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# **CBCS syllabus**

## **for**

### **Post-graduate Courses**

## **SUBJECT: ZOOLOGY**

Submitted by  
University Department of Zoology  
T.M.Bhagalpur University  
Bhagalpur-812007

4213/4  
15/06/18

### **Revised by Subject Experts**

- (1) Prof U.S. Sinha, Retd. Professor, V.K.S. University, Ara**
- (2) Prof P.K.Khan, Dept. of Zoology, Patna University, Patna**
- (3) Dr. G.B. Chand, Dept. of Zoology, Patna University, Patna**

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15/06/18

Dated-14/06/2018

To  
His Excellency  
The Chancellor cum Governor  
Universities of Bihar, Patna

Sub: Submission of CBCS Syllabus of Zoology (M.Sc.) after revision

Hon'ble Sir,

With reference to your letter No. BSU (Regulation) -20/2018-1510/GS(1) dated 05/06/2018, we have been appointed as subject experts for examining the CBCS Syllabus of Zoology (M.Sc.) submitted by T.M. Bhagalpur University. We studied ~~the syllabus~~ and found that it needs certain necessary modifications.

We are submitting a revised CBCS Syllabus of Zoology (M.Sc.) after necessary modifications for your kind perusal and approval.

Yours faithfully

- (1) Dr. U.S. Sinha, Retd. Prof., V.K.S.U., Ara- *U.S. Sinha 14/6/18*  
(2) Dr. P.K. Khan, Dept. Of Zoology, P.U., Patna- *P.K. Khan 14/6/18*  
(3) Dr. G.B. Chand, Dept. Of Zoology, P.U., Patna- *G.B. Chand 14/6/18*

ENCL:

1. Revised CBCS Syllabus of Zoology (hard copy)
2. Soft copy (CD) of the same.
3. CBCS Syllabus of Zoology (prepared by T.M. Bhagalpur University)

## SEMESTER – I

**Core Course (CC- 1): Functional Biology of Invertebrates and Chordates** Full Marks – 70

Time: 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

### Unit – I

- 1.1 Organization of coelom and its significance
- 1.2 Patterns of feeding and digestion in invertebrates
- 1.3 Invertebrate larvae: Types and significance

### Unit – II

- 2.1 Respiratory pigments in different phylogenetic groups
- 2.2 Organs of Respiration in Invertebrates: Gills, Lungs and Trachea
- 2.3 Mechanism of Respiration in Invertebrates

### Unit- III

- 3.1 Organs of respiration in vertebrates: Gills, ARO and Lungs
- 3.2 Principles of gaseous exchange and Fick's modified equation
- 3.3 Transport of gases in blood and body fluid
- 3.4 Regulation of respiration (Neural and chemical control)
- 3.5 Respiratory adaptations at higher altitude and in diving mammals

### Unit – IV

- 4.1 Patterns of nitrogenous excretion in different phylogenetic groups
- 4.2 Organs of excretion: Coelomoducts, nephridia, malpighian tubules and kidney
- 4.3 Mechanism of osmoregulation and excretion in aquatic (freshwater and marine) and terrestrial animals
- 4.4 Mechanism of acid-base balance

### Unit – V

- 5.1 Thermoregulation in vertebrates
- 5.2 Mechanism of energetic of muscle contraction (Skeletal)
- 5.3 Physiology of electrical and synaptical transmitters in neurons
- 5.4 Neurotransmitters and their functions
- 5.5 Acoustico-lateral system and electroreception in aquatic vertebrates

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## SEMESTER – I

### Core Course (CC- 2): Molecular Cell Biology

Full Marks – 70

Time: 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

#### Unit I:

##### (A) Bio membrane

- 1.1 Molecular composition, arrangement and functional consequences
- 1.2 Models of bio-membrane
- 1.3 Transport across bio-membrane: diffusion, active transport and membrane pumps (P-type pump, V-type pump and ABC transporter)
- 1.4 Cotransport by symporters and antiporters

##### (B) Cytoskeleton

- 1.5 Microtubules and microfilaments: Structure and dynamics
- 1.6 Role of Kinesin and Dynein in intracellular transport
- 1.7 Axonal transport and cell movement (with respect to non-muscle motility)

#### Unit II: DNA replication

- 2.1 Outline of prokaryotic replication
- 2.2 Replication features of single stranded phages
- 2.3 Mechanism and machinery of replication in eukaryotes
- 2.4 DNA damage and repair mechanisms

#### Unit III: Transcription

- 3.1 Outline mechanism of prokaryotic transcription
- 3.2 Organization of eukaryotic transcription machinery
- 3.3 General and specific transcription factors
- 3.4 Regulatory elements & DNA binding domains of transcription apparatus
- 3.5 Processing of primary transcript & RNA editing in eukaryotes

#### Unit IV: Translation

- 4.1 Genetic code: Codon assignment and features
- 4.2 Outline of Prokaryotic translation
- 4.3 Eukaryotes translation: machinery (Ribosome & t RNA)
- 4.4 Eukaryotes translation: mechanism (Initiation, elongation and termination)

#### Unit V: Intra cellular protein trafficking:

- 5.1 Targeting proteins to ER: Signal hypothesis
- 5.2 Co- and post – translational modifications of proteins
- 5.3 Trafficking mechanisms:
  - (a) Vesicular transport
  - (b) Protein sorting
  - (c) Endocytosis and exocytosis

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## SEMESTER – I

### Core Course (CC- 3): Genetics

Full Marks – 70

Time: 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

#### Unit I: Organization of Chromosomes

- 1.1 Organization of prokaryotic chromosomes
- 1.2 Organization of eukaryotic chromosome: Nucleosome as functional particle, 30 nm chromatin fibre, higher order structure of chromatin
- 1.3 Organization of centromere and kinetochore, Organization of telomere and its maintenance
- 1.4 Heterochromatin: Types, organization, formation and significance
- 1.5 Structural organization and functional significance of Polytene and Lampbrush chromosomes.

#### Unit II: Microbial genetics

- 2.1 Transformation, conjugation, transduction and sex-duction in bacteria
- 2.2 Construction of linkage map in bacteria
- 2.3 Molecular mechanism of recombination

#### Unit III: Cell cycle

- 3.1 Stages and check points in cell cycle
- 3.2 Genetics of cell cycle regulation: Role of cyclins and CDKs
- 3.3 Molecular basis of cellular check points

#### Unit IV: Sex determination and dosage compensation

- 4.1 Genetic and Molecular basis of sex determination in *Caenorhabditis elegans*, *Drosophila* & human
- 4.2 Genetic basis of dosage compensation in *Caenorhabditis elegans*, *Drosophila* & mammals

#### Unit V: Techniques & Methods in genetics

- 5.1 DNA sequencing: Base destruction method, chain termination method and automated sequencing, pyro- sequencing and whole genome short-gun sequencing.
- 5.2 DNA amplification: Polymerase chain reaction, its application and limitations.
- 5.3 DNA finger printing: VNTR profiling, STR profiling (Autosomal & Y Chromosome), mitochondrial DNA profiling and SNP profiling
- 5.4 Genome expression analysis: Southern, Northern & Western blotting, Reverse Transcription PCR, DNA micro array.

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**SEMESTER - I**

**Core Course (CC- 4) Practical**

**Full Marks - 70**

**1<sup>st</sup> Sitting**

1. Squash preparation using any of the following: 10
  - (a) *Chironomus/Drosophila* larvae for polytene chromosomes
  - (b) Onion root tip for mitosis and mitotic index
  - (c) Grasshopper testes for meiosis and related features
  
2. Experimental demonstration (any one of the following): 10
  - (a) Enumeration of RBC
  - (B) Enumeration of WBC (TC and DC)
  - (C) Preparation of a histological slide of the given paraffin section/whole mount of an invertebrate larva 05
  
3. Identification and comments upon spots (cytological slides: Nos. 02) 05

**2<sup>nd</sup> Sitting**

4. Identification and comments upon spots (invertebrate slide-03, vertebrate slide-02) 10
  
5. Genetics (any of the following) 10
  - (a) Solving problems on Mendelian principles and sex-linked inheritance
  - (b) Preparation of linkage map based on data from *Drosophila* crosses and tetrad analysis in *Neurospora*
  - (c) Pedigree analysis in human
  
6. Class records, charts/ models & field collection 10
  
7. Viva-voce 10

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## SEMESTER – II

**Core Course (CC- 5): Environmental Science**

Full Marks – 70

Time : 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

**Unit I: Concept and Dynamics of ecosystem**

- 1.1 Abiotic factors and Biotic factors.
- 1.2 Energy flow
  - (a) Lindemann's rule of trophic dynamics
  - (b) Energy flow models
- 1.3 Biogeochemical cycles: Nitrogen, Carbon, Sulphur and Phosphorous cycle
- 1.4 Hydrological cycles

**Unit II: Principles pertaining to limiting factors**

- 2.1 Liebig's Law of minimum, Shelford's Law of tolerance
- 2.2 Concept & Law of limiting factors
- 2.3 Factors compensation and ecotypes

**Unit III: Population Growth, Predation and Regulation**

- 3.1 Demography: Life tables, Generation time, Net reproductive rate, Reproductive value
- 3.2 Population growth: Exponential growth, Verhulst-Pearl logistic growth model,
- 3.3 Population regulation extrinsic and intrinsic mechanisms
- 3.4 Concept of niche, niche width and overlap, fundamental and realized niche, resource partitioning character displacement

**Unit IV: Global Environmental Issues**

- 4.1 Climate Change
- 4.2 Carbon Footprint
- 4.3 Water Security – conservation of surface and ground water
- 4.4 wildlife conservation
  - (a) Causes of extinction
  - (b) National and International efforts for conservation (CITIES, IUCN, CBD)
  - (c) National parks and sanctuaries
  - (d) Biosphere reserves
  - (e) Wildlife protection Acts

**Unit V: Pollution Biology**

- 5.1 Pollutants, their sources and classification
- 5.2 Causes, effects and control of Water and Air Pollution
- 5.3 Biomagnification and Eutrophication
- 5.4 Thermal and Radioactive pollution
- 5.5 Emerging pollutants: POPs, Pharmaceuticals
- 5.6 Bio-indicators as index of pollution and their significance

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## SEMESTER – II

### Core Course (CC- 6) Bio-instrumentation & Biostatistics

Full Marks – 70

Time : 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

#### Unit – I

- 1.1 Principles and uses of analytical instruments – pH meter, colorimeter, Spectrophotometer, Ultra-centrifuge.
- 1.2 Microscopy – Principles of light, Transmission Electron, Scanning Electron, Fluorescence, Phase-contrast and Confocal Microscopes Photomicrography.

#### Unit – II

##### (A) Separation techniques

1. Electrophoresis: SDS PAGE, Agarose gel electrophoresis
2. Chromatography: Column, GLC, HPLC
3. Organelle separation by centrifugation
4. Cell separation by flow cytometry and density gradient centrifugation

##### (B) Immunological techniques

1. Radio- immunoassay (RIA)
2. Enzyme-linked Immunosorbent assay (ELISA)

#### Unit – III

- 4.1 Basic concepts in Biostatistics (sampling design, data collection and scaling techniques)
- 4.2 Mean: Arithmetic, Geometric & Harmonic Mean
- 4.2 Standard Deviation
- 4.3 Standard Error
- 4.4 Analysis of Variance (ANOVA)

#### Unit-IV

1. Correlation (Karl Pearson and Rank's correlation)
2. Regression

#### Unit –V

- 1.1 Rules of probability
- 1.2 Binomial probability distribution
- 1.3 Poisson probability distribution
- 1.4 Normal probability distributions
- 5.5 Test of Significance
  - (a) Chi-square test
  - (b) Student's t-test

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## SEMESTER – II

### Core Course (CC- 7): Biochemistry

Full Marks – 70

Time : 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

#### Unit-I: Bioenergetics

- 1.1 Laws of thermodynamics, internal energy, enthalpy, entropy
- 1.2 Concept of free energy, redox potential, energy rich compounds
- 1.3 Mitochondrial electron transport chain and oxidative phosphorylation

#### Unit-II: Biochemistry of Carbohydrates

- 2.1 Monosaccharides and Disaccharides, Types and properties
- 2.3 Polysaccharides: Homopolysaccharide and Heteropolysaccharide
- 2.3 Glycolysis, HMP shunt, Glyconeogenesis and Glycogenolysis

#### Unit-III: Biochemistry of proteins and lipids

- 3.1 Primary, secondary, tertiary, quaternary and domain structures
- 3.2 Stabilizing forces in protein structure
- 3.3 Peptide conformation (Ramachandran plot, helices, turns and sheets)
- 3.4 Biosynthesis of Urea
- 3.5 Free fatty acids: Synthesis and importance
- 3.6  $\beta$ -Oxidation of long chain fatty acids

#### Unit – IV: Enzyme Biochemistry

- 4.1 Enzyme: Classification and nomenclature
- 4.2 Mechanism of enzyme action
- 4.3 Kinetics of enzyme catalyzed reaction
- 4.4 Non-genetic Regulation of enzyme activity:
  - (a) Feedback inhibition
  - (b) Allosteric inhibition
- 4.5 Free radicals, Antioxidants and detoxification

#### Unit – V: Principles of Histology and Histochemistry

- 5.1 General principles of fixation and types of fixatives
- 5.2 General principles of staining and types of dyes
- 5.3 General principles of histochemistry:
  - (a) Carbohydrate
  - (b) Protein
  - (c) Lipid
  - (d) Nucleic acids
  - (e) Enzymes

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## SEMESTER – II

### Core Course (CC- 8): Biosystematics and Evolution

Full Marks – 70

Time : 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five questions (three to be answered) of 10 marks each.

#### Unit 1: Biosystematic

1. Definition & basic concept of Biosystematics and taxonomy , its importance and application in biology.
2. Hierarchy of categories, outline of classification of animals, important criteria used for classification up to Classes in each phylum
3. Species concept : Biological and phylogenetic, sub - species and other infra-specific categories, evolutionary relationship among taxa
4. International code of Zoological nomenclature (ICZN): operative principles, and important rules, Zoological nomenclature and scientific names of various taxa
1. Trends in taxonomy : Chemo - taxonomy, cyto - taxonomy and molecular taxonomy

#### Unit 2: Pattern of genetic variation and natural selection

1. Genetic polymorphisms, variation in chromosome structure, protein structure and nucleotide sequences
2. Concept of Natural Selection (Darwinian and neo- Darwinian), mode of its operation: stabilizing, directional and disruptive modes of Natural Selection

#### Unit 3: Molecular evolution

1. Variation in the evolution of protein and DNA sequences
2. Molecular phylogenies
3. Rates of molecular evolution and molecular clock
4. Neutral theory of molecular evolution
5. Origin of new genes and evolution of multi gene family

#### Unit 4: Mechanism of speciation

1. Patterns and mechanisms of reproductive isolation and its role in evolution
2. Models of speciation : sympatric and allopatric

#### Unit 5: Population genetics

1. Concept of Gene pool, allele frequency and genotype frequency
2. Hardy-Weinberg principle of genetic equilibrium and its mathematical derivation
3. Detailed account of destabilizing forces of genetic equilibrium: Natural selection, Mutation ,Migration, Meiotic drive, and Genetic Drift

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## SEMESTER - II

### Core Course (CC- 9) Practical

Full Marks - 70

#### First Sitting

1. Biochemical experiments (any one of the followings) 10
  - (a) Determination of salivary amylase activity
  - (b) Colorimetric estimation of glucose, urea, uric acid or albumen in a given sample
  - (c) Separation of amino acids by paper chromatography
  - (d) Biochemical detection of glucose, starch, protein or lipid in a given sample
2. Identify and comment upon the spots of evolutionary significance (any one of the following): 10
  - (a) Archaeopteryx
  - (b) Darwin's finches
  - (c) Serial homology in cephalothoracic appendages in prawn
  - (d) Homology vs Analogy
  - (e) Adaptive radiation in beaks of birds
3. Histochemistry; Histochemical demonstration involving the following reagents: 10  
PAS, Alcian Blue, Sudan Black B, Sudan III/IV, Feulgen, Methyl green- Pyronin,  
Mercury bromophenol or  
Preparation of temporary mount of any two of the specimens of planktons  
Second Sitting

4. Environmental studies (any one of the following) 10
  - (i) Measurement of pH
  - (ii) Estimation of dissolved O<sub>2</sub>
  - (iii) Estimation of free CO<sub>2</sub>
  - (iv) Estimation of carbonate & bicarbonate alkalinity
  - (v) Composition & assessment of the taxonomic diversity/biodiversity in a habitat (of grassland, arid & wetland)
  - (vi) Estimation of the total hardness
5. Biostatistics: 10  
Standard deviation, standard error, correlation, regression, t-test
6. Class record 10
7. Viva-voce 10

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## SEMESTER – III

### Core Course (CC- 10): Vertebrate Immunology

Full Marks – 70

Time : 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five questions (three to be answered) of 10 marks each.

#### Unit I: Innate and Acquired Immunology

1. Cell types of innate and adaptive immunity, Lymphocyte trafficking
2. Phagocytosis and inflammation
3. Humoral immunity:  $\beta$  cell activation and differentiation, primary and secondary humoral response
4. Cell mediated immunity: T - cell development and T-cell activation, CTL and NK cell mediated immunity

#### Unit 2: (A) Nature of Antigens

1. Antigenicity and immunogenicity, and the factors influencing it.
2. Characteristics of  $\beta$  and T cell epitopes and haptens
3. Super antigen and its role in T cell activation
4. Antigen processing and presentation
5. MHC complex

#### (B) Structure and functions of Antibodies

- (a) Gross and fine structure
- (b) Classes and sub-classes
- (c) Antibody mediated effector functions and monoclonal antibodies

#### Unit 3: (A) Antigen- antibody interaction and Complement system

1. Antibody affinity and antibody avidity
2. Precipitation reactions
3. Agglutination reactions
4. Complement System - activation pathway, biological function and complement deficiencies
5. ELISA

#### (B) Cytokines : Classification and function, Cytokines receptors.

#### Unit 4: Organization and expression of Ig genes

1. Organization of Ig genes
2. Generation of antibody diversity
3. BCR and Generation of T-cell receptor diversity

#### Unit 5: Immunology and Diseases

1. Hypersensitivity (Type I, II, III, IV).
2. Auto-immunity
3. Immune responses to infectious agents - bacterial, viral and parasitic infection (Protozoa and Helminth parasites).
4. Immunodeficiencies

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## SEMESTER – III

### Core Course (CC- 11): Gamete and Developmental Biology

Full Marks – 70

Time : 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

#### Unit-I: Gamete Biology

- 1.1 Cellular basis of spermatogenesis and Biochemistry of semen
- 1.2 Ovarian follicular growth and differentiation
- 1.3 Oogenesis and vitellogenesis
- 1.4 Ovulation and ovum transport
- 1.5 Molecular events during fertilization

#### Unit II: (A) Multiple ovulation and Embryo transfer technology

- 2.1 *In vitro* oocyte maturation
- 2.2 Super ovulation
- 2.3 *In vitro*-fertilization

#### (B) Assisted Reproduction technologies

- 2.4 Collection and preservation of gametes
- 2.5 ICST, GIFT & Immuno - contraception

#### Unit III: Basic concept of development

- 3.1 Potency, commitment, specification, induction, competence, determination and differentiation
- 3.2 Morphogenetic gradients, cell fate and cell lineages, genomic equivalence and cytoplasmic determinants.

#### Unit IV: Differentiation, morphogenesis and organogenesis

- 4.1 Cell differentiation: Role of cytoplasm and nucleus
- 4.2 Gene amplification and rearrangement during development
- 4.3 Axes and pattern formation in *Drosophila*.
- 4.4 Limb development and regeneration in vertebrates

#### Unit V: Stem cell Biology

- 5.1 Definition and characteristics of stem cell
- 5.2 Type of stem cell ( embryonic, adult and cancer stem cell)
- 5.3 Nuclear reprogramming of induced pluripotent stem cell, test for pluripotency
- 5.4 Potential application of stem cells, therapeutic cloning

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## SEMESTER – III

### Core Course (CC- 12): Vertebrate Endocrinology

Full

Marks – 70

Time : 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five questions (three to be answered) of 10 marks each.

Time: 3 hrs.

#### Unit- I

- 1.1 Aims and scope of endocrinology
- 1.2 Hormones as messengers
- 1.3 Chemical nature and gross features of hormones
- 1.4 Neuro-endocrine system and neurosecretion
- 1.5 Hypothalamic control of endocrine system

#### Unit- II

- 2.1 Hormones involved in reproduction
  - (a) Seasonal breeders
  - (b) Continuous breeders
- 2.2 Hormonal regulation of reproductive cycle
  - (a) Ovarian cycle
  - (b) Menstrual cycle
  - (c) Oestrus cycle

#### Unit-III

- 3.1 Biosynthesis of steroid hormones
- 3.2 Biosyntheses of amino acid derived hormones (T<sub>4</sub>, Epinephrine)
- 3.3 Biosynthesis of simple peptide hormones. Pre and Prohormones.

#### Unit- IV Hormone Receptors:

- 4.1  $\beta$ -adrenergic receptor
- 4.2 Insulin receptor
- 4.3 Steroid hormone receptor

#### Unit-V: General principles of hormone actions (signal transduction)

- 5.1 Second messenger concept [G proteins, Nucleotides (cAMP, cGMP), Calcium, Calmodulin, Phospholipids]
- 5.2 Lipid soluble hormones and intracellular receptor
- 5.3 Lipid insoluble hormone and intracellular signalling

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## SEMESTER – III

### Core Course (CC- 13): Animal Behaviour

Full Marks – 70

Time : 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions(Four to be answered) of 5 marks each. Part C will consist of five questions (three to be answered) of 10 marks each.

Time: 3 hrs.

#### Unit-I: Basics of Animal Behavior

- 1.1 Ethology- Definition, Branches, Significance
- 1.2 Approaches and methods in the study of Behavior
- 1.3 Patterns of Behavior-
  - (a) Innate behavior- Kinases/ Taxes, Simple reflex, Comparison of reflex and complex behaviors, Instinct and, Motivation
  - (b) Learned behavior- Habituation, Imprinting, Conditioned reflex, Trial & error learning, Reasoning and Cognition

#### Unit II: Social Behavior

- 2.1 Social behavior of insects (Honey bees, Ants and termites)
- 2.2 Schooling in fish, Flocking in birds,
- 2.3 Social organization of Primates
- 2.4 Parental care in fishes
- 2.5 Altruism: Reciprocal altruism, Inclusive fitness, group selection, and Kin – selection

#### Unit. III: Reproductive Behavior

- 3.1 Evolution of sex and reproductive strategies
- 3.2 Mating system
- 3.3 Courtship & Parental Behaviors: Parental care and parental Investment

#### Unit IV. Biological Rhythms

- 4.1 Circadian, Circannual, Lunar, Tidal and Epicycles
- 4.2 Navigation including orientation
- 4.3 Migration of fishes and Birds

#### Unit V. Control of Behavior

- 5.1 Neural control of behaviour
- 5.2 Hormones and Behavior
- 5.3 Ecological aspects of behavior: Habitat selection, Optimal foraging theory, and Aggressive behavior

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## SEMESTER - III

### Core Course (CC- 14) Practical

Time : 6 hrs

Full marks – 70

1. Any one of the immunological experiments 10
  - (a) Determination of blood group using ABD antisera
  - (b) Preparation of blood film and identification of blood cells of immunological importance
  - (c) Hormonal assessment of T3/Testosterone/oestrogen by ELISA reader
2. Identify and comment upon the given spots 10
  - (a) Endocrinological slides-03
  - (b) Embryological slides -02
3. Prepare a permanent mount of chick embryo or 10  
Identify and comment upon the exposed endocrine glands in a mammal
4. Comment upon the behavioural aspects of specimens provided 10  
(any two)
  - (a) Parental care (Hippocampus, Cichlids, Alytes, Hyla, Ichthyophis)
  - (b) Caste system (Honey bee/termites/ants) and its significance
  - (c) Dance as means of communication in honey bees
5. Identification and comment upon the given embryonic stages 10  
(any two)
6. Class record 10
7. Viva voce 10

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**List of Elective Courses (EC):**

- (1) Cell and Molecular Biology (EC-1A & 2A)
- (2) Fish and Inland Fisheries (EC-1B & 2B)
- (3) Environmental Biology (EC-1C & 2C)
- (4) Entomology (EC-1D & 2D)
- (5) Parasitology (EC-1E & 2E)
- (6) Cytogenetics (EC-1F & 2F)
- (7) Comparative Endocrinology (EC-1G & 2G)

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## Semester – IV

EC – 1A Elective paper: Cell and Molecular Biology

Full Marks – 70

Time: 3 hrs

Questions to be set in three parts representing all the five units. Part A will consist of 10 objective questions of 2 marks each. Part B will consist of five short questions (Four to be answered) of 5 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

### Unit I: (A) Regulation of gene expression in bacteria

- 1.1 Concept and basic mechanism
- 1.2 Inducible system: Lac operon with negative control and Positive control (CAP/cAMP regulation)
- 1.3 Repressible system: Tryptophan operon and mechanism of attenuation in *E.coli*

### (B) Levels of gene regulation in eukaryotes

- 1.4 Transcriptional control involving chromatin remodelling and genome imprinting
- 1.5 Post – transcriptional control involving alternate polyadenylation and alternate splicing
- 1.6 Translational control involving Ribosome selection, translation inhibition, mRNA degradation and gene silencing (RNA interference)

### Unit II: (A) Cancer Biology

- 2.1 Cytology of cancer cells and types of cancer
- 2.2 Genetic basis: Oncogenes and tumour – suppressor genes
- 2.3 Chromosomal anomalies associated with cancer

### (B) Apoptosis

- 2.4 Machinery of programmed cell death
- 2.5 Extrinsic and intrinsic pathways
- 2.6 Control of programmed cell death

### Unit III: (A) Nucleus

- 3.1 Functional architecture of interphase nucleus and nuclear envelope
- 3.2 Ultra structure of nucleolus: organization of rDNA
- 3.3 Nucleolar function: synthesis of rRNA, its processing and biogenesis of ribosomes
- 3.4 Mechanism of nuclear cytoplasmic exchange

### (B) Cell – Cell signaling

- 3.5 Signaling from plasma membrane to nucleus: Type of signal (G protein and protein kinases), target cells and effector organs
- 3.6 Cell surface receptors of signaling molecules
- 3.7 Signal transduction pathways and their regulation Second messenger system

### Unit – IV: (A) Genomics

- 4.1 Functional genomics: Predicting gene and protein function by sequence analysis
- 4.2 Genome organization in humans: The Human Genome Project, Main features of human genome
- 4.3 Gene therapy: Prospects and application

**(B) Recombinant DNA Technology**

4.4 Tools and techniques (enzymes, vectors, cloning strategies)

4.5 Construction and screening of DNA libraries

4.6 Application of recombinant DNA technology

**Unit – V : Transposable genetic elements**

5.1 Discovery and definition: Ac/Ds elements in maize

5.2 Prokaryotic elements: Insertion sequences and transposons

5.3 Retrotransposons and DNA transposons in eukaryotes

5.4 Mechanism of transposition (conservative and replicative)

**SEMESTER - IV**

**EC – 2A Elective paper (Practical): Cell and Molecular Biology**

**Time: 6 hrs**

**Full Marks – 70**

**1<sup>st</sup> Sitting**

- |  |    |
|--|----|
| 1. Cyochemical demonstration of protein/lipid/carbohydrate/nucleic acids | 15 |
| 2. Vital staining of mitochondria  | 10 |
| 3. Identify and comments upon spots (1-5): Cytological slides            | 10 |

**2<sup>nd</sup> Sitting**

- |  |    |
|--|----|
| 4. <b>Any one of the following</b>                                       | 10 |
| (a) Estimation of sperm count from epididymal wash of laboratory mammals |    |
| (b) DNA separation by agarose gel electrophoresis (demonstration only)   |    |
| 2. Practical records (including slides, charts, model, field work)       | 05 |
| 3. Dissertation and Viva-Voce  | 20 |