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# SEMESTER SYSTEM OF P. G. ZOOLOGY

## P. G. SEMESTER EXAMINATION REGULATIONS

### CHAPTER – I

#### REGULATION OF GENERAL ACADEMIC MATTERS

1.1 The Departments shall follow Semester System of teaching and Examination based on continuous evaluation internally as well as externally subject to moderation of question papers. The system of evaluations of the students shall be based on Course Credit System.

##### **1.1.1 Academic Year**

The Academic Year of the department shall ordinarily be from JUNE to MAY. It may however, be modified by the Staff Council from time to time.

##### **1.1.2 Semester**

The academic year shall have two semesters, each of which shall be of 6 months duration.

##### **1.2 Minimum working days in a Semester**

A Semester shall have a minimum of 90 working/instructional days excluding examination days/Sundays/Holidays etc. The minimum number of classes in a semester shall not fall short of the number of classes as mentioned below.

1. One Credit hour courses = 10 classes minimum
2. Two Credit hour courses = 20 classes minimum
3. Three Credit hour courses = 30 classes minimum
4. Four Credit hour courses = 40 classes minimum
5. Five Credit hour courses = 50 classes minimum

##### **1.3 Credit hours**

One credit shall signify the quantum of teaching imparted corresponding to one hour of theory class and two hours of laboratory/project work and two hours of seminar per week during a semester in respect of a particular course. Each teaching hour of theory class will be of 60 minutes and practical classes/project work will be of 120 minutes duration and seminar will be of 120 minutes duration. For field study outside headquarters, one working day will be considered as two teaching hours. However, the field study should not exceed 30 days (including Sundays) in one semester.

The P. G. Syllabus may be so designed that the total of credit hours for all four semesters shall be 80 spread equally over all semesters as far as practicable, tutorials and proctorials shall be treated as non-credit components.

##### **1.4 Course**

A course is a Unit of instruction under any discipline carrying a specific number of credit hours describing its weightage. Those courses, which a student must take as compulsory requirement, are called Core Courses. Those courses, which a student opts out of a list of specialized courses offered by the department, are called Elective Courses.

Choice Based Credit System (CBCS) is introduced at the P. G. Semester-I level uniformly in all the subjects to be taught in paper-103. The students of P. G. Arts stream can not opt for the CBCS course of Science stream. The details of the CBCS courses offered by different P. G. Departments are given in Annexure-II.

# SEMESTER SYSTEM OF P. G. ZOOLOGY

## ANNEXURE-II

### CBCS: P. G. Paper-103

<u>Department</u>	<u>Name of the CBCS Course</u>
Botany	Plant in Human Welfare
Chemistry	Polymer Science
Commerce	Fundamental of Business Organization and Entrepreneurship Development
Economics	Indian Economy
Education	Pedagogical Trends and Issue
English	Global English
Geography	Introduction to Geography
History	Tourism & Heritage Management
Mathematics	Elements of Computer Programming
Odia	“Adhunika Odia Nataka o Odia Bhashara Dhwanitatwa” (Modern Odia Drama and Odia Phonetics)
Physics	Foundation in Physics
Philosophy	Practical Ethics
Political Science	Indian Government & Politics
Psychology	Fundamentals of Psychology
Sanskrit	Ancient Indian Culture
Zoology	Animal World, Human Health & Economic Zoology

#### 1.4.1 *Grade*

The grade awarded to a student in any particular course shall be based on his/her performance in all the tests conducted during a semester and shall be awarded at the end of the semester. The grade in each course is expressed in numerical value in 10.00 scale. The marks of a student shall be converted to 10.00 scale and the points scored thereby shall be called the “Grade Point” in the course. Respective “Grade Point Average” (GPA) and “Overall Grade Point Average” (OGPA) shall be awarded at the end of each semester and all semester respectively. A 3.0 Grade Point is required for passing in individual paper and 4.0 GPA to pass any semester examination. The G. P. shall be rounded to one decimal point and GPA to two decimal points.

#### 1.4.2 *Grade Point Average (G.P.A.)*

Grade Point Average (G.P.A.) of a semester shall be calculated as:

$$\text{GPA} = \frac{\text{Summation of } \{( \text{Credits in each course} \times \text{Grade point in that course} \}}{\text{Total No. of Credits in that Semester}}$$

Where the summation is taken over all courses in a given semester, G.P.A. shall be rounded up to 2 decimal points.

#### 1.4.3 *O.G.P.A. (Overall Grade Point Average)*

It is the average of accumulated grade points of a student, worked out by dividing the cumulative total of grade points by the cumulative total of credit hours of all the courses covered and completed by a student during all the Semesters. For the first semester of the programme the GPA and OGPA shall be the same.

$$\text{OGPA} = \frac{\text{Summation of } \{( \text{Credits in each semester} \times \text{Total Credits in that semester} \}}{\text{Total No. of Credits in that Semester}}$$

Where the summation is taken over all semesters in a given programme. OGPA shall be rounded up to 2 decimal points. For merit lists, in case of equality, the OGPA shall be calculated beyond two decimal places if necessary.

## SEMESTER SYSTEM OF P. G. ZOOLOGY

### 1.4.4 Conversion of grades to marks and classification of results under course credit system

The OGPA can be converted to percentage of marks in the following manner:

Percentage of Marks = (OGPA) × 10

A student after successful completion of all the semesters, Degree shall be awarded in the following manner:

O.G.P.A. ≥ 6.0 : FIRST CLASS

O.G.P.A. ≥ 5.0 - < 6.0 : SECOND CLASS

O.G.P.A. 4.0 - < 5.0 : THIRD CLASS

O.G.P.A. < 4.0 : FAIL

### 1.5 *Academic Calendar*

The Examination Section and the academic section shall finalise the schedule of semester registration and other academic activities at the start of academic session. The Academic Calendar shall be prepared by the Academic Committee of the University in consultation with examination section.

The broad format for academic calendar for P. G. with regard to admission, registration and commencement of classes shall be as follows:

Admission and Registration and

Commencement of Classes for 1st Semester	JULY
1 <sup>st</sup> Semester Examination	DECEMBER
Commencement of Classes 2 <sup>nd</sup> Semester	JANUARY-MAY
2 <sup>nd</sup> Semester Examination	JUNE
Commencement of 3 <sup>rd</sup> Semester Classes	JULY-NOVEMBER
3 <sup>rd</sup> Semester Examination	DECEMBER
Commencement of 4 <sup>th</sup> Semester Classes	JANUARY-APRIL
4 <sup>th</sup> Semester Examination	APRIL & MAY
Final Results to be published in the month of	JUNE

### 1.5.1 *Requirement of award of degree*

The minimum credit hour requirement for the Master Degree shall be 80 (eighty) credits and the residence required for Master Degree shall be continuous four semesters from the first date of registration and the maximum time allowed to complete the Master Degree shall be 8 (eight) semesters.

### 1.6 *Requirement for attendance*

A candidate shall be required to attend 75% lectures, tutorials and practical classes separately during the semester (For late admitted students' attendance to be calculated from the date of admission). Condonation may be granted by the staff council only to the extent of 15% in exceptional cases. (Illness, accident, mishap in the family, deputation by University/Department). When a candidate has been deputed by the University to represent the University/state for any activity, the lectures delivered during his/her absence for the purpose shall not be counted towards the calculation of attendance provided the student submits a certificate to that effect from the appropriate authority.

### 1.7 *Registration in a semester*

A student has to register his/her name at the beginning of every semester in the prescribed form, for the course he/she wants to take in that semester. Examination Section (General) shall notify the registration dates and the list of registered students for the semester shall be given to the Head of the Department within two weeks of the commencement of the Semester.

# **SEMESTER SYSTEM OF P. G. ZOOLOGY**

## **CHAPTER – II** **REGULATIONS ON EXAMINATION MATTERS**

### **2.1 Mid Term Examination**

In each Semester there shall be one Mid Term Assessment examination of 60 minutes duration. The Mid Term examination shall be conducted by COE like that of End Term examination. The answer scripts shall be evaluated by the external and internal examiners and the marks along with answer scripts shall be retained in COE.

### **2.2 Semester Examination**

After the end of each semester there shall be an examination of each theory paper of 2 hours duration and of each practical paper of 4 hours duration, which shall be called Term End / “Semester Examination”. The maximum marks for each theory paper shall be 50 out of which 40 marks for term end and 10 marks for Mid Term. The maximum marks for each practical/ semester/ project/ dissertation/ review examination shall be 50 for Arts and Commerce and 100 marks for Science. The classes shall remain suspended ten days (including Sundays and holidays, if any) before the date of commencement of semester test for preparation by the students.

### **2.3 Results of Examinations**

The results shall be declared ordinarily within four weeks of completion of the examinations. A student who seeks re-addition of his/her marks in a course shall be allowed to do so by submitting an application to Registrar along with a required fees in the fee counter of the University. All such cases/complaints if any shall be disposed of by the Examination Section in a prefixed day and necessary corrections if any shall be reflected in the mark/grade sheet. The candidates shall have to appear in all the Units of a semester examination to be eligible to be a declared ‘pass’ provided he/she secures minimum pass marks/grade.

### **2.4 Promotion to the next semester**

A student shall be admitted to the next semester only when he/she appears in all the papers of the concerned semester examination. However, a student failing to appear semester examination in some or of all papers due to some reasons as mentioned in 2.5 may be admitted to the next semester. Such a student shall produce sufficient proof in favour of his/her reason for not being able to appear in some or all papers of the Semester Examination on the next academic session in the corresponding semesters.

### **2.5 Absence from Examination**

If a student is unable to appear a semester examination in some or all papers the Registrar shall consider his/her case for admission into the next higher semester only the following cases:

- (a) When he/she is hospitalized.
- (b) When he/she is not be able to appear in the examination due to serious illness or death of parents, brothers, sisters, spouse or children.
- (c) When he/she met an accident of serious nature.
- (d) When the department/University or any official directive deposes him/her

### **2.6 Procedure for Repeat/Improvement**

A student who wants to sit for the semester examination of first and/or second semester in the subsequent academic session (for repeat or improvement) he/she shall have to apply to the Registrar in plain paper before fifteen days of the commencement of the said examination. If allowed by the Registrar, he/she shall deposit the required fees for each paper with centre charge and produce the proof to the teacher in-charge examination with permission letter from the Registrar.

In a semester to appear improvement examination the candidates must have passed the semester examination. A candidate can appear repeat examination of papers in which he/she has failed or not appeared for reasons mentioned in 2.5.

## **SEMESTER SYSTEM OF P. G. ZOOLOGY**

The Master Degree student seeking to appear/improvement examination in any course(s) shall get 3 chances for 1<sup>st</sup> and 2<sup>nd</sup> semester within 8 semesters.

Candidates appearing in repeat/improvement examination shall not be considered in the merit list and it shall be reflected in the Provisional Certificate cum Mark sheet (PCM) but not in the final degree certificate.

### **2.7 Award of Degree Certificate, Grade/Mark sheet**

A Degree certificate under the official seal of the university and signed by the Vice-Chancellor shall be presented at the Convocation or in absentia to each of the successful students of particular degree. The Controller of Examinations shall issue the mark/grade sheet of each semester to the candidates in the sheet of each semester to the candidates in the prescribed format by depositing the required fees for marks/Grade Sheet to be deposited in the University counter.

### **2.8 Guideline for filling up of Forms for PG Classes (IMP/ Repeat)**

A student shall repeat all the theory and practical papers in which he/she failed in the semester examination within a period of eight semesters from the date of first registration. Such students shall have to apply to the Head of the Department/Registrar in plain paper during the filling up of form for the ensuing semester examination. If allowed, he/she shall deposit the fees as prescribed by the University

If a candidate secures less than 3.0 Grade point in a paper(s) and less than 4.0 Grade point average in a Semester examination he/she has to appear all the papers in that Semester.

If a candidate secures less than 3.0 Grade Point in a paper(s) and a minimum 4.0 Grade point average in a semester examination, he/she has to appear only the paper(s) in which he/she secured less than 3.0 Grade point.

A candidate is eligible to sit for improvement in a paper(s) only when he/she has passed the semester examination concerned. Further, he/she can improve in a maximum of EIGHT paper(s) in the entire course. The Master Degree students seeking to take improvement examination in any course(s) shall get chances within 8 semesters from the year of admission to the course. The candidates taking this advantage (improvement) will be examined on the basis of current syllabus and the higher marks shall be retained during computation of result.

### **2.9 If a candidate fails to appear in any paper of the said examination and marked ABSENT his/her results will be declared only when he/she clears that paper/those papers.**

### **2.10 Disciplines in the Examination**

(A) Late Comers: A student arriving in the examination hall/room fifteen minutes after the commencement of the examination shall not be ordinarily allowed to sit for the examination. No examinee shall be allowed to go out of the examination hall within one hour of commencement of examination. The invigilators shall keep a record of temporary absence of students from the examination hall/room during the examination.

(B) Adoption of unfair means in the Examination:

Possession of unauthorized materials and using it, copying from scripts of other students or from any other source, showing his/her answer script to others during the examination, creating disturbance or acting in a manner so as to cause inconvenience to other students in the examination hall or near about shall be treated as adoption of unfair means or malpractice.

**Sd/-  
REGISTRAR**

**FIRST SEMESTER**

**PAPER-101: NON-CHORDATA & BIOSTATISTICS**

Marks – 50 (Mid Term 10 + 40 End Term)

**Unit-I**

- A) **Protozoa** - Nutrition, Reproduction, Parasitic forms with special reference to human host.
- B) **Porifera** - Origin of metazoa, Canal system, Reproduction, Spicules of sponges.

**Unit-II**

- A) **Coelenterata** - Polymorphism, Corals and Coral reef formation, Ctenophora and its affinities.
- B) **Platyhelminthes and Aschelminthes** - Parasitism and Parasitic adaptations in helminthes.
- C) **Annelida** - Metamerism and segmental organs, Origin of coelom, Excretion.

**Unit-III: Biostatistics** – Concept of sampling, Graphical representation of data, Frequency distribution (Normal, Binomial and Poisson), Measures of central tendency (Mean, Median and Mode). Measures of dispersion, Correlation, Probability, Tests of significance (F, t and  $\chi^2$ ), Regression analysis.

**PAPER-102**

**CELL BIOLOGY, IMMUNOLOGY, TAXONOMY & BIODIVERSITY**

Marks – 50 (Mid Term 10 + 40 End Term)

**Unit-I**

**Cell Biology** – Structure and functions of Endoplasmic Reticulum, Golgi complex, Mitochondria, Lysosomes, Ribosomes, Nucleus.

**Unit-II**

- A) **Cell Biology** – Ultra structure of chromosome, Euchromatin & heterochromatin, Lampbrush & polytene chromosome, Cell cycle, Cell adhesion, Cell Signalling.
- B) **Immunology** – Innate and acquired immunity, structure and function of Antibody, Major Histocompatibility complex, B & T cell diversity, Auto immune diseases. Immuno deficiency & AIDs.

**Unit-III**

- A) **Taxonomy** – History of Taxonomy, Types of Taxonomy (Cyto, Biochemical & Behavioural), Classification, Artificial Vs Natural Classification, Species concept, Rules & Theories of ranking and nomenclature.
- B) **Biodiversity** – Wild lives of India, Hotspots of biodiversity, conservation of biodiversity.

## SEMESTER SYSTEM OF P. G. ZOOLOGY

### PAPER-103 ANIMAL WORLD, HUMAN HEALTH & ECONOMIC ZOOLOGY Marks – 50 (Mid Term 10 + 40 End Term)

**Unit-I Animal World:** Understanding life, Origin of life, Diversity of life, Classification of animals, Levels of organization, Cell as the basic Unit of life, Continuity of life.

**Unit-II Human Health & Diseases:** Elementary idea on various systems and physiological processes of human being, common diseases affecting human health, modern techniques in disease diagnosis & treatment.

**Unit-III Economic Zoology:** Beneficial insects (Honey bee, Silk moth & Lac insects). Economic importance of Honey, Silk and Lac. Common edible fishes of Odisha, Fish products. Common breeds of domestic animals. Transgenic animals.

### PAPER - 104: (PRACTICAL) NON-CHORDATA, BIostatISTICS, CELL BIOLOGY, TAXONOMY, IMMUNOLOGY AND BIODIVERSITY

**Time - 6 hours**

**Marks - 100**

**SECTION – A: DISSECTIONS RELATED TO PAPER – 101** 20 Marks

**SECTION – B: MOUNTING** 10 Marks  
Paramecium, Hydra, Obelia colony, Obelia medusa, Setae of earthworm, Ovary of earthworm, Spicules and gemmules of sponges, Scolex of Taenia, Larval forms of Fasciola, Ephyra larva.

**SECTION – C: CYTOLOGICAL PREPARATION** 10 Marks  
1. Squashing of onion root tip to study mitosis.  
2. Squashing of Grasshopper testis to study meiosis.  
3. Study of sex chromatin from buccal epithelium or hair root cells of human females.

**SECTION – D: BIostatISTICS**  
15 Marks  
Problems related to mean, median, mode, standard deviation, 't' test and  $\chi^2$  test.

**SECTION – E: SPOTTING** 3×10=30  
Marks  
1. Museum specimens from the Phyla Porifera, Coelenterata, Helminthes and Annelida.  
2. Permanent slides from Paramecium, Amoeba, Noctiluca, Trypanosoma, Hydra, Earthworm, Leech, Sponge, Taenia and Nereis  
3. Slides of different stages of mitosis and meiosis.

**SECTION – F: VIVA-VOCE** 05 Marks  
**SECTION – G: RECORD AND SESSIONAL COLLECTIONS**  
10 Marks



## **SEMESTER SYSTEM OF P. G. ZOOLOGY**

### **SECOND SEMESTER**

#### **PAPER-201: NON-CHORDATA, EVOLUTION, PALAENTOLOGY**

**Marks – 50 (Mid Term 10 + 40 End Term)**

**Unit-I: Arthropoda** – Onychophora-Peripatus, Xiphosura - Limulus, Larval forms in Crustaceans, Life cycle of Sacculina and Parasitic castration, Useful insects (Silk moth, Honey bee, Lac insects).

#### **Unit-II**

- A) **Mollusca** - Foot in molluscs, Torsion and de-torsion in Gastropoda.
- B) **Echinodermata** - Water vascular system, Larval forms in Echinoderms.
- C) **Minor Phyla** - Structure and affinities of Rotifera, Brachiopoda, Phoronida.

#### **Unit-III**

- A) **Evolution** - Origin of life, Neo-Lamarckism, Neo-Darwinism, Modern Synthetic theory, Isolation, Hardy-Weinberg equilibrium and origin of species. Evolution of man
- B) **Palaeontology** - Fossils, Fossilization and dating of fossils, Continental drift & Animal distribution.

#### **PAPER-202: ECOLOGY, BIOTECHNOLOGY & ETHOLOGY**

**Marks – 50 (Mid Term 10 + 40 End Term)**

**Unit-I: Ecology** - Concept and structure of ecosystems, Food chain, Food web, Tropic level, Energy flow, Ecological pyramid, Bio-geochemical cycles (Carbon and Nitrogen), Environmental factors (Light and Temperature), Soil, Biotic commUnity, Population dynamics, Animal associations.

**Unit-II: Biotechnology** - Recombinant DNA Technology, Isolation of DNA, C-DNA synthesis, Restriction endonucleases, Cloning vectors, Blotting techniques (Southern blot, Northern blot, Western blot, Dot and Slot blot), DNA sequencing, DNA finger printing, Application of recombinant DNA in agriculture and medicines.

**Unit-III: Ethology** - Ethological concept, Orientation in animals, Courtship and mating behavior, Physiological basis of behavior, Learning, Migration in fishes and birds.

## **SEMESTER SYSTEM OF P. G. ZOOLOGY**

### **PAPER-203: GENETICS, MOLECULAR BIOLOGY, MICROBIOLOGY**

**Marks – 50 (Mid Term 10 + 40 End Term)**

**Unit-I: Genetics** – Interaction of genes, Multiple allele, Blood group inheritance, Rh-factor, Linkage, Crossing over, Chromosome mapping, Sex determination, Sex linked inheritance, Regulation of sex chromosome and Lyon's hypothesis, Structural and numerical changes in chromosomes, Cytoplasmic inheritance.

**Unit-II: Molecular Biology** – Structure of DNA and RNA, Types of DNA and RNA, Nucleic acid as the genetic material, Replication of DNA, Recon, Muton, Cistron, Split gene, Overlapping gene, Jumping gene, Genetic code, Protein synthesis, Regulation of gene expression, Operon concept, C-value paradox.

**Unit-III: Micro Biology** – Virus, Types of virus, Viral infection, Life cycle of bacteriophage, Bacteria-structure, Types and reproduction. Growth in bacteria, Bacterial recombination, Retrovirus, Adenovirus, Oncogenes.

### **PAPER - 204 (PRACTICAL) NON-CHORDATA, EVOLUTION, PALAENTOLOGY, ECOLOGY, BIOTECHNOLOGY, ETHOLOGY, GENETICS, MOLECULAR BIOLOGY AND MICROBIOLOGY**

**Time - 6 hours**

**Marks - 100**

**SECTION A: DISSECTION OF SYSTEMS OF PRAWN, PILA AND SEPIA** 20 Marks

**SECTION – B: MOUNTING**

10 Marks

Larvae of crustaceans, Echinoderms, Statocyst of Prawn, Osphradium of Pila, Radula of Pila, Larvae of molluscs, Pedicellaria of Echinoderms.

**SECTION – C: ECOLOGICAL EXPERIMENT**

10 Marks

1. Determination of dissolved O<sub>2</sub> content of water.
2. Determination of dissolved CO<sub>2</sub> content of water.
3. Determination of chlorine content of water.
4. P<sup>H</sup> of soil.
5. Study of animal associations.

**SECTION – D: ETHOLOGICAL EXPERIMENT**

10 Marks

1. Study of learning.
2. Negative and positive transfer of learning.

**SECTION – E: MICROBIOLOGY**

05 Marks

1. Staining of Lactobacilli from curd.
2. Staining of gram positive and gram negative bacteria.

## SEMESTER SYSTEM OF P. G. ZOOLOGY

### SECTION – F: SPOTTING

3×10=30 Marks

1. Museum specimens from Arthropoda, Mollusca, Echinodermata and Mirror phyla.
2. Permanent slides from Arthropoda, Mollusca, Echninodermata (larvae).
3. Slides of stages of bacteria.
4. Models of fossils.
5. Models of DNA and RNA.

### SECTION – G: VIVA VOCE

5 Marks

### SECTION – H: RECORD AND SESSIONAL COLLECTIONS

10 Marks

## THIRD SEMESTER

### PAPER - 301: CHORDATA

Marks – 50 (Mid Term 10 + 40 End Term)

#### Unit-I

- A) **Protochordata** - Origin of chordates, Biology and affinities of Balanoglossus, Structure and affinities of Herdmania, Structure and affinities of Amphioxus.
- B) **Cyclostomata** – Structure and affinities of Petromyzon.

#### Unit-II

- A) **Pisces** - Origin of fishes, Biology and affinities of Dipnoi, Biology and affinities of Latimeria, Development of swim bladder in fishes, Lateral line system in fishes.
- B) **Amphibia** – Origin of tetrapoda, Parental care in Amphibia, Neoteny in Amphibia.

#### Unit-III

- A) **Reptilia** – Structure and affinities of Sphenodon, Biting mechanism and venom in snakes.
- B) **Aves** - Origin of birds, Perching mechanism in birds.
- C) **Mammalia** – Structure, distribution and affinities of Prototheria and Metatheria.
- D) **Comparative Study** – Comparative account of heart, aortic arches and kidney.

### PAPER - 302: PHYSIOLOGY, ENDOCRINOLOGY AND EMBRYOLOGY

Marks – 50 (Mid Term 10 + 40 End Term)

**Unit - I: Physiology** – Physiology of digestion, Mechanism of respiration, Respiratory pigments, Oxygen equilibrium curve, Structure of heart and its working, Cardiac cycle and its regulation, Blood coagulation, Structure and function of nephron, Mechanism of urine formation, Osmoregulation.

## SEMESTER SYSTEM OF P. G. ZOOLOGY

### Unit - II

- A) **Physiology** – Nerve conduction and synaptic transmission of impulses, Mechanism of muscle contraction.
- B) **Endocrinology** – Chemical nature of hormones, Mechanism of hormone action, Second messenger concept, Structure and function of Pituitary, Thyroid and Adrenal gland.

**Unit - III: Embryology** – Structure and formation of gametes, Fertilization, Concept and types of cleavage, Role of yolk on cleavage and development, Gastrulation, Embryonic induction and organiser concept, Placentation in Mammal, Regeneration.

### PAPER - 303: BIOCHEMISTRY, BIOPHYSICS AND INSTRUMENTATION

Marks – 50 (Mid Term 10 + 40 End Term)

**Unit-I: Biochemistry** – Structure of Biomolecules such as carbohydrates, Proteins, Lipids, Amino acids and Vitamins, Protoplasm, P<sup>H</sup>, Buffers and buffering mechanism, Classification of enzymes, Enzyme action, Enzyme kinetics, Regulation of enzyme activities.

#### Unit-II:

- A) **Biochemistry** – Metabolism of carbohydrate-glycolysis, TCA cycle, HMP shunt,  $\beta$ -oxidation of fatty acids, Electron transport system, Oxidative phosphorylation.
- B) **BiophysicS** – Membrane system, Membrane composition, Membrane transport (osmosis, diffusion and active transport).

#### Unit-III

- A) **Biophysics** – Intermolecular forces, Dipole-dipole movement, Ionic and Hydrogen bonding, Vander Wall's forces, Principle of thermodynamics.
- B) **Instrumentation** – Microscopy, Types and Principles of compound, Electron and phase contrast microscope, Centrifugation, Electrophoresis Spectroscopy.

### PAPER – 304 (PRACTICAL) CHORDATA, PHYSIOLOGY, ENDOCRINOLOGY, EMBRYOLOGY, BIOCHEMISTRY, BIOPHYSICS, INSTRUMENTATION

Time - 6 hours

Marks - 100

#### SECTION – A: DISSECTION

20 Marks

1. Cranial nerves of Scoliodon.
2. Affarent and Efferent branchial arteries of scoliodon.
3. Arterial and venous system of frog.
4. Arterial and venous system of calotes.

## **SEMESTER SYSTEM OF P. G. ZOOLOGY**

### **SECTION – B: MOUNTING**

10 Marks

1. Ampulae of Lorenzini of Scoliodon,
2. Hyoid apparatus of frog and calotes,
3. Pecten of bird, Feathers of birds.
4. Scales of fishes.

### **SECTION – C: PHYSIOLOGICAL EXPERIMENTS**

10 Marks

1. Estimation of Hb% of human blood.
2. Preparation of haemin crystals of frog and man.
3. Total RBC and WBC count of human blood.
4. Estimation of MCH value of human, frog and calotes.

### **SECTION – D: BIOCHEMISTRY**

10 Marks

1. Determination of ascorbic acid content in lemon juice.
2. Determination of casein content of milk.
3. Estimation of glycogen content of liver.
4. Estimation of lactose content of milk.
5. Determination of isoelectric point of glycine.
6. Determination of unknown sugar.

### **SECTION – E: EMBRYOLOGICAL EXPERIMENTS**

05 Marks

1. Window preparation of chick blastodisc.
2. Preparation of permanent slides of chick embryo of different hours of incubation.
3. Collection of different stages of tadpole larva.

### **SECTION – F: SPOTTING**

3×10=30 Marks

1. Museum specimens from Cyclostomes, Pisces, Amphibia, Reptilia, Aves, Mammalia.
2. Histological slides of different regions of digestive tract, artery, vein, testes, ovary, liver, kidney of frog and rabbit.
3. Histological slides of Endocrine glands.
4. Bones of frog and rabbit.
5. Description and working principles of instruments.

### **SECTION – G: VIVA VOCE**

5 Marks

### **SECTION – H: RECORD AND SESSIONAL COLLECTIONS**

10 Marks

## **FOURTH SEMESTER**

### **PAPER - 401: (SPECIAL PAPER – I)- ICHTHYOLOGY AND FISHERIES**

Marks – 50 (Mid Term 10 + 40 End Term)

**Unit-I: Body Form, Diversity And Classification** - Classification of fishes with character and example of all important orders bearing local fauna; Hill stream fishes emphasizing hill stream adaptation; Deep sea fishes Emphasizing deep sea adaptation; Fin structure, modification and function; Theories regarding origin of paired fins; Colouration in fishes.

## **SEMESTER SYSTEM OF P. G. ZOOLOGY**

**Unit-II: Special Organs** - Sound production mechanism; Electric fishes-their types; Location of electric organs; origin, structure and function of electric organs; Bioluminescence-physiology and biological significance of luminescence; poisonous fishes and their poison apparatus: pharmacology and toxicology of fish poison.

**Unit-III: Morphology, Histology And Behavior** - Circadian rhythm in fishes; Pairing, courtship & parental care in fishes; Migration of fishes; Digestive system, excretory system and Respiratory system of fishes.

### **PAPER-402: (SPECIAL PAPER – I) ICHTHYOLOGY AND FISHERIES Marks – 50 (Mid Term 10 + 40 End Term)**

**Unit-I: Fish Physiology**- Food, feeding habit, feeding behavior and adaptation; Structure of alimentary canal and physiology of digestion and absorption; Respiratory system, morphology of gill filament, gas exchange at gill surface; Air breathing fishes.

**Unit-II: Ecology** - Ecology of aquatic ecosystem- river, reservoirs, estuaries, lakes and fish farm ponds; Fish population, population density, structure estimation of population, population dynamics, Growth and age studies on fishes; Aquatic pollution and fisheries; Interspecific relationship between fishes and other living organisms.

**Unit-III: Fish Pathology and Fish Product and by Product** - Symptoms- etiology and treatment of common diseases of fishes, fish product and by products ( liver oil, body oil, fish meal, fish flour, manure, guano, isinglass, fish fin and leather) and marketing of fish and fish products.

### **PAPER-403: (SPECIAL PAPER - I): ICHTHYOLOGY AND FISHERIES Marks – 50 (Mid Term 10 + 40 End Term)**

**Unit-I: Fisheries (Capture and Culture Fisheries)** -Marine fisheries of world; Inland fisheries of the world, Indian fisheries - statistics of Indian catches; Inland capture fisheries of India (riverine, estuarine, reservoir and cold water fisheries); Marine capture fisheries of India (coastal, deep sea and shore); Hilsa fishery; Oil sardine fishery, Mackerel fishery, shark and ray fishery; carp fish farm and its management - intensive and extensive fish farm management; Induced breeding of major carps; composite fish culture; Exotic and transplanted fishes; Importance of exotic fishes in India.

**Unit-II: Methods of Fishing and Preservation** : Crafts and gears used in India for fishing in inland and marine water; Unconventional fishing methods: Electro fishing, light fishing, fish finders (Echo sounder and sonar); Principles, methods and problems in fish preservation; Handling & clearing of fishes; fish chilling, freezing, canning, sating, drying, smoking and pickling.

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**Unit-III: Nutritional Value of Fish and Non-Fish Organism Fisheries** – Biochemical composition of raw fish; Nutritional value of raw, preserved, processed fish and fishery products; Fish decomposition - post mortem changes and rigor mortis, post rigor decay and spoilage of fish, bacterial spoilage, chemical spoilage, autolysis; Spoilage of marine and fresh water fish; Food poisoning; intoxication and allergies from fish; Culture of non-fish organism (Prawn, Frog and Pearl culture).

### **PAPER-404 - (PRACTICAL): (SPECIAL PAPER - I) ICHTHYOLOGY AND FISHERIES**

**Time - 6 hours**

**Marks - 80+20**

**(Practical - 80 Marks + Dissertation / Project - 20 Marks)**

#### **SECTION - A: DISSECTION**

15 Marks

- 1) **Major-** (i) Nervous system of Wallago attu, Labeo rohita or any major carp  
(ii) Other system of the fish.
  
- 2) **Minor-** (i) Accessory respiratory organs of Channa, Heteropneustes, Clarias, Anabas.  
(ii) Electric organ and its nerve supply in electric ray-Torpedo.  
(iii) Weberian ossicles and internal ear of carp or any other fish.

#### **SECTION - B: TAXONOMY**

5 Marks

Identification of at least 25 local fishes and tracing their classification up to species.

#### **SECTION - C: MICROTOMY AND PERMANENT MOUNTING**

10 Marks

1. Early preparation of paraffin embedded blocks of fish tissues for examination.
2. Section cutting & stretching.
3. Staining, mounting & identification.
4. Permanent mounting of different scales.

#### **SECTION - D: FISH ECOLOGY**

10 Marks

1. Test of water from fishing ponds/ reservoirs/local tanks for p<sup>H</sup> alkalinity, turbidity, hardness and CO<sub>2</sub> content. (Any three parameters)
2. Oxygen consumption of given fish.
3. Estimation of DO<sub>2</sub> of different fishing ponds/ local tanks by Winkler's method.

#### **SECTION - E: SPOTTING**

3×5=15 Marks

1. Fishing craft and gears. (Any one to be set)
2. Fish food.
3. Fish bone.
4. Adaptive features of hill stream/ migratory / flying / deep sea fishes.
5. Any other suitable items.

#### **SECTION - F: INDUCED BREEDING**

5 Marks

1. Removal of pituitary gland from any major carp.
2. Method of preparation of gland extract for injection and preservation.

#### **SECTION - G: VIVA VOCE**

10 Marks

#### **SECTION - H: PRACTICAL RECORD / COLLECTION**

10 Marks

**Dissertation / Project**

20 Marks

## **SEMESTER SYSTEM OF P. G. ZOOLOGY**

### **PAPER-401: (SPECIAL PAPER): CYTOGENETICS**

**Marks – 50 (Mid Term 10 + 40 End Term)**

#### **Unit-I : Physical Basis of Heredity**

A) **Nucleus** - Structure and function (Number, Shape, size, nuclear envelope, nuclear lamina, nuclear matrix, nucleoplasm, chromatin, nucleolus, NOR, chromosomes, functions).

B) **Chromosome** - Ultra structure and function of eukaryotic chromosome, Karyotype; Types of chromosomes (sex chromosomes, autosomes, B chromosome or supernumerary chromosomes, microchromosomes, megachromosomes, limited chromosomes, holocentric, monocentric and dicentric chromosome), Special chromosomes / giant chromosomes (Polytene chromosomes and lamp brush chromosomes).

C) **Centromere and Telomere** - Structure and function of centromere; Synaptonemal complex; Structure and function of telomere, kinetochore. mitotic apparatus.

#### **Unit-II: Genomic Composition, Changes and Inheritance:**

A) **Heterochromatin and Euchromatin** - Chemical nature and function of heterochromatin; Types of heterochromatin; Chemical nature and function of euchromatin; Difference between euchromatin and heterochromatin. Role of heterochromatin in evolution.

B) **Chromosomal Changes and Inheritance** - Chromosomal basis of inheritance, chromosomal aberrations (structural and numerical); Human chromosomes, Recognition of sex from interphase nucleus; Chromosomal disorders in man (involving number of sex chromosomes and autosomes and structure of chromosomes); Inheritance of Mendelian characters in man; Heredity of twins (in man) and the significance of study of twins.

#### **Unit-III: Prokaryotic Genome and Genomic Differentiation**

A) Viral and bacterial genomes: Recombination in bacteria; Retroviruses; Reproduction of DNA virus and RNA virus.

B) Variation in genome size and composition: C-value paradox; Repetitive DNA; Satellite DNA; Cot value, Dosage compensation, Genetic mapping (Restriction mapping, mapping by RFLPs and mapping by RAPDs and VNTRs), Cytogenetic maps using molecular markers.

### **PAPER - 402: (SPECIAL PAPER): CYTOGENETICS**

**Marks – 50 (Mid Term 10 + 40 End Term)**

#### **Unit-I : Genes and Their Action**

A) Mechanism of transcription; Reverse transcription; RNA dependent RNA synthesis, Regulation of transcription; Replication of DNA in prokaryotes and eukaryotes.

B) Protein synthesis; Regulation of protein synthesis: Operon concept and different types of operon in prokaryotes. (Lac, Gal, Ara, Trp, Operon).

C) Exons, introns, split genes and RNA splicing.



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### **Unit-II: Recombinations, Sequencing And Synthesis Of Genome**

- A) Recombination at molecular level; Sister chromatid exchanges; Transposable elements; Retroposons.
- B) Cytogenetics of cancer (including chromosomal and genetic causes of cancer).
- C) Artificial gene synthesis; DNA sequencing; RFLP; PCR.

### **Unit-III: Recombinant DNA Technology**

- A) **Cloning Of Gene** - Restriction endonucleases ligases, cloning vectors; cloning by colony hybridization; Selection of clones; Southern blotting, Northern blotting; Western blotting.
- B) **Gene Transfer** – Isolation on gene; preparation of the gene to be transferred; Techniques of gene transfer; Fate of transferred gene; Problems of gene transfer; Gene therapy.
- C) **Transgenic Animal** - Methods of creating transgenic animals; Transgenic mice; Transgenic cattle; Transgenic fishes; Transgenic pig; Transgenic sheep.

## **PAPER-403: (SPECIAL PAPER): (CYTOGENETICS)**

**Marks – 50 (Mid Term 10 + 40 End Term)**

**Unit-I: Cytogenetics:** Plant tissue culture techniques; Animal culture techniques, Kinetics of cell growth; Culture media, Hybridoma; Monoclonal antibody; Chimeric antibody.

**Unit- II: Cytogenetic Techniques:** In situ hybridization with DNA probes; Fluorescence in situ hybridization (FISH); Genomic in situ hybridization; Autoradiography; Chromosome painting; Chromosome banding techniques (G-banding, Q-banding, C-banding, R-banding, N-banding and T-banding); DNA finger printing.

### **Unit-III: Chromosome Manipulation Techniques**

- A) Whole genome transfer; Individual whole chromosome transfer; Substitution of chromosome arms; Interchanges through irradiation.
- B) Flow cytometry; Ames-test; Technique to demonstrate sister-chromatid exchange; Micronucleus Test (induction of MN and its demonstration), Construction of artificial chromosome.

## **PAPER-404 (PRACTICAL): (SPECIAL PAPER) CYTOGENETICS**

**Time - 6 hours**

**Marks - 80+20**

**(Practical - 80 Marks + Dissertation / Project - 20 Marks)**

### **SECTION –A:**

12 Marks

1. Temporary chromosomal preparation by squashing onion root tip to study mitosis.
2. Temporary chromosomal preparation by grasshopper testis to study meiosis.
3. Permanent chromosomal preparations from onion root tip and grasshopper testes.

### **SECTION – B:**

12 Marks

Chromosomal preparations from bone marrow cells of rat/mice, gill epithelial cells of fish and bone marrow cells of chick by air-dry-Giemsa stain technique.

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**SECTION – C:** 06 Marks

1. Preparation of slides to demonstrate sexchromatin/Barr body in hair root cells /buccal epithelial cells of human female.
2. Preparation of slides to demonstrate polytene chromosome in the salivary gland cells of *Drosophila* larvae.
3. Staining of DNA and RNA.

**SECTION – D:** 5 Marks

Drawing of Camera Lucida diagrams of chromosomes.

**SECTION – E:** 10 Marks

1. Staining of heterochromatin by C-band technique
2. Staining of NOR by N-band technique.

**SECTION – F: SPOT IDENTIFICATION** 3×5=15 Marks

1. Chromosomal aberrations Karyotype of rat, mouse, bird
2. Dicentric bridges, sex chromatin molecules, lagging chromosomes and micronuclei
3. Banding pattern of chromosomes.
4. Sister chromatic exchanges
5. Cytochemically stained DNA and RNA
6. Autoradiographs of chromosomes
7. Different stages of mitosis
8. Different stages of meiosis

**SECTION – G: VIVA VOICE** 10 Marks

**SECTION – H: RECORD AND SESSIONAL PREPARATIONS AND COLLECTIONS** 10 Marks  
**Dissertation / Project** 20 Marks

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