



**अटल बिहारी वाजपेयी विश्वविद्यालय बिलासपुर**  
(छत्तीसगढ़)  
सेमेस्टर पाठ्यक्रम  
**M.Sc. ZOOLOGY**

**SCHEME OF EXAMINATION & DISTRIBUTION OF MARKS**

**SEMESTER - I**

Paper No.	Title of the Paper	Marks	
		External	Internal
I	Invertebrate structure and function, Minor Phyla	80	20
II	Animal Behaviour	80	20
III	Quantitative Biology	80	20
IV	Ecology and environmental physiology	80	20
	M.Sc. Zoology Lab Course I	100	
	M.Sc. Zoology Lab Course II	100	

**SEMESTER - II**

Paper No.	Title of the Paper	Marks	
		External	Internal
I	General & comparative endocrinology of vertebrates	80	20
II	Gamete biology and reproductive physiology in human beings	80	20
III	Molecular cell biology	80	20
IV	Tools and techniques for biology	80	20
	M.Sc. Zoology Lab Course I	100	
	M.Sc. Zoology Lab Course II	100	

**SEMESTER - III**

Paper No.	Title of the Paper	Marks	
		External	Internal
I	Comparative anatomy of vertebrates	80	20
II	Biosystematics, taxonomy & biodiversity	80	20
III	Immunology and developmental biology	80	20
IV	Population genetics & evolution	80	20
	M.Sc. Zoology Lab Course I	100	
	M.Sc. Zoology Lab Course II	100	

**SEMESTER - IV**

Paper No	Title of Paper	Marks	
		External	Internal
I	General physiology and neurophysiology ( <i>compulsory</i> )	80	20
II	Biochemistry and metabolic regulation and cell function ( <i>compulsory</i> )	80	20
<b>Optional Group-I</b>			



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III	Fish(Ichthyology) structure and function	80	20
IV	Applied Fisheries	80	20
<b>Optional Group-II</b>			
III	Cell biology	80	20
IV	Cellular organization and molecular organization	80	20
<b>Optional Group-III</b>			
III	Entomology	80	20
IV	Applied Entomology	80	20
<b>Optional Group-IV</b>			
III	Wildlife conservation	80	20
IV	Environment and biodiversity conservation	80	20
	M.Sc. Zoology Lab Course I	100	
	M.Sc. Zoology Lab Course II	100	

Student has choice to opt. For any one group out of four optional groups. ( Paper III and IV in semester four)

Each theory paper will have 5 questions of equal marks. First question will be compulsory encompassing all the five units without any internal choice, whereas rest questions will be unit wise with internal choice.

Internal Assessment shall comprise of two parts- Ten marks for test and ten marks for seminar/ assignment /presentation.



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SEMESTER-I

PAPER-I

INVERTEBRATE STRUCTURE AND FUNCTION, MINOR PHYLA

## Unit 1

- Origin of life unicellular and multicellular cellular organisms
- Body cavity-Acoelome, Pseudocoelome, Coelome  
Locomotion;  
Amoeboid movement, ultra structure of cilia and flagella, ciliary and flagellar movements  
Myonemes and muscle fibres in invertebrates, structure and their involvement in locomotive action  
Hydrostatic movements in Coelenterates, Annelida and Echinodermata

## Unit 2

- Nutrition and digestion  
Patterns of feeding and digestion in lower metazoa  
Filter feeding in Polychaete, Mollusca and Echinodermata
- Respiration.  
Respiratory organs- Gills, Trachea and Lungs  
Physiology of Respiratory pigments in Invertebrates  
Mechanism of Respiration in invertebrate phyla

## Unit 3

- Excretion  
Excretion in lower invertebrates -simple diffusion, contractile vacuole, protonephridea and Solenocytes  
Excretion in higher invertebrates – Coelom, Caelomoduct, Nephridia, Coaxal gland, malphigian tubes, organs of Bojanus and green gland  
Mechanism of excretion
- Nervous system.  
Primitive nervous system.-Coelenterata and Echinodermata  
Advances Nervous system- Annelida, Anthropoda(Crustacea and Insecta ) and Mollusca (Cephalopoda) Torsion in Gastropoda.

## Unit 4

- Invertebrate larval forms  
Larval forms of Trematoda and Cestoda  
Larval forms of Crustacea  
Larval forms of mollusca



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Larval forms of Echinodermata

- Minor phyla
- Organization and general characters of-
  - Ctenophora
  - Rotifera
  - Brachiopoda
  - Acanthocephala

**Suggested Reading Materials**

1. Invertebrate structure and functions:-  
E. J. W Barrington English language Book Society UK
2. Invertebrate Zoology :-  
Robert Barnes IVth edition Holt Saunders International Edition Japan
3. The Cambridge Natural History Vol1-9  
S.F Harmer, A.E. Shipley  
Todays & Tomorrows Book Agency, N Delhi India
4. A text book on Zoology Invertebrate  
Park Hasvell, Marshall & Williams, AITBS  
Publishing & Distributers, Delhi
5. The invertebrates Vol. 1-9  
Libbic Henrietta Hyman, McGraw Hill Book Company



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## SEMESTER-I PAPER-II ANIMAL BEHAVIOUR

### Unit 1

- **Introduction-**  
Introduction to Ethology  
History of Ethology, observation and Description  
Ethology as a branch and its significance  
Methods of studying behaviour
- **Ecological aspects of behaviour-**  
Food selection and feeding behaviour  
Antipredator defences  
Aggression  
Territoriality  
Innate Behaviour

### Unit 2

- **Perception of the environment**  
Mechanical  
Electrical  
Olfactory  
Auditory  
Visual
- **Communication**  
Chemical  
Visual  
Light  
Audio  
Species specificity of Songs  
Evolution of Languages
- **Neural and Hormonal Control of Behaviour**

### Unit 3

- **Social Behaviour**  
a. **Aggregations**  
Schooling in Fishes  
Flocking in Birds  
Herding in Animals



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## b. Group selection

Kin selection

Altruism

## c. Social Organization in insects and primates

### • Reproductive Behaviour

Reproductive strategies

Mating System

Courtship

Sexual selection

## Unit 4

### • Biological rhythms

Circadian and circannual rhythms

Orientation and navigation

Migration of fish and birds

### • Learning and memory

Conditioning

Habituation

Insight Learning

Associative Learning

Reasoning

## Suggested Reading Material

1. Alcock, J. Animal Behaviour: An evolutionary approach. Sinauer Assoc. Sunderland, Mass. USA
2. Bradbury, J.W. and Vehrencamp S.L., Principles of animal communication, Sinauer Assoc. Sunderland, Mass, USA
3. Clutton-Brock, T.H. The evolution of Parental Care, Princeton University, Press Princeton NJ, USA
4. Eibl-Eibesfeldt, I. Ethology. The biology of behaviour. Holt, Rinehart & Winston, New York
5. Goud, J.L. The mechanisms and evolution of behaviour
6. Hauser, M. The evolution of communication, MIT press, Cambridge, Mass, USA
7. Hinde, R. A. Animal Behaviour: The synthesis of Ethology and Comparative psychology McGrawHill, New York
8. Krebs, J.R. and N.B. Davier: Behavioural Ecology. Blackwell, Oxford, UK
9. Wilson, E.O. Sociobiology: The new synthesis Harvard University Press, Cambridge



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SEMESTER-I  
PAPER-III  
QUANTITATIVE BIOLOGY

**Unit 1**

• **Basic mathematics for biologists**

Matrices and vectors

Exponential functions

• **Biostatics**

Collection and presentation of data, Tabulation, diagrammatic and graphical presentation

**Unit 2**

- General ideal about normal, binomial and poisson distribution
- Measures of Central tendencies –Mean, Median, Mode, Standard Error
- Mean and standard deviation, Variance
- Hypothesis testing-t test, chisquare test, f test

**Unit 3**

- Probability theory, distribution and their properties
- Correlation
- Regression
- Analysis of Variance

**Unit 4**

• **Mathematical Modelling**

Types of models-statistical, empirical and mechanistic, simulation

Properties of models- generality, precision and realism

Detailed treatment of model of cycling of nutrients in an ecosystem

**Suggested reading materials:-**

1. Batschelet, E. Introduction to mathematics for site scientist, springer-verlag, Berlin
2. Jorgenser, S.E. Fundamental of Ecological Modelling E. sevier New York
3. Lenderen D Modelling in behavioural ecology, chapman & Hall London U.K
4. Sokal, R.R and F.J Rohit Biometry Freeman San Fransisco
5. Snedecor, G. W and W.G Cochran, Statistical methods, AffiliatedEast, West Press New Delhi (Indian ed.)
6. Murray, J.D Mathematical Biology, Springer Verlag Berlin





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SEMESTER-I  
PAPER-IV  
ECOLOGY AND ENVIRONMENTAL PHYSIOLOGY

**Unit 1**

• **Ecology:-**

Abiotic, Climatic, Edaphic and Biotic Factors

Limiting Factors

Biogeochemical cycle-Nitrogen, Phosphorous, Sulphur, Carbon and Water Cycle

Community Ecology-Biotic community, community structure and its characteristics, Ecotone and Edge effects

Ecological Succession

• **Adaptation:-**

Levels of adaptation

Types of adaptation

Significance of body size

Physiological adaptation to different Environment of-

a)Marine b)Freshwater c)Terrestrial d)Extreme aquatic & extreme terrestrial

**Unit 2**

• **Population Ecology**

Exponential growth

Logistic growth model

Stochastic and time lag model of population growth

• **Demography**

Life table

Net reproductive rate

Reproductive value

• **Population regulation**

Extrinsic mechanism

Intrinsic mechanism

• **Models of pray-predator dynamics**

**Unit 3**

• **Pollution Ecology**

Definition and types of pollution

Bio indicator of pollution

Environment and impact assessment

• **Environmental toxicology**



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Toxic chemicals  
Toxicity, toxicants and mechanisms of action

• **Environmental Issues**

Green House gases  
Ozone Depletion  
Environmental awareness programmes

**Unit 4**

• **Stress Physiology**

Basic concept of stress and strain , stress resistance, stress tolerance and stress avoidance  
Adaptation-acclimatization and acclimation  
Concept of homeostasis  
Endothermy and Physiological mechanisms of regulation of body temperature  
Osmoregulation in aqueous and terrestrial environment  
Physiological response to Oxygen deficient stress  
Physiological response to body exercise  
Meditation, yoga and their effects

**Suggested reading material**

1. Eckert, r Animal Physiology : Mechanism and adaptation W.H. freeman & co, NY
2. Environmental Physiology: Pat Willmer, Grahum Stone
3. Hochanchka, P.W. and Somero, G.N:Biochemical Adaptation, Princeton NJ
4. Hoar, W.S General and comparative animal physiology, Prentice hall of India
5. Schiemdt Nielsen, animal Physiology : adaptation and environment, Cambridge
6. Strand, F.L Physiology: Regulatory systems approach, Macmillan Pub Co, NY
7. Pummer, L. Practical Biochemistry, Tata McGraw Hill
8. Prosser, C.L. Environmental and metabolic animal physiology, Willey-Liss Inc. NY
9. Wilson, K. and Walker, J. Practical Biochemistry
10. Wilmer, P.G. Stone and, Johnston, environmental Physiology. Blackwell Sci Oxford
11. Newell, R.C(ed.)1976 Adaptation to environment Essays on the physiology of marine animals , Butterworths , London , UK
12. Townsend, C.R. and P. Calow : Physiology Ecology : an evolutionary approach to resource use, Blackwell Sci. Publ.Oxford, UK
13. Alexander, R.M.N. Optima for animals Princeton Univ press, Princeton NJ



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SEMESTER-I  
LAB-COURSE I

Time-06 Hours  
Max. Marks-100

**Invertebrates**

1. Study of non-chordates through museum specimen
2. Study of permanent slides of non-chordates
3. Dissection of representative types (invertebrates)
4. Squilla, Mytilus, Sepia, Aplysia, Echinus

**5. Mounting-**

Permanent and suitable stained micro-preparation

Earthworm-nerve ring, ovary, spermathecal, nephridia

Cockroach-mouth parts, salivary glands, trachea

Prawn appendages, statocyst

Protozoan- rhizopods, flagellates and ciliates ( fresh water forms) prolozoon  
ullase

Porifera-spicule sand gemmules of fresh water sponges

Crustaceans and rotifers

Larval forms of the free living invertebrates

**Animal behaviour-**

**6. Experiments related to Animal Behaviour**

Feeding behaviour in house fly

Life cycle of Lac insect and honey bee ( chart/model/material)

Study of structural organization of the bee hive

Learning behaviour-

Conditioned and unconditioned reflex

**7. Projects-**

a) Visit to study the management of following->

Fish farm, dairy farm, poultry farm, sericulture and apiculture

b) Study of Invertebrate local fauna

c) Any other relevant topic

***Student should prepare a report and submit***

**Note-**

1. Use of animal for dissection and practical work is subject to the conditions that they are not banned under the wildlife protection act
2. External features and anatomy should be studied by digital techniques and the alternatives. Wherever live animals is studies it should be either pest or colourable species without painning them



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SEMESTER-I  
LAB-COURSE I

Time-06 Hours  
Max. Marks-100

Distribution of marks in practical exam

1. Spotting (1-10)-invertebrates	(20)
2. Mounting	(10)
3. Dissection (virtual)	(10)
4. Exercises based on behaviour (Two exercises)	(30)
5. Viva	(10)
6. Sessional	(20)

Total = 100

M.SC. SEMESTER I  
LAB-COURSE II

**Quantitative Biology**

1. Collection methods of different types of data
2. Data analysis- tabulation
3. Different graphical and diagrammatic methods of data presentation
4. Calculation of central tendencies based on given data
5. Application of parametric and non-parametric tests
6. ANOVA
7. Study of model types
8. Exercises based on regression
9. Exercise based on correlation

**Ecology and Environmental Physiology**

10. Study of animals showing adaptation to different environments
11. Soil analysis physical and chemical composition of soil
12. Effect of physical exercise on blood pressure
13. Exercise based on blood glucose level
14. Carbonates and nitrates from soil sample
15. Determination of free CO<sub>2</sub> and salinity in pond

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M.SC. SEMESTER I  
LAB-COURSE II

Time-06 Hours  
Max. Marks-100

Distribution of marks in practical exam

1. Exercises based on biostatics (Three)	(30)
2. Exercises based Soil and Water analysis (Two)	(20)
3. Exercises based on Physiology (Two)	(20)
4. Viva	(10)
5. Sessional	(20)

Total = 100



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SEMESTER-II

PAPER-I

GENERAL AND COMPARATIVE ENDOCRINOLOGY OF VERTEBRATES

**Unit 1**

• **AIMS and scope of endocrinology**

Discovery of hormones

Classification of endocrine glands and hormones

Experimental methods of hormones research

• **Comparative morphology of Endocrine tissue**

Pituitary gland

Thyroid, Adrenal

Gastrointestinal tract

Juxtaglomerular apparatus (kidney)

**Unit 2 (15 Lectures)**

• **Life history of hormones-**

Biosynthesis of hormones

- Biosynthesis of simple peptide hormone
  - Biosynthesis of amino acid derived small size hormone (T<sub>3</sub>, T<sub>4</sub>, epinephrine and nor-epinephrine)
  - Biosynthesis of steroid hormone (cortisol, cortisone, corticosterone, progesterone)
- Release of hormone from endocrine gland
- Releasing stimuli
  - Pulsatile release of hormone
  - Releasing mechanism
- **Concentration and transport of hormone in the blood**
- **General mechanism of hormone action**

Plasma membrane hormone receptor and its action

Cytosolic hormone receptor and its action

• **Termination of hormone action and metabolism of hormone**

**Unit 3 (15 Lectures)**

- **Neuro-endocrine system-types of neuro-hormones, synthesis and function of endorphins, enkephalin and hypothalamic hormones**



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• **Synthesis, function control and disorder of following endocrine gland hormones**

- Pituitary hormones
- Adrenal hormones
- Thyroid and parathyroid hormones
- Gastro-intestinal hormones
- juxta-glomerular hormones

**Unit 4 (15 Lectures)**

• **Hormonal regulation and its metabolic activity**

Role of hormone in –

- Carbohydrate metabolism
  - Protein metabolism
  - Fat metabolism
  - Calcium metabolism
- **Role of hormone in fasting**
- **Hormone & behaviour**
- **Role of hormone in growth & development**

**Suggested Reading Materials-**

1. General & comparative endocrinology : E.J.W. Barrington, oxford, Clarendon Press
2. Text book of Endocrinology : R.H. Williams, W.B Saunders
3. Endocrine Physiology : C.R Martin, Oxford Univ. Press
4. Comparative endocrinology : A. Gorbman et al, John Wiley and sons
5. Medical Physiology : W.F. Ganong(1981) :10<sup>th</sup> edition Lange Medical Publications
6. Principles of anatomy and physiology : Torota Grabowski, 9<sup>th</sup> edition, John Wiley & sons
7. Reproductive Physiology of vertebrates: Van Tienhoven, A,(1983) 2<sup>nd</sup> edition Cornell Univ.Press,NY
8. The pituitary gland :Imura.H(1994)2<sup>nd</sup> edition Comprehensive Endocrinology revised series Raven, NY
9. Comparative vertebrate endocrinology : Bentley, P.J.(1976),Cambridge Univ. press, Cambridge
10. Comparative vertebrate endocrinological: Bentley, P.J(1976) Cambridge Univ. press, Cambridge
11. Invertebrate endocrinology:D.B. Temblare,Himalaya Publishing house
12. Endocrinology : Hardley
13. Endocrinology : Negi



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SEMESTER-II

PAPER-II

GAMETE BIOLOGY & REPRODUCTIVE PHYSIOLOGY IN HUMAN BEINGS

Unit 1

- **Endocrinology of sex differentiation & judgment-**  
Chromosomal (genetic) basis of sex determination  
Gonadal sex  
Phenotypic sex  
Brain sex differentiation
- **Reproductive cycle-**  
Adrenarche  
Pubarche and puberty  
Ovarian cycle
  - Formation of ova
  - Luteal cycle
  - Uterine cycle
  - Menstruation cycle
  - Estrous cycle

Unit 2 (15 Lectures)

**Male reproductive system-**

- Anatomy, physiology and morphology of male reproductive system
- Spermatogenesis and development of spermatozoa
- Biochemistry of semen
- Endocrine function in male-**  
Endocrine control of testicular function  
Chemistry and biosynthesis of androgens  
Secretion transport and metabolism of testis hormone  
Physiological role of androgens-
  - Role in spermatogenesis
  - Secondary sex characteristics
  - Anabolic function
  - Physiological roles of estrogens in male
    - Fertility
    - Male behaviour
    - Epiphyseal fusion

Unit 3 (15 Lectures)

- **Female reproductive system**  
Anatomy of female reproductive system-
  - Ovary
  - Fallopian tube
  - Uterus
  - Oogenesis
- **Ovarian hormones**