
9. 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.
4. Computation of measures of central dispersion anthropometric data of school children.
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**

John T (2002) Practical statistics for environmental and biological scientists john wiley and sons.

**UNIVERSITY OF CALICUT**

**(Abstract)**

Syllabus of M.Sc Zoology (II semester) of affiliated colleges under Credit Semester System (CUCSS-PG-2010) – implemented with effect from 2010 admission – Orders issued.

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**GENERAL & ACADEMIC BRANCH-IV ‘J’ SECTION**

No. GA IV/J1/4279/2010

Dated, Calicut University PO, 11.01.2011

- 
- Read: 1. U.O.No.GAIV/J1/1373/08 dated 23.07.2010.  
2. U.O.No.GAIV/J1/4279/10 dated 26.07.2010.  
3. Item 1 and 2 of the minutes of the meeting of the Board of Studies in Zoology (PG) of 04.01.2011.  
4. Orders of the Vice-Chancellor, in the file of even no.on 10.01.2011.

**ORDER**

As per paper read as (1) above, Credit Semester System at PG level in affiliated colleges (CUCSS-PG-2010) has been implemented from the academic year 2010 onwards.

The Scheme and syllabus of I semester of M.Sc Zoology of affiliated colleges under Credit Semester System was implemented with effect from 2010 admission vide paper read as (2) above.

The Board of Studies at its meeting vide paper read as (3) above, discussed, in detail the syllabus for the 2<sup>nd</sup> semester PG (CSS) in Zoology, approved the same and prepared model question papers for the theory courses of 2<sup>nd</sup> semester.

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

Sanction has therefore been accorded to implement the syllabus and model question papers for the II semester M.Sc Zoology programme of affiliated colleges under Credit Semester System with effect from 2010 admission.

Orders are issued accordingly. Syllabus and model question papers appended.

**Sd/-**

**DEPUTY REGISTRAR(G&A IV)  
For 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/System Administrator  
(with a request to upload in the University website)/Enquiry/  
Information centres/DR III (Exams)/EG-I/DR PG/Tabulation section/EX section/  
GAI ‘F’ ‘G’ sections/GAII/GAIII/DDLFA/SF/FC

Forwarded/By Order

**Sd/-**

**SECTION OFFICER**

**UNIVERSITY OF CALICUT**  
**CURRICULUM AND SYLLABI FOR M.Sc. ZOOLOGY PROGRAMME**  
**(CREDIT SEMESTER SYSTEM)**

**SECOND SEMESTER**

<b>CODE NO. AND TITLE OF THE COURSE</b>	<b>CREDITS</b>	<b>EXTERNAL WEIGHTAGE</b>	<b>INTERNAL WEIGHTAGE</b>
ZO 2 CT 04 - PHYSIOLOGY	4	36	5
ZO 2 CT 05 – ECOLOGY & ETHOLOGY	4	36	5
ZO 2 CT 06 – DEVELOPMENTAL BIOLOGY & ENDOCRINOLOGY	4	36	5
ZO 2 CP 01 – BIOCHEMISTRY, BIOPHYSICS & BIostatISTICS	4	24	5
ZO 2 CP 02 – PHYSIOLOGY, DEVELOPMENTAL BIOLOGY & ENDOCRINOLOGY	4	24	5
ZO 2 CP 03 – SYSTEMATICS, EVOLUTION, ECOLOGY & ETHOLOGY	4	24	5

1. **Nutrition:** **12hrs**
  - 1.1. Constituents of normal diet and their daily requirements
  - 1.2. Physiological calorie value of food stuffs
  - 1.3. Antioxidant nutrients
  - 1.4. Digestion of carbohydrate, protein & lipids– Brief note on the role of salivary glands, liver, pancreas and intestinal glands in digestion
  - 1.5. Absorption of carbohydrates, lipids, amino acids, water, electrolytes, vitamins and minerals in GIT
  - 1.6. Movements of GI tract: deglutition, gastric motility and emptying, intestinal motility and defecation
  - 1.7. The role of hormones and neurotransmitters in the control of gastrointestinal motility
  - 1.8. Energy balance and obesity-causes and consequences
  - 1.9. BMR and its significance (Ref. 4)
  
2. **Excretory system:** **12hrs**
  - 2.1 Introduction: Brief description of different types of excretory organs in different animal groups
  - 2.2 Functional anatomy of mammalian kidney, nephron and juxtaglomerular apparatus - structure, parts and function
  - 2.3 Urine formation (glomerular filtration, tubular reabsorption and tubular secretion)
  - 2.4 Regulation of water balance -Mechanism of concentration of urine – Counter current system (counter current multiplier and counter current exchanger)
  - 2.5 Renal regulation of acid base balance
  - 2.6 Composition (normal & abnormal) and characteristics of urine
  - 2.7 Physiology of micturition
  - 2.8 Renal clearance – definition, concept and significance; clearance value of urea, creatinine, phosphate, potassium, chloride and sodium
  
3. **Respiratory system:** **13hrs**
  - 3.1 Introduction: Brief description of major respiratory organs (tracheal system, book lungs, gills and ctenidia)
  - 3.2 Physiological anatomy and histology of respiratory passage and lungs
  - 3.3 Mechanism of pulmonary ventilation (inspiration & expiration) -
  - 3.4 Alveolar ventilation, dead space and its effect on alveolar ventilation
  - 3.5 Role of surfactant in alveolar expansion
  - 3.6 Pulmonary volumes and capacities – definition & normal values (tidal volume, inspiratory reserve volume, expiratory reserve volume, residual volume, functional residual capacity, inspiratory capacity, vital capacity, total lung capacity)
  - 3.7 Exchange of gases
  - 3.8 Transport of gases
    - 3.8.1 Transport of oxygen and carbon dioxide
    - 3.8.2 Oxygen dissociation curve – factors affecting binding of oxygen to haemoglobin ( $PO_2$ ,  $PCO_2$ , CO, pH, body temperature, diphosphoglyceric acid level, faetal haemoglobin and also myoglobin)
  - 3.9 Neural and chemical regulation of respiration

#### **4. Nervous system**

**18hrs**

- 4.1. Introduction: Basic details of neurons and action potential
- 4.2. Gross neuroanatomy of the brain (histology & neural pathway not expected unless otherwise specified)
  - 4.2.1. Cerebral cortex- Motor cortex: mention functional areas (including specialized areas) and their motor functions
  - 4.2.2. Cerebral cortex- Association areas, their sub areas and their functions; Wernicke's area and its intellectual function
  - 4.2.3. Memory – definition, types of memory (positive and negative memory), brief note on the mechanism of short term, intermediate long term and long term memory, consolidation of memory
  - 4.2.4. Brain stem – List the components (medulla, pons, mesencephalon, reticular and vestibular nuclei) and functions
  - 4.2.5. Cerebellum- mention parts and functions
  - 4.2.6. Basal ganglia – mention components and functions
  - 4.2.7. Limbic system; structure and functions (emotion and motivation)
- 4.3. Gross neuroanatomy of the spinal cord
  - 4.3.1. Spinal cord - structural organization
  - 4.3.2. Reflex action – reflex arc, muscle spindle, Golgi tendon organ
  - 4.3.3. Types of reflexes- monosynaptic reflex (e.g., Muscle stretch reflex, negative stretch reflex), polysynaptic reflex (e.g., withdrawal reflex)
- 4.4. Diseased states of brain – brief description of epilepsy, depression, schizophrenia, Alzheimer's disease, Senile dementia & Parkinson's disease

#### **5. Special senses**

**13hrs**

##### **5.1. Vision:**

- 5.1.1. Structure of eyeball
- 5.1.2. Fluid systems of the eye
- 5.1.3. Layers of Retina and photoreceptors (rods & cones)
- 5.1.4. Brief notes on the neuronal cell types and neural circuitry of the retina and visual pathways from retina to visual cortex
- 5.1.5. Image formation
  - 5.1.5.1. Formation of image on the retina
  - 5.1.5.2. A brief general account of electrophysiology of vision
  - 5.1.5.3. Photochemistry of vision & colour vision

##### **5.2. Taste:**

- 5.2.1. Primary sensations of taste (agents and site of sensation)
- 5.2.2. Taste buds (location, structure, receptors and nerve supply)
- 5.2.3. Physiology of taste (receptor stimulation, generation of nerve impulse by taste buds and its transmission to CNS)

##### **5.3. Smell:**

- 5.3.1. Olfactory membrane and receptor cells
- 5.3.2. Physiology of olfaction (stimulation of olfactory cells and transmission of smell signals to CNS)

#### **6. Tactile response: (brief note)**

**4hrs**

- 6.1.1. Mechanoreceptors and their stimulation
- 6.1.2. Pain receptors and their stimulation
- 6.1.3. Thermal receptors and their stimulation

## **7. Cardiovascular system**

**8hrs**

- 7.1. Introduction: Brief description of vertebrate hearts
- 7.2. Structural organization of myogenic heart (in human beings)
- 7.3. Physiological anatomy of cardiac muscle – specialized tissue
- 7.4. Heart as a pump
- 7.5. Cardiac cycle
- 7.6. ECG – Principle and application
- 7.7. Neural and chemical regulation of heart function
- 7.8. Blood volume and blood pressure
- 7.9. Physiological anatomy of coronary blood flow, coronary blood flow and its control
- 7.10. Ischemic heart disease – mention causes and example

## **8. Lymphatic system**

**5hrs**

- 8.1. Lymph channels of the body
- 8.2. Composition and formation of lymph
- 8.3. Functions of lymph and lymphatic system including role of in controlling interstitial fluid protein concentration, interstitial fluid volume and interstitial fluid pressure

## **9. Environmental physiology**

**5hrs**

- 9.1. Thermoregulation
  - 9.1.1. Comfort zone, normal body temperatures (oral, skin & core), heat production & heat loss, factors affecting body temperature, lethal temperature
  - 9.1.2. Temperature regulating mechanisms (hot & cold), mention the role of hypothalamus, thyroid and adrenal glands
  - 9.1.3. Acclimatization

## **REFERENCES**

1. Arthur C.Guyton & John E. Hall (2003): Textbook of Medical Physiology, Saunders (An imprint of Elsevier).
2. William F.Ganong (1999): Review of Medical Physiology, Lange Medical Publications (Appleton & Lange).
3. Jain A.K. (2009): Text Book of Physiology (Vol. I & II), Avichal Publishing Company, New Delhi.
4. Deb, A.C. (2002): Fundamentals of Biochemistry (2002): New Central Book Agency (P) LTD, India.
5. Prosser & Brown, Comparative Animal Physiology
6. William S. Hoar, Comparative Animal Physiology
- 7 Kunt-Schmidt-Nielsen: Animal Physiology, Adaptation and Environment.
- 8 Jensen D. (1976): Principles of Physiology, Appleton Century Crafts, N.Y.

- 9 Lonco, G.N. (1993): *Physiological Animal Ecology*. Longman Scientific and Technical, Essex.
- 10 Caer BL-Haw's *Physiological chemistry*, 14<sup>th</sup> Edn. Tata McGraw Hill Pub. Co. New Delhi.
- 11 Shepherd, G.M: *Neurobiology-Principles of Neural Science*, E. Kandel & P. Schwartz.
- 12 Campbell *et al.* (1984): *Clinical Physiology*, 5<sup>th</sup> Edn. Blackwall Scientific Publications, Oxford.
- 13 Pragnelli, C.V & Farhi, L.E. (1989): *Physiological function of special Environment*-Springer verlag, N.Y.
- 14 Davie IV & Lewid S.M.- *Practical Haematology*, 6<sup>th</sup> Edn. Churchill, Livingstone, Edinburgh.

## **SECOND SEMESTER MSc ZOOLOGY (CSS) DEGREE PROGRAMME**

### **ZO- 2- CT- 05 - ECOLOGY AND ETHOLOGY**

**(90 Hours)**

#### **Part-A-ECOLOGY**

**65 hrs**

#### **1- Natural history of Indian subcontinent:**

3 hrs

- 1.1. Major habitat types of the subcontinent
- 1.2. Geographic origins and migrations of species
- 1.3. Seasonality of the subcontinent

#### **2-Habitat and niche –**

3 hrs

- 2.1. Concept of habitat and niche
- 2.2. Niche width and overlap
- 2.3. Fundamental and realized niche
- 2.4. Resource partitioning
- 2.5. Character displacement

#### **3- Ecosystem-**

9 hrs

- 3.1. Structure and function
- 3.2. Ecosystem energetics
- 3.3. Primary production,
- 3.4. Energy flow models,
- 3.5. Mineral cycling (CNP)
- 3.6. Trophic levels, Food chain, food web and secondary production.
- 3.7. Decomposers and detritivores.
- 3.8. Structure and function of some Indian ecosystems- terrestrial- major forest types in India with their features, Grassland, desert, fresh water, marine, coral reef, estuarine, wetland and mangrove ecosystems.

#### **4 -Population Ecology-**

7 hrs

- 4.1. Characteristics of a population
  - 4.2. Methods of estimating population density of animals, ranging patterns through direct, indirect and remote observations.
  - 4.3. Sampling methods in the study of behaviour, habitat characterization.
  - 4.4. Ground and remote sensing methods.
  - 4.5. Population growth curves, Life tables, survivorship curves, population regulation, Life history strategies, r and k selection, Demes and dispersal, interdemec extinctions, age structure of populations.
  - 4.6. Growth and regulation of human population.
- 5 -Species interactions-** 6 hrs
- 5.1. Types of interactions, interspecific competition
  - 5.2 Herbivory, Carnivory, Pollination, Symbiosis;-mutualism, commensalisms and proto-cooperation
- 6 - Community Ecology-** 7 hrs
- 6.1. Nature of communities
  - 6.2. Characteristics of a biotic community
  - 6.3. Species diversity and its measurements, Alpha diversity: Simpson's Diversity Index -Shannon index -Fisher's Alpha – Rarefaction; Beta diversity –[Sorensen's similarity index](#)-[Whittaker's measure](#); Gamma diversity –
  - 6.4. Latitudinal gradients in diversity,
  - 6.5. Edges and ecotones.
- 7 -Ecological succession-** 4 hrs
- 7.1. Types, mechanisms
  - 7.2. Changes involved in succession
  - 7.3. Concept of climax
- 8 -Biogeography-** 6 hrs
- 8.1. Major terrestrial biomes:
    - (a) Tropical rain Forest (b) Grassland (c) Desert (d) Chaparral (e) Temperate deciduous Forest
    - (f) Temperate boreal forest (g) Tundra (h) Savanna
- 9 -Theory of island biogeography-** 4 hrs
- 9.1. Theory – Influencing factors –
  - 9.2 Applications in conservation biology- species-area relationship -single large or several small (SLOSS) - development of habitat corridors-
- 10 -Biogeographical zones of India** 4hrs
- (a) Trans Himalayan zone; (b) Himalayan zone; (c) Desert zone; (d) Semiarid zone;
  - (e) Western Ghats zone; (f) Deccan plateau zone; (g) Gangetic plain zone;

(h) North east zone. (i) Coastal zone; (j) Islands present near the shore line.

### **11-Applied ecology-**

8 hrs

11.1. Environmental pollution (air, water, terrestrial and noise pollution - causes and consequences,

11.2. Global environmental change (global warming and ozone layer depletion)

11.3. Biodiversity with special reference to India-status monitoring and documentation, major drivers of biodiversity change

11.4. Biodiversity management approaches- Exsitu and insitu conservation strategies.

### **12- Conservation Biology-**

12.1. Principles of conservation

12.2. Major approaches to management,

12.3. Indian case studies on conservation & management strategy (concepts of project tiger, Biosphere reserves).

### **REFERENCES**

1. Ahluwalia and sunitha malhorta-Environmental Science-Ane Books Pvt.Ltd
2. Allan Beebi and Anne Maria Brennan-2006- First Ecology-Ecological principles and environmental issues-Oxford university press
3. Archbold, O. W. *Ecology of World Vegetation*. New York, NY: Chapman and Hall, 1995.
4. Begon,Harper,Townsend- Ecology-Individuals,Populations,and communities-Blackwell Science,Second edition
5. Brewer Richard-The Science of Ecology-Saunders college publishing
6. Chapman J.L and Reiss.M.J- Ecology principles and applications-Cambridge law price editions
7. Charles J .Krebs- Ecology .The experimental analysis of distribution and abundance
8. David Quammen. 1997. *The Song of the Dodo: Island Biogeography in an Age of Extinctions*. Scribner. ISBN 0-684-82712-3
9. Dick Neal- Introduction to population Biology- Cambridge University Press
10. Eugene P.Odum- Fundamentals of Ecology- W.B.Saunders Company
11. MacArthur, R. H. and Wilson, E. O. 1967. *The Theory of Island Biogeography*. Princeton, N.J.: Princeton University Press.
12. Magurran, A. E. 2004. *Measuring biological diversity*. Oxford: Blackwell Publishing. ISBN 0-632-05633-9
13. May and Mc Lean- Theoretical Ecology principles and applications-Oxford university press
14. Whittaker, Robert H. *Communities and Ecosystems* New York: MacMillan Publishing Company, Inc., 1975.

### **Part B. ETHOLOGY**

25 hrs

Unit 1. Introduction	
1.1 Ethology as different from the other schools studying animal behaviour like behaviourism.	1hr
1.2 Behaviour as a reaction to stimuli - sign stimuli, social releasers, Ethograms , super normal stimuli, stimulus filtering.	2hrs
Unit 2. Motivating factors	3hrs
2.1 General factors in motivation; Studies of motivation in guppies;	
2.2 mating systems-parental investment and reproductive success	
Unit 3. Conflict behaviour- stress-displacement activities- Ritualization.	2hrs
Unit 4. Instinctive behaviour & reflex action,	3hrs
neural basis of sleep and arousal --Learning.	
Unit 5. Adaptiveness of behaviour	3hrs
JP Scotts categories of behaviour.	
Unit 6. External stimulus - circadian rhythms	3hrs -
6.1- Proximate and Ultimate factors	6.2-Types of
orientation-reafference theory of Von Holst & Mittel Stadt.	
6.3-Navigation & migration	
Unit 7. Parental care -Social behaviour of termites & Primates-	4hrs
Unit 8. Evolution of behaviour-Altruism, Kin selection, inclusive fitness,	4hrs
selfish gene theory, cultural transmission of behaviour; domestication and behavioural changes.	

## References

1. Chris Barnard (2003) : Animal Behaviour: Mechanism, Development, Function and Evolution, Publisher: Pearson Education.
2. David McFarland (1999) : Animal Behaviour: Psychobiology, Ethology and Evolution, 3rd Edition. Publisher: Pearson Education.
3. David Mcfarland (2006) A Dictionary of Animal Behaviour. Publisher: Oxford University Press.
4. Goodenough, J; McGuire B. and Robert, W. (1993) Perspectives on Animal Behaviour. John Wiley and Sons, Lond.
5. Graham Scott (2004) Essential Animal Behaviour. Publisher: Wiley-Blackwell
6. Lenher, P. (1996) Handbook of Ethological methods. Cambridge Univ.Press, Lond.
7. Manning, A. (1967) An Introduction to Animal Behaviour. Edward Arnold Pub., London.
8. Manning, A. and Dwakins, M.S. (1995) An Introduction to Animal Behaviour. Cambridge Univ. Press, Lond.

9. Scott, J.P. (1972) *Animal Behaviour*. Publisher: Univ of Chicago

**SECOND SEMESTER M. Sc.ZOOLOGY(CSS) DEGREE PROGRAMME**  
**ZO 2 CT 06 - DEVELOPMENTAL BIOLOGY & ENDOCRINOLOGY**  
**(90 Hours)**

**Part- A - DEVELOPMENTAL BIOLOGY**

**(55 hrs)**

**Unit 1. Introduction: Basic concepts of development**

**(7hrs)**

- 1.1 Potency
- 1.2 Commitment
- 1.3 Specification - autonomous, conditional
- 1.4 Induction
- 1.5 Competence
- 1.6 Determination and differentiation
- 1.7. Morphogenetic gradients

**Unit 2. Gametogenesis, fertilization and early development:**

**(10hrs)**

- 2.1 Production of gametes
- 2.2 Cell surface molecules in sperm-egg recognition in animals
- 2.3 Zygote formation
- 2.4 Cleavage and blastula formation
- 2.5 Embryonic fields
- 2.6 Gastrulation and formation of germ layers in amphibia

**Unit 3. Embryogenesis and Organogenesis**

**(10hrs)**

- 3.1 Axis formation in amphibians - primary embryonic induction
- 3.2 Anterior posterior patterning in Amphibians - Hox code hypothesis
- 3.3 Anterior posterior patterning in *Drosophila* - gap genes, bicoid gradient, segmentation genes, pair rule genes, homeotic selector genes, realistor genes
- 3.4 Dorsoventral patterning and Left right patterning - dorsal protein gradient
- 3.6 Limb development in chick
- 3.7 Insect wings and legs
- 3.8 Vulva formation in *Caenorhabditis elegans*

**Unit 4. Cellular and Molecular basis of development:**

**(10hrs)**

- 4.1 Cellular interactions during development  
Epithelial - mesenchymal interactions, paracrine factors, RTK pathway, cell death pathways
- 4.2 Cellular interactions concerned in fertilization
- 4.3 Cellular changes during blastulation and gastrulation
- 4.4 Cellular interactions in organogenesis
- 4.5 Molecular basis of cellular differentiation - cadherins

**Unit 5. Genetic basis of development:**

**(7hrs)**

- 5.1 Differential gene expression  
Promoters, transcription factors, silencers, DNA methylation, insulators, dosage compensation, differential RNA processing
- 5.2 Models of cell differentiation
- 5.3 Reversibility of patterns of gene activity

**Unit 6. Metamorphosis, Regeneration and Aging:**

**(7hrs)**

- 6.1 Metamorphosis in Amphibians and Insects and their hormonal control
- 6.2 Types of regeneration - Super, Hetero, Epimorphic, Morphallactic and Compensatory regeneration, Histological process during regeneration
- 6.3 Ageing – cellular and extra cellular aging, Causes - Wear and tear, Oxidative damage, Mitochondrial genome damage, genetically programmed aging

**Unit 8. Environmental regulation of animal development: (4hrs)**

- 8.1 Environmental regulation of normal development – types of polyphenism  
Sex determination in *Bonellia*; primary and secondary sex determination, environmental sex determination
- 8.2 Environmental disruptions of normal development (Teratogenesis)  
Teratogenic agents - Alcohol, retinoic acid, bisphenol, heavy metals, pathogen
- 8.3 Environmental oestrogens

**References – Developmental biology**

- 1. Balinsky, B. I. An introduction to Embryology.
- 2. Berril, N. J. Developmental biology.
- 3. Deuchar, E. M. Cellular interactions in animal development.
- 4. Gilbert, S. F. Developmental Biology. Sinauer Associate, 8<sup>th</sup> edition
- 5. Hodge, R. Developmental Biology: From a Cell to an Organism.
- 6. Hopper, A. S. & N. H. Hart. Foundation of animal development.
- 7. Lash, J & J. R. Whittaker. Concepts of development.
- 8. Muller, W. A. Developmental biology. Springer.
- 9. Snustad, D. P., J. M. Simmons & J. B. Jenkins. Principles of Genetics.  
Wolpert, L. Principles of Development. Oxford university press, 2<sup>nd</sup> edition

**Part B Endocrinology (35 Hours)**

**Unit 1. Endocrine glands and their Hormones (Brief account)**

- 1.1. Hormone secreting tissues –skin, liver, kidney, heart.
- 1.2. General classes of chemical messengers- Peptide, thyroid, steroid hormones, neurotransmitters and pheromones
- 1.3. Physical characteristics of hormones – latency, post-secretory modification and half-life
- 1.4. Synthesis and delivery of hormones- storage, secretion and transportation.
- 1.5. Physiological roles of hormones.
- 1.6. Control of hormone secretion. (3 Hours)

**Unit 2. General mechanisms of Hormonal action**

- 2.1. Cell signalling
- 2.2. Receptors and transducers; types of receptors, regulation of receptor number, receptor activation
- 2.3. Second messengers of hormone action, receptor signal transduction
- 2.4. Eicosanoids and hormone action (5 Hours)

**Unit 3. Anatomy of endocrine glands; structure, physiological functions, and control of secretion of their hormones and pathophysiology.**

- 3.1. Hypothalamus
- 3.2. Hypophysis
- 3.3. Thyroid
- 3.4. Parathyroid
- 3.5. Adrenal
- 3.6. Pancreas (15hours)

**Unit 4. Hormones and male reproductive physiology**

- 4.1. Synthesis, chemistry, and metabolism of androgens
- 4.2. Endocrine control of testicular function

- 4.3. Physiological roles of androgens and estrogens  
4.4. Pathophysiology (3 Hours)

**Unit 5. Hormones and female reproductive physiology**

- 5.1. Synthesis, chemistry, and metabolism of Ovarian steroid hormones  
5.2. Physiological roles of Ovarian steroid hormones  
5.3. Hormonal regulation of female monthly rhythm  
5.4. Hormonal factors in pregnancy, parturition and lactation (6 Hours)

**Unit 6. Neurohormones**

- 6.1. Gases as neural messengers  
6.2. Endorphins- physiological roles, mechanism of action and pathophysiology  
6.3. Brain hormones and behaviour  
6.4. Neuroendocrine pathophysiology (3 Hours)

**References - Endocrinology**

1. Bentley, P. J. Comparative vertebrate endocrinology
2. Bern, H. A. Text book of comparative endocrinology
3. Bolander, F. F. 2006. *Molecular endocrinology*, Academic press, New Delhi.
4. Ganong, W. F. 2005. *Review of medical physiology*, Mc Graw Hill, New Delhi.
5. Hadley, M. E. 2000. *Endocrinology*, Pearson education, Inc., New Delhi.
6. Harris, G. W. 1995. *Neural control of the pituitary gland*, Edward Arnold, London.
7. Hazelwood, R. 1990. *The endocrine pancreas*, EnglewoodCliffs, Prentice Hall, NJ.
8. Horrbins, D. F. Essentials of Biochemistry, endocrinology and nutrition.
9. Prakash Lohr. Hormones and human health
10. Nelson R. J. Introduction to behavioural endocrinology
11. Norris D. O. 2005. Vertebrate endocrinology.
12. Vinzen, G. Et al, 1992. Adrenal cortical steroid hormones, EnglewoodCliffs, Prentice Hall, NJ.
- 13.

**SECOND SEMESTER**

**PRACTICALS**

**ZO 2 CP 02 – PHYSIOLOGY**

1. Kymograph: working principle and applications
2. Effect of different substrate concentration, pH and temperature on human salivary amylase activity. Colorimetric method, plot graphs.
3. Qualitative demonstration of digestive enzymes in cockroach – amylases, lipases, proteases, invertases and controls.
4. Digestion in a vertebrate and calculation of peptic value.
5. Influence of temperature and pH on the ciliary activity in fresh water mussel/mytilus using silver foil. Plot graphs
6. Determination of respiratory quotient – estimation of O<sub>2</sub> consumption by an aquatic animal.
7. Determination of the rate of salt loss and gain in an aquatic animal (fish or crab).
8. Estimation of urea and ammonia in human Urine. Titrimetric method.
9. Rate of glucose – absorption – calculation of Cori coefficient
10. Estimation of haemoglobin of Fish/Man – Sahli's method.
11. Blood volume determination by dye dilution method (Vertebrate)

12. Blood: clotting time, bleeding time, rouleaux formation, preparation of haemin crystals.
13. Enumeration of RBCs in human blood.
14. Determination of lactic acid in muscle tissue.
15. Differential count of human WBCs
16. Haematocrit and ESR of human blood.
17. WBC total count

## References

1. Oser B. L., Hawk's Physiological chemistry, McGraw Hill Book Company
2. Hill R.W., Wyse G.A. (1989), Animal Physiology 2<sup>nd</sup> edition. Harper Collins Publishers
3. Schmidt-Nielsen, K. (1997), Animal Physiology, adaptation and environment, Cambridge university Press

## ZO 2 CP 02 - Developmental Biology & Endocrinology

1. Induced ovulation in fish.
2. Identification of different developmental stages of frog – Egg, blastula, gastrula, neurula, tadpole external gill and internal gill.
3. Vital staining of chick embryo.
4. Preparation of temporary/permanent whole mounts of chick embryo of the following stages to study the extent of development of the circulatory and nervous system in detail in 20, 24, 33, 48 & 72 hours of incubation.
5. Tracing the development of stained parts. Candling, identification of blastoderm, window preparation – staining using stained agar strips and following the development.
6. Preparation of stained temporary/permanent mounts of larvae.
7. Experimental analysis of insect development - *Drosophila*.
8. Regeneration studies in frog tadpole tail.
9. Demonstration of sperm of rat/calotes/frog.
10. Morphological and histological studies of different types of placenta in mammals.
11. Hormones in Amphibian metamorphosis - Thyroxine/Iodine solution.
12. Culture of early chick embryo *in vitro*.
13. Study of invertebrate/vertebrate larval forms (minimum 7).
14. Observation of the mid-sagittal sections and cross sections of the chick embryo through head/heart region of 24, 48 & 56 hours of incubation.

### Reference for Practicals

1. Adamstone, E. B. & Waldo Shumway (1954). 3 Ed. A Laboratory Manual of Vertebrate Embryology. John Wiley & Sons, Inc.
2. Roberts Rugh (1961). Laboratory Manual of Vertebrate Embryology. Indian Ed., Allied Pacific Pvt. Ltd.
3. Browden, L. W., Erikson, C. A., & Jeffery, R. W. (1991). Developmental Biology. 3 Ed., Saunders College Publi., Philadelphia.
4. Zarrow, M. X., Yochim, J. M., Mc Carthy, T. L. & Sanborn, R. C. (19964). Experimental Endocrinology: A source book of basic Techniques. Academic Press, New York.
5. Thomas, J. A. (1996). Endocrine methods. Academic press, New York.
6. Humason, G. L. (1962). Animal Tissue techniques. W. H. Freeman & Co.

## **Ecology Practicals**

- 1-Identification, qualitative and quantitative estimation of marine plankton
- 2- Estimation of BOD in polluted water sample.
- 3-Estimation of COD in water sample
- 4-Estimation of salinity, phosphates, chlorides and silicates and nitrates in water samples
- 5-Separation and identification of soil arthropods using Berlese funnel.
- 6-Determination of moisture content of soil sample.
- 7- Determination of water holding capacity of soil sample.
- 8-Testing the transparency of water using Secchi disc
- 9- Determination of primary productivity in pond water using light and dark bottle.
- 10-Study of termitorium / ant colony
- 11-Principle and application of the following instruments-GPS, Thermo hygrometer, Altimeter, Air samplers, soil samplers, Berlese funnel, Lux meter, anemometer, Rain gauge, Plankton net, Plankton counting chamber, Weather balloon, Secchi disc etc ( at least six items)
- 12- **FIELD STUDY**-A study tour of at least five days duration (need not be at a stretch) to observe the ecology and behaviour of animals should be under taken. The places of visit include inter tidal region, fresh water bodies, lakes, rivers, hill streams ,wetlands, mangroves, forests grasslands, drinking water treatment plants, and sewage treatment plants.

A report of the field study is to be included in the practical record to be submitted at the time of examination.

### **Reference for Practicals**

- 1- NC Aerry 2010– A manual of environmental analysis . Ane books private limited.

## **Ethology Practicals**

- 1-Studying and reporting the behaviour and ecology of animals in selected fields ( Social spider/Jungle babbler/white headed babbler or Bonnet Macaques)
- 2-Study of circadian rhythm
- 3-Chemo reception and behaviour in flies –finding the tarsal threshold for sugar
- 4- Behavioural reaction to moisture and light using isopods.

## **References:**

1. Goodenough, J; McGuire B. and Robert, W. (1993) Perspectives on Animal Behaviour. John Wiley and Sons, Lond.
2. Manning, A. (1967) An Introduction to Animal Behaviour. Edward Arnold Pub., London.

## MODEL QUESTION PAPER

### SECOND SEMESTER M. Sc. ZOOLOGY (CSS) DEGREE EXAMINATION ZO 2 CT 04: PHYSIOLOGY

Time: Three hours

Maximum weightage: 36  
(Weightage – 1)

I. Answer **all fourteen** questions

1. What is physiological calorie value? Give the calorie value of carbohydrate, protein and lipid.
2. Define and give the normal values of tidal volume and inspiratory reserve volume.
3. Name 4 antioxidant nutrients
4. List the different layers of retina.
5. Mention the association areas of cerebral cortex.
6. What are surfactants? Mention their function.
7. Define renal clearance. Give the clearance value of urea, creatinine and phosphate
8. Write short note on dead space.
9. Give the methods of transportation of oxygen in blood
10. Chloride shift
11. What is organ of Corti? What is its function?
12. Comment on Wernicke's area.
13. Comment on intestinal motility
14. What is basal ganglia? What is its major function?

(14 x 1 = 14)

II. Answer any **seven** questions

(Weightage – 2)

15. What is BMR? What is its significance?
16. Enlist the normal and abnormal constituents of urine.
17. Distinguish between slow wave sleep and REM sleep.
18. Write notes on Parkinson's disease
19. Write the principle and applications of ECG
20. What are the major causes of obesity?
21. Give an account of factors causing shift of oxygen dissociation curve.
22. What is memory? Explain the physiology of short term and long term memory.
23. Composition of lymph
24. Give short note on pain receptors and their stimulation

(7 x 2 = 14)

III. Answer any two questions:

(weightage-4)

25. Describe the mechanism of pulmonary ventilation. Add a note on the neural and chemical regulation of respiration .
26. Describe the formation of urine.
27. Present an account of the functional areas of motor cortex and their motor functions.
28. Explain the taste buds and physiology of taste. (2x4=8)

### SECOND SEMESTER M.SC ZOOLOGY (CSS) DEGREE EXAMINATION

#### ZO 2 CT 05- ECOLOGY AND ETHOLOGY

Time: Three Hours

Weightage: 36

I. Short Answer type (10 questions from ecology and 4 from ethology)

**Number of questions to be answered:14**

**Weightage :1x14=14**

- 1-Describe any four characteristic features of population?
- 2-Explain the term ecological succession, types, sere and climax.
- 3-What is symbiosis, mention the types with examples
- 4-What is primary production, describe three important points.
- 5-what is decomposition, mention decomposers, detritivores with suitable examples.
- 6-Describe four features of grasslands.
- 7-Distinguish between lentic and lotic systems with examples.
- 8-Describe four major causes of water pollution.
- 9-What is carnivory, mention three important points.
- 10-What is meant by niche ,distinguish between fundamental and realized niche and niche width.
- 11- Explain Klinotaxis with example
- 12- Sign stimulus with examples
- 13- Describe Selfish gene theory,
- 14- Define Ethograms give a suitable example

**11-Short Essay type(Seven questions from Ecology and 3 from ethology)**

**Number of questions to be answered is seven out of ten. Weightage:7x2=14**

- 15- Describe the biogeographic zones of India
- 16-What are the aims and objectives of Project Tiger
- 17-Describe the mechanism of Ecological succession.
- 18-What is herbivory, mention plant defences against herbivory.
- 19-Describe ecotone and edge effect.
- 20-Explain the features of Savanna biome
- 21-Explain ex situ conservation strategies.
- 22-What is life table , mention its significance
- 23- Describe circadian rhythm
- 24- Explain ritualization.

**III-Essay type( Three questions from Ecology and one from Ethology)**

**No.of questions to be answered is two out of four.**

**Weightage: 2x4=8**

- 25- Write an essay on biotic divisions of the sea with its major fauna and adaptations.
- 26-What is biotic community,Explain its characteristics with examples.
- 27-Explain the term biodiversity,describe alpha,beta,and gamma diversity,and methods of measuring diversity
- 28-Describe motivation and importance of guppies in the study of motivation.

**SECOND SEMESTER M.SC ZOOLOGY (CSS) DEGREE EXAMINATION  
ZO 2 CT 06- DEVELOPMENTAL BIOLOGY AND ENDOCRINOLOGY**

**Time:Three Hours**

**Weightage:36**

**I. Short Answer type (9 questions from Developmental biology and 5 from Endocrinology)**

**Number of questions to be answered:14**

**Weightage :1x14=14**

1. Primary sex determination
2. Explain embryonic fields
3. Grey crescent?
4. RTK pathway
5. Morula
6. Induction
7. Realistor gene
8. DNA methylation

9. Epimorphic regeneration
10. Glucagon
11. ADH
12. Calcitonin
13. Pineal gland
14. Oxytocin

**II-Short Essay type (6 questions from Developmental biology and 4 from Endocrinology)**

**Number of questions to be answered is seven out of ten. Weightage: 7x2=14**

15. Describe the cellular interactions in organogenesis
16. Different types of regeneration
17. Differentiate between determination and differentiation
18. Hox code hypothesis
19. What is dorsoventral partitioning?
20. Explain cortical reaction
21. Explain the physiological role of ovarian steroid hormones.
22. What is endorphins? Explain its physiological role.
23. Explain the physical characteristics of hormones.
24. Hormonal factors in pregnancy.

**III-Essay type (3 questions from Developmental biology and 1 from Endocrinology)**

**No. of questions to be answered is two out of four.**

**Weightage: 2x4=8**

25. Write an essay on metamorphosis in Amphibians and their hormonal control
26. Explain limb development in chick
27. Explain different types of cleavages and blastulas
28. Give an account on adrenocortical hormones.