

**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 3 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 Inducible system: Lac operon with negative control and Positive control (CAP/cAMP regulation)
- 1.2 Repressible system: Tryptophan operon and mechanism of attenuation in *E. coli* & *B. subtilis*
- 1.3 The arabinose operon

(B) Levels of gene regulation in eukaryotes

- 1.4 Transcriptional control involving chromatin remodelling and genome imprinting
- 1.5 Post - transcriptional control involving alternate poly-adenylation 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 Prospect & 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-VI Transposable genetic elements and Epigenetics

- 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)

10/20/17

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10/20/17

## SEMESTER - IV

EC - 1A Elective paper (Practical): Cell and Molecular Biology  
Time: 6 hrs

Full Marks - 70 CIA-30

### 1<sup>st</sup> sitting

1.	Cytochemical demonstration of protein/lipid/carbohydrate/nucleic acids	15	05
2.	Vital staining of secretory granules and mitochondria	10	05
3.	Identify and comments up on spots (1-5): Cytological slides	10	05

### 2<sup>nd</sup> sitting

4.	Any one of the following:	10	05
(a)	Estimation of sperm count from epididymal wash of laboratory mammals		
(b)	Isolation of DNA and its separation by agarose gel electrophoresis (demonstration)		
2.	Practical records (including slides, charts, model, field work)	05	05
5.	Dissertation and Viva-voce	30	05

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## SEMESTER - IV

EC - IB Elective paper : Fish and Inland Fisheries

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.

### Fish Biology

Unit I: (A) Taxonomy and evolution

- 1.1 Classification of fishes
- 1.2 Origin and evolution of elasmobranch
- 1.3 Origin and evolution of teleost
- 1.4 Crossopterygi: distribution, structure and affinities
- 1.5 Holocephali: structure and affinities

(B) Fish Anatomy

- 1.6 Integument: Structure and function
- 1.7 Alimentary canal & its modification in relation to feeding habit
- 1.8 Apuistio-lateralis system
- 1.9 Air bladder & its modification

Unit II: (A) Fish Physiology

- 2.1 Mechanism of gill respiration
- 2.2 Accessory respiratory organs
- 2.3 Sound production
- 2.4 Excretion and osmoregulation
- 2.5 Reproduction in fish

(B) Fish endocrinology

- 2.6 Pituitary
- 2.7 Thyroid
- 2.8 Adrenal
- 2.9 Corpuscles of Stankus and Hepatopancreas

### Applied Fisheries

Unit III: Fresh water Aquaculture

- 3.1 Construction and lay out plan of different types of ponds and their management
- 3.2 Role of physico-chemical and biological factors in aquaculture
- 3.3 Aquatic weeds & their control
- 3.4 Pen & cage culture
- 3.5 collection and transport of fish seeds from riverine resources
- 3.6 Fish food organisms: Types and their culture; supplementary feeding
- 3.7 Pollutants and their effect on fisheries

Unit IV: (A) Fish Pathology

- 4.1 Nutritional diseases
- 4.2 Intrinsic diseases
- 4.3 Bacterial diseases in fish and their control
- 4.4 Fungal and viral diseases in fish and their control
- 4.5 Parasitic diseases in fish and their control

(B) Fish biotechnology

- 4.6 Cryopreservation of fish gamete
- 4.7 Induced Breeding in fish using Carp pituitary extract (CPE) and new generation drugs

- 4.8 Androgenesis, Gynogenesis and transgenic fish
- 4.9 Cytogenetical techniques in aquaculture
- 4.10 Integrated fish farming

**Unit V: (A) Fisheries resources**

- 5.1 Riverine fisheries resources of India
- 5.2 Reservoir fisheries in India
- 5.3 Lacustrine fisheries in India
- 5.4 Estuarine fisheries in India

**(B) Post harvest Technology**

- 5.5 Principles and methods of inland fishing crafts and gears
- 5.6 Fish spoilage and methods of fish preservation
- 5.7 Fish byproducts
- 5.8 Fish marketing

100  
10/10/20

4-5  
10-10

## SEMESTER – IV

EC – 1B Elective paper (Practical): Fish and Inland Fisheries

Time : 4 hrs

Full Marks – 70

04-20

### 1<sup>st</sup> Sitting

- |  |            |    |
|--|------------|----|
| 1. Any one of the following experiments:   | 10         | 05 |
| i) O <sub>2</sub> Consumption in relation to body size                                   |            |    |
| ii) Hematological analysis (Hb estimation, RBC counting)                                 |            |    |
| iii) Estimation of pH using pH meter, Dissolved Oxygen, Total alkalinity, Total Hardness |            |    |
| 2. Spotting:   | 5 x 2 = 10 | 05 |
| i) Museum specimen   | - 01       |    |
| ii) Bones  | - 01       |    |
| iii) Slides  | - 02       |    |
| iv) Fishing gear/aquatic weeds   | - 01       |    |
| 3. Microtomy/paraffin sectioning and permanent slide preparation                         | 10         | 05 |
| or   |            |    |
| Mounting: scales, olfactory lamella, respiratory epithelium                              |            |    |

### 2<sup>nd</sup> Sitting

- |   |    |    |
|---|----|----|
| 4. Taxonomic identification of a local available fish up to species level (based upon morphometric- meristic analysis and identification key) | 05 | 05 |
| 5. Any one of the following:  | 10 | 05 |
| i) Biological analysis of water including Phytoplankton, Zooplankton, Macrophytes and Zoosarcobenthos.  |    |    |
| ii) Identification of representative fish parasites and their life histories  |    |    |
| iii) Identification of fry and fingerlings of major cultivated species of fresh water fish  |    |    |
| 6. Practical records (including slides/chart/model/field work)  | 05 |    |
| 7. Dissertation and Viva  | 20 | 05 |

$\frac{100}{100} \times \frac{60}{70} = \frac{600}{70} = 8.57$

## SEMESTER – IV

EC – 10 Elective paper : Entomology

Time : 3 hrs

Full Marks – 70

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 3 marks each. Part C will consist of five long questions (three to be answered) of 10 marks each.

### Unit I: (A) Classification

- 1.1 Outline of classification of class Insecta upto suborders
- 1.2 Classification upto superfamilies in following economically important groups (Coleoptera, Hemiptera and Lepidoptera, Dipterans)
- 1.3 Origin of insects.

### (B) Morphology

- 1.4 General organization of insect body
- 1.5 Comparative study of Antennae and their modification
- 1.6 Comparative study of Mouth parts: structure, modification and function
- 1.7 Comparative study of Legs and their modification
- 1.8 Compound eye: structure including image formation
- 1.9 Wings : Venations and modifications
- 1.10 Integument : Structure and moulting
- 1.11 Genitalia

### Unit II: (A) Insect Physiology

- 2.1 Alimentary canal : Structure and Physiology of digestion.
- 2.2 Tracheal system: Structure and Physiology of Respiration
- 2.3 Excretory system : Structure & types of Malpighian tubules, Physiology of Excretion and osmoregulation
- 2.4 Haemolymph : Composition and function

### (B) Neuro-Endocrinology

- 2.5 Brain: Protocerebrum, Deutocerebrum & Tritocerebrum
- 2.6 Ventral nerve cord and ganglia
- 2.7 Neuro-endocrine glands: Types, structure & function
- 2.8 Neuro-haemal organs: corpora cardiaca and Aorta

### Unit III: (A) Insect Control and Management

- 3.1 Chemical Control: Types (Chitin synthesis inhibitor, ecdysoids, juvenoids and anti-hormones) merits and demerits
- 3.2 Biological control: Types (parasites, parasitoids and predators) merits and demerits
- 3.3 Integrated Pest Management (IPM): Definition, tool, basic principle and importance

100/24/15  
45/24/15  
20/24/15



(B) Chemical nature and function

3.4 Pheromones

3.5 Diapause

3.6 Attractants, repellants and anti-feedants

Unit IV: Reproductions and Development

4.1 Male reproductive organs: Testes, Vas deferens, ejaculatory duct, accessory glands & seminal vesicles

4.2 Female reproductive organs: Ovaries, types of ovarioles, oviduct & common oviduct and accessory glands

4.3 Types of Larvae and their metamorphoses

Unit V(A) Agricultural Entomology

5.1 Pests of Paddy: Life history and control measures

5.2 Pests of Wheat: Life history and control measures

5.3 Pests of Sugarcane and stored grains: Life history and control measures

5.4 Pests of Vegetable and stored grains: Life history and control measures

(B) Veterinary Entomology

5.5 Bionomics, life cycle, prevention and control of house fly (*Fabonax* spp.) and Black fly (*Simulium* spp.)

5.6 Insect of medical importance associated with disease transmission (Malaria, Filaria and Kala-azar): Biology and control

(C) Forensic Entomology

5.7 Forensically important insects

5.8 Collection of data from cadaver site

5.9 Interpretation of data for predicting time and cause of death

## SEMESTER - IV

EC - 2D Elective paper (Practical): Entomology

Time : 4 hrs

Full Marks - 70 CIA- 30

- |    |   |         |    |
|----|---|---------|----|
| 1. | Any one of the following experiments:   | 10      | 05 |
|    | (i) Dissection of grasshopper or honey bee or wasp to expose general anatomy and nervous system |         |    |
|    | or  |         |    |
|    | (ii) Identification of any two insects [5+2]  |         |    |
| 2. | Permanent slide preparation of any one  | 10      | 05 |
|    | (i) Whole specimen (small insect)   |         |    |
|    | (ii) Mouth parts  |         |    |
|    | (iii) Antennae  |         |    |
|    | (iv) Legs   |         |    |
|    | (v) Wings   |         |    |
|    | (vi) Poison apparatus   |         |    |
|    | (vii) External genitalia  |         |    |
|    | (viii) Spiracles  |         |    |
|    | (ix) Gills of aquatic insect  |         |    |
| 3. | Identification and comments upon spots 1-5  | 3x5= 15 | 05 |
|    | (i) Morphological slides -2   |         |    |
|    | (ii) Histological slides -2   |         |    |
|    | (iii) Damaged material by a pest- 1   |         |    |

2<sup>nd</sup> sitting

- |    |   |    |    |
|----|---|----|----|
| 4. | Identification and life history of any one pest | 10 | 05 |
| 5. | Field works and records                         | 05 | 05 |
| 6. | Dissertation & Viva voce                        | 20 | 05 |

*Handwritten notes:*  
 100/200  
 1/2  
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 1/2

## SEMESTER – IV

### EC – 1C Elective paper : Environmental Biology

Time : 3 hrs

Full Marks – 70

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 1 : (A) Concept and dynamics of ecosystem

- 1.1 Biological productivity, primary production and method of its measurement
  - 1.2 structure and function of major ecosystem's of the world (fresh water ecosystems, forest ecosystems, grassland, desert ecosystem)
- (B) Limnology
- 1.3 Origin and types of lakes
  - 1.4 Ecological zonation in lakes

#### Unit 2 : (A) Population ecology

- 2.1 Concept of meta-population, demes and dispersal, inter-demic extinctions, age structured populations.
  - 2.2 Stochastic and time lag models of population growth. Lotka-Volterra equation for competition and predation, functional and numerical responses.
- (B) Community ecology & succession

- 2.3 Nature of communities, community structure and attributes
- 2.4 Levels of species diversity and its measurements
- 2.5 Influence of population interaction on communities, types, mechanisms
- 2.6 Changes involved in succession, concept of climax

#### Unit III: (A) Biodiversity

- 3.1 Importance, status, monitoring, documentation, threats and conservation of biological diversity.
  - 3.2 Shannon-Weiner index, dominance index, Similarity index, Association index
- (B) Wildlife Management
- 3.3 Principles of conservation
  - 3.4 Major approaches to management, and Indian case studies on conservation/management strategy (project tiger, biosphere reserves)

#### Unit IV : (A) Pollution and environmental health

- 4.1 Global environmental problems, global warming, ozone depletion, acid rain, photochemical smog
  - 4.2 Sources, hazards and control of air, water and solid waste pollution
- (B) Ecotoxicology
- 4.3 Definition of toxicology
  - 4.4 Toxic substances in the environment
  - 4.5 Concept of dose response relationship

- 4.6 Acute toxicity, chronic toxicity, lethal concentration, effective concentration
- 4.7 Bioaccumulation, biomagnification, median tolerance limits.

#### Unit V (4) Environmental monitoring

- 5.1 Chemical and biological monitoring
- 5.2 Concept of indicator organisms and bio-monitoring of water quality
- 5.3 Concept of biotic and diversity indices.
  
- 5.4 Need and scope of bioremediation, environmental applications of bioremediation, future outlook
- 5.5 Phytoremediation- biotechnology of cleaning up the environment by plants

## SEMESTER - IV

EC - 2C Elective paper (Practical): Environmental Biology

Time : 6 hrs

Full Marks - 70 CIA-30

### Ist sitting

1. Qualitative and quantitative estimation of Zooplankton and Benthos	30	05
2. Studies of soil fauna by Quadrats method	05	05
3. Physico-chemical analysis of any one	10	05
(a) Water : DO, BOD, COD, Chloride, Carbonate and Bicarbonate alkalinity, Calcium and Magnesium hardness / $Ca^{++}$ and $Mg^{++}$		
(b) Soil: pH, Chloride, Total alkalinity, Hardness, Water retention capacity of different types of soil.		
4. Estimation of Nitrite, Sulphate, and Phosphate by Spectrophotometry.	10	05

### IInd sitting

5. Spotting - Zooplankton, Zoo-macro-benthos, Nekton (2x5)	30	05
7. Class Records	05	
8. Dissertation including Power Point Presentation and Viva	20	05