



**बिलासपुर विश्वविद्यालय, बिलासपुर (छ.ग.) से संबद्ध
समस्त स्नातकोत्तर (शासकीय एवं अशासकीय) महाविद्यालयों में
सत्र 2016-17 से लागू सेमेस्टर पद्धति के अनुसार
नियमित छात्रों के लिए
सेमेस्टर पाठ्यक्रम**

**एम.एससी. (मास्टर ऑफ साइंस)
M.Sc. (Master of Science)**

**विषय - जन्तु विज्ञान
Subject – Zoology**

बिलासपुर विश्वविद्यालय, बिलासपुर (छ.ग.)

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फोन : 07752-220031, 220032, 220033 फैक्स 07752-260294,
ई-मेल : bilaspur.university2012@gmail.com,
वेबसाईट : www.bilaspuruniversity.ac.in

BILASPUR UNIVERSITY, BILASPUR

Syllabus for 2016-17

M.Sc. Zoology

First Semester	Paper No.	Title of 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	200	

Second Semester	Paper No	Title of 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	200	

Third Semester	Paper No	Title of 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	200	

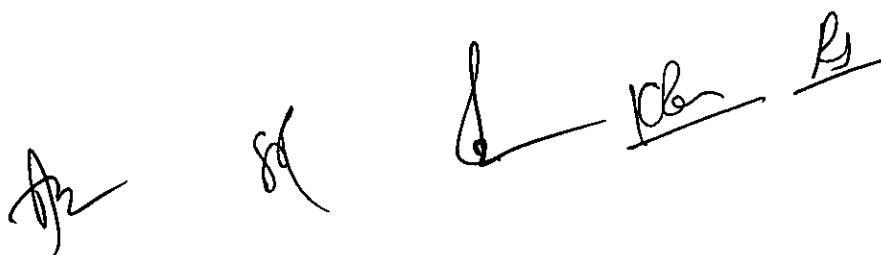
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Dr. R. Sao

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Fourth Semester	Paper No	Title of Paper	Marks	
			External	Internal
	I	General physiology and neurophysiology (compulsory)	80	20
	II	Biochemistry and metabolic regulation and cell function (compulsory)	80	20
Optional Papers (GROUP 1)				
	III	Fish(Ichthyology) structure and function	80	20
	IV	Applied Fisheries	80	20
Optional Papers (GROUP 2)				
	III	Cell biology	80	20
	IV	Cellular organization and molecular organization	80	20
Optional Papers (GROUP 3)				
	III	Entomology	80	20
	IV	Applied Entomology	80	20
Optional Papers (GROUP 4)				
	III	Wildlife conservation	80	20
	IV	Environment and biodiversity conservation	80	20
Practical		M.Sc. Zoology Lab Course	200	





- 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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M.Sc. Semester 1 Zoology

M.Marks= 100

Theory = 80

Internal = 20

Paper 1 -Invertebrate Structure and function, Minor phyla (60 Lectures)

Unit 1 (15 Lectures)

- 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 (15 Lectures)

- 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 (15 Lectures)

- Excretion
 - Excretion in lower invertebrates -simple diffusion, contractile vacuole, protonephridia 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.

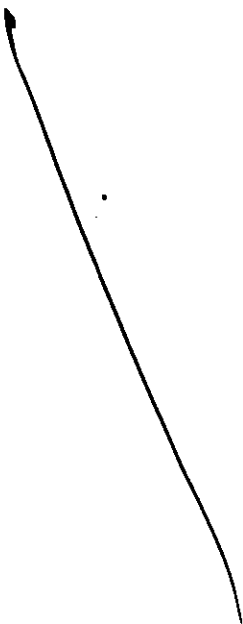
Unit 4 (15 Lectures)

- Invertebrate larval forms
 - Larval forms of Trematoda and Cestoda
 - Larval forms of Crustacea
 - Larval forms of mollusca
 - Larval forms of Echinodermata
- Minor phyla
- Organization and general characters of-
 - Ctenophora
 - Rotifera
 - Brachiopoda
 - Acanthocephala

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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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BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester 1
Zoology

M.Marks= 100

Theory = 80

Internal = 20

Paper II -Animal Behaviour (60 Lectures)

Unit 1 (15 Lectures)

- **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 (15 Lectures)

- **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 (15 Lectures)

- **Social Behaviour**
 - a. **Aggregations**
 - Schooling in Fishes
 - Flocking in Birds
 - Herding in Animals
 - b. **Group selection**
 - Kin selection
 - Altruism
 - c. **Social Organization in Insects and primates**







- **Reproductive Behaviour**
 - Reproductive strategies
 - Mating System
 - Courtship
 - Sexual selection

Unit 4 (15 Lectures)

- **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. SinauerAsoc. 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. he 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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M.Sc. Semester 1 Zoology

M.Marks= 100

Theory = 80

Internal = 20

Paper III Quantitative Biology (60 Lectures)

Unit 1 (15 Lectures)

- **Basic mathematics for biologists**
 - Matrices and vectors
 - Exponential functions
- **Biostatics**
 - Collection and presentation of data, Tabulation, diagrammatic and graphical presentation

Unit 2 (15 Lectures)

- 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 (15 Lectures)

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

Unit 4 (15 Lectures)

- **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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M.Sc. Semester 1 Zoology

M.Marks= 100

Theory = 80

Internal = 20

Paper IV Ecology and Environmental Physiology (60 Lectures)

Unit 1 (15 Lectures)

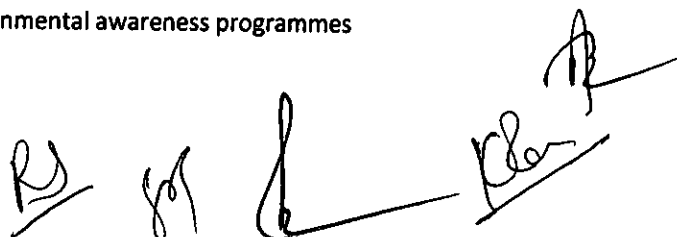
- **Ecology:-**
 - Abiotic, Climatic, Edaphic and Biotic Factors
 - Limiting Factors
 - Biogeochemical cycle-Nitrogen, Phosphorous, Sulphur, Carbon and Water Cycle
 - Community Ecology-Biotic community, community structure and its characteristics, Ecotone and Edge effects
 - Ecological Succession
- **Adaptation:-**
 - 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 (15 Lectures)

- **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 (15 Lectures)

- **Pollution Ecology**
 - Definition and types of pollution
 - Bioindicator of pollution
 - Environment and impact assessment
- **Environmental toxicology**
 - Toxic chemicals
 - Toxicity, toxicants and mechanisms of action
- **Environmental issues**
 - Green House gases
 - Ozone Depletion
 - Environmental awareness programmes



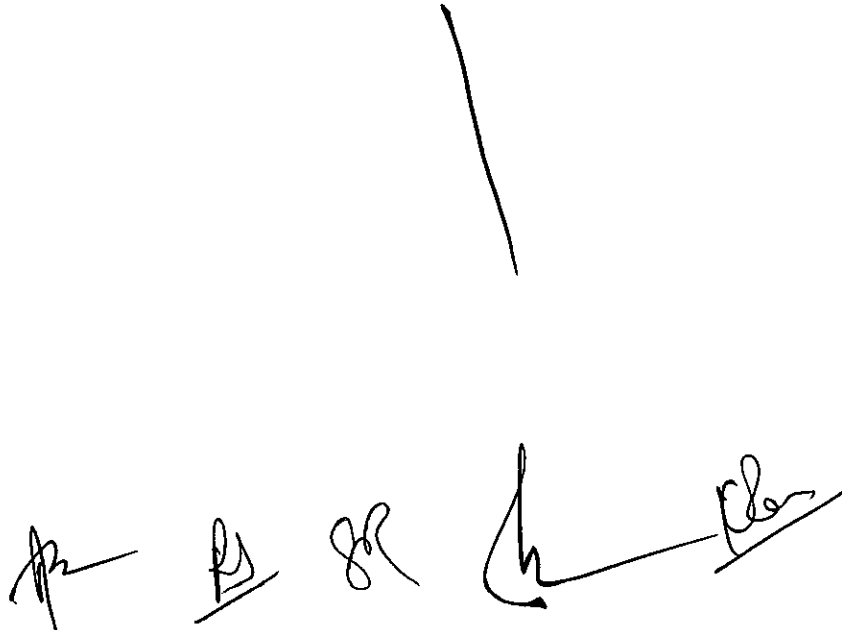
Unit 4 (15 Lectures)

- **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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BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester I

Zoology practical

Lab-course I

1. Study of non-chordates through museum specimen
2. Study of permanent slides of non-chordates
3. Dissection of representative types (invertebrates) (any available animal) virtual/demonstration Squilla, Mytilus, Sepia, Aplysia, Echinus
4. 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)
 - Porifera-spicule and gemmules of fresh water sponges
 - Crustaceans and rotifers
 - Larval forms of the free living invertebrates
5. Animal behaviour-
 - Feeding behaviour in house fly
6. Projects-
 - a) Visit to study the management of following->
Fish farm, dairy farm, poultry farm, sericulture and apiculture
 - b) Study of invertebrate local fauna
Student should prepare a report and submit
7. Life cycle of Lac insect and honey bee (chart/model/material)
8. Study of structural organization of the bee hive
9. Learning behaviour-
 - Conditioned and unconditioned reflex
10. Collection methods of different types of data
11. Data analysis- tabulation
12. Different graphical and diagrammatic methods of data presentation
13. Calculation of central tendencies based on given data
14. Application of parametric and non-parametric tests
15. ANOVA
16. Study of model types
17. Exercises based on regression
18. Exercise based on correlation
19. Study of animals showing adaptation to different environments
20. Soil analysis physical and chemical composition of soil
21. Effect of physical exercise on blood pressure
22. Exercise based on blood glucose level
23. Carbonates and nitrates from soil sample
24. Determination of free CO₂ and salinity in pond

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 are studied it should be either pest or culturable species without painning them

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M.Sc. Semester I

**Zoology Practical
Lab-course I**

Time-08 Hours

Max. Marks-200

Distribution of marks in practical exam

1. Spotting (1-10)-Invertebrates	(20)
2. Mounting	(10)
3. Exercise based on behaviour	(20)
4. Project Report	(20)
5. Exercise based on biostatics	(30)
6. Soil/Water analysis	(20)
7. Exercise based on Physiology	(20)
8. Viva	(20)
9. Sessional	(40)

Total = 200

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M.Sc. Semester II
Zoology

M.Marks= 100

Theory = 80

Internal = 20

Paper I General and Comparative Endocrinology of Vertebrates (60 Lectures)

Unit 1 (15 Lectures)

- **AIMS and scope of endocrinology**
 - Types of chemical messengers
 - Discovery of hormones
 - Classification of endocrine glands and hormones
 - Experimental methods of hormones research
- **Comparative morphology of Endocrine tissue**
 - Hypothalamus
 - Pituitary gland
 - Thyroid, parathyroid
 - Adrenal
 - Gastrointestinal tract
 - Justaglomerular apparatus (kidney)
 - Heart

Unit 2 (15 Lectures)

- **Life history of hormones-**
 - Biosynthesis of hormones
 1. Biosynthesis of simple peptide hormone
 2. Biosynthesis of amino acid derived small size hormone (T₃, T₄, epinephrine and nor-epinephrine)
 3. Biosynthesis of steroid hormone (cortisol, cortisone, corticosterone, progesterone)
 - Release of hormone from endocrine gland
 4. Releasing stimuli
 5. Pulsatile release of hormone
 6. 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 etc.**
- **Synthesis, function and disorder of following endocrine gland hormones**
 - Pituitary hormones
 - Adrenal hormones
 - Thyroid and parathyroid hormones

- Gastro-intestinal hormones
- Justaglomerular hormones
- Hormones of heart
- Synthesis and function of eicosanoid specially Prostaglandin and Leukotriene and its hormonal role

Unit 4 (15 Lectures)

- **Hormonal regulation and its metabolic activity**
 - Role of hormone in –
 1. Carbohydrate metabolism
 2. Protein metabolism
 3. Fat metabolism
 4. 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) :10th edition Lange Medical Publications
6. Principles of anatomy and physiology : Torota Grabowski, 9th edition, John Wiley & sons
7. Reproductive Physiology of vertebrates: Van Tienhoven, A,(1983) 2nd edition Cornell Univ.Press,NY
8. The pituitary gland :Imura.H(1994)2nd edition Comprehensive Endocrinology revised series Raven, NY
9. Comparative vertebrate endocrinology : Bentley, P.J.(1976),Cambridge Univ. press, Cambridge
10. Comparative vertebrate endocrinology: 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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M.Sc. Semester II Zoology

M.Marks= 100

Theory = 80

Internal = 20

Paper II Gamete Biology & Reproductive Physiology in Human Beings (60 Lectures)

Unit 1 (15 Lectures)

- **Endocrinology of sex differentiation & judgment-**
 - Chromosomal (genetic) basis of sex determination
 - Gonadal sex
 - Phenotypic sex differentiation of the internal and external genitalia
 - Brain sex differentiation
- **Reproductive cycle-**
 - Adrenarche
 - Pubarche and puberty
 - Ovarian cycle
 1. Formation of larva
 2. Luteal cycle
 3. Uterine cycle
 4. Menstruation cycle
 - Menopause
 - 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
- Phallus erection
- Ejaculation
- Y-specific probes
- **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-
 1. Role in spermatogenesis
 2. Nervous system
 3. Secondary sex characteristics
 4. Anabolic function
 5. Aging
 - Physiological roles of estrogens in male
 1. Fertility
 2. Male behaviour
 3. Epiphyseal fusion
 4. Cardio vascular function



- Mechanism of androgen action
- Patho-physiology

Unit 3 (15 Lectures)

- **Female reproductive system**
 - Anatomy of female reproductive system-
 1. Ovary
 2. Fallopian tube
 3. Uterus
 - Oogenesis
- **Ovarian hormones**
 - Chemistry, biosynthesis, secretion, transport, function, action and metabolism of Estrogens Progesterone and Relaxin
 - Control of ovarian function
 - Abnormalities of ovarian function

Unit 4 (15 Lectures)

- **Fertilization**
 - Pre-fertilization event
 - Biochemistry of fertilization
 - Post fertilization event
- **Collection and cryopreservation of gamete and embryo**
- **Formation and development of placenta and its endocrine function**
- **Role of hormone in Parturition and Lactation**
- **Hormonal and Immune contraception**

Suggested reading material-

1. Developmental Biology, 2nd edition, Leon, W.B Saunders College publishing
2. Current topics in Developmental Biology eds. R.A. Pederson and G.P. Schatten
3. Principles of animal development biology : S.C. Goel, Himalaya Publishing house
4. Developmental biology, S.F Gilbert, 4th edition, Sinauer Assoc. Inc. Publishers
5. An introduction to Developmental biology : D.A. Ede
6. Principles of Developmental Biology : Paul Weiss edited by Hafner Publishing Co., NY
7. Cells into organs : 2nd edition The forces that shape the embryo John Phillip Trinkaus, Tom Aloisi
8. Principles of development : Lewis Wolpert et al 1998. Oxford Univ. Press
9. Foundations of embryology ; B.M Pattern & B.M. Carlson, Tata McGraw Hill Publications , New Delhi
10. An introduction to embryology : Balinsky 1981 5th ed. (CBS College publishing)
11. Embryonic and foetal development Cambridge Univ press. By Austin and Short 1982, 1992 2nd ed.
12. Marshall physiology of reproduction : Longmont Green and Co. London Vol 1 and 2 , Jamming 1984, 2000
13. Developmental biology; Gudrick
14. Endocrinology : Hardley
15. Endocrinology : Negi

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M.Sc. Semester II Zoology

M.Marks= 100

Theory = 80

Internal = 20

Paper III Molecular Cell Biology (60 Lectures)

Unit 1 (15 Lectures)

- **Biomembranes**
 - Structure, molecular composition and function of plasma membrane
 - Specialization of plasma membrane
 - Transport across cell membrane, diffusion, facilitated diffusion, ion channel, active transport and pumps, Uniports, Symports and Antiports

Unit 2 (15 Lectures)

- **Cytoskeleton-**
 - Microfilaments and microtubules-structure and dynamics
 - Role of microtubules in mitosis
 - Cell movements- intracellular transport role of kinesin and dynein
 - Signal transduction mechanism
- **Cilia and flagella**

Unit 3 (15 Lectures)

- **Cell cycle and its controlling mechanism check points in cell cycle regulations CDK's and cyclase**
- **Cell-cell Signalling-General idea**
- **Cell-cell adhesion and communication**
 - Ca⁺⁺ dependent homophilic cell-cell adhesion
 - Ca⁺⁺ independent homophilic cell-cell adhesion
- **Cell matrix and adhesion**
 - Integrins
 - Collagens
- **Cell organelles**
 - Structure and function of mitochondria, ribosomes, golgi bodies, endoplasmic reticulum

Unit 4 (15 Lectures)

- **Genome organization**
 - Morphological and functional elements of Eukaryotic chromosome
 - Morphology of giant chromosome
 - DNA- structure, replication and genetic code, repetitive data
 - RNA-structure, transcription and transposon
- **Intracellular protein traffic**
 - Protein synthesis on free and bound polysomes
 - Uptake into E.R
 - Uptake into mitochondria
- **Biology of cancer**
- **Biology of ageing**
- **Apoptosis-definition, mechanism and significance**

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Suggested reading materials

1. Molecular cell biology : J.H Darnell, H. Lodish and D. Baltimore Scientific American book Inc USA
2. Molecular biology of the cell, : B.Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J.D. Watson, Garland Publishing Inc NY
3. Molecular cell biology : P.K Gupta
4. Molecular cell biology : D Robertis



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M.Sc. Semester II Zoology

M.Marks= 100

Theory = 80

Internal = 20

Paper IV Tools and Techniques for Biology (60 Lectures)

Unit 1 (15 Lectures)

- **Principal and use of analytic instruments**
 - Balances, pH meter, colorimeter, spectrophotometer, ultra centrifuge
- **Microscopy**
 - Principle of light transmission, Electron (SEM, TEM) phase contrast, Fluorescence, Microphotography, Camera Lucida

Unit 2 (15 Lectures)

- **Microbiological techniques**
 - Media preparation and sterilization
 - Inoculation and growth monitoring
- **Cell structure techniques**
 - Design and function of tissue culture laboratory
 - Culture media preparation
 - Cell harvesting method
 - Cell viability testing
 - Cell proliferation measurements

Unit 3 (15 Lectures)

- **Cryotechniques**
 - Cryopreservation for cells tissues and organisms
 - Cryotechniques for light microscopy
 - Cryotechniques for electron microscopy
- **Immunological techniques based on antigen antibody interactions Agglutination and precipitation**
- **Biosensors**

Unit 4 (15 Lectures)

- **Separation techniques in Biology**
 - Molecular separations by chromatography and its different types
 - Electrophoresis- paper and gel
 - Organelle separation by centrifugation
 - Cell preparation by density gradient, centrifugation affinity adsorption

Suggested Reading materials

1. Introduction to instrumental analysis-Robert Braun , McGraw Hill Publication
2. A biologist guide to principles and techniques of practical biochemistry-K, Wilson and K,HGoulding EBS Edn.
3. Clark and Swizer, Experimental Biochemistry, Freeman, 2000
4. Locquin and Langeron, Handbook of Microscopy, Butterwaths, 1983
5. Boyer, Modern Experimental Biochemistry, Benjamin, 1993

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BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester II

Zoology practical

Lab-course II

1. Dissection of various endocrine glands of vertebrates (Fishes, Amphibians, Reptiles, Birds, Mammals etc.)
2. Dissection of various endocrine glands of insects (Cockroach/any other insect)
3. Study of microscopic slides of endocrine and related structures
 - T.S. Pituitary, T.S. of Thyroid, T.S. of Parathyroid, T.S. of Adrenal, T.S. of Testes, T.S. of Ovary, T.S. Thymus, T.S. of Kidney, T.S. of Heart, T.S. of Stomach, T.S. of Intestine
4. Effect of epinephrine on chromatophores of fishes
5. Biochemical estimation of cholesterol content in adrenal tissue, glycogen in uterine tissue
6. Microtomy-block preparation, section cutting, stretching and straining
7. Study of Estrous cycle in mouse or rat
8. Preparation on Blastodisc of hen's egg
9. Formation of egg window in chicken egg
10. Collection of developmental stages of eggs of Lymnea or any gastropod
11. Collection of developmental stages of insects/ fishes
12. Study of development stages of frog through slides and whole mounts.
13. Study of development stages of chick through slides and whole mounts.
14. Slide preparation (earthworm ovary, amphibian, reptiles, birds and mammals testes & ovary)
15. Study of Prokaryotic and Eukaryotic cells
16. Study of permanent slides -Mitosis, Meiosis and cell organelles
17. Temporary squash preparation to show mitosis and meiosis
18. Preparation of giant chromosomes, barr bodies
19. Histological study of cancer cells
20. Use of balance Ph meter, colorimeter, centrifuge spectrophotometer, cameralucida etc.
21. Molecular separation by Chromatography, Electrophoresis
22. Media preparation
23. Cell culture
24. Colorimetric estimation of glucose, protein, RNA, DNA
25. Absorption spectrum of any coloured solution
26. Histochemical techniques

Note-

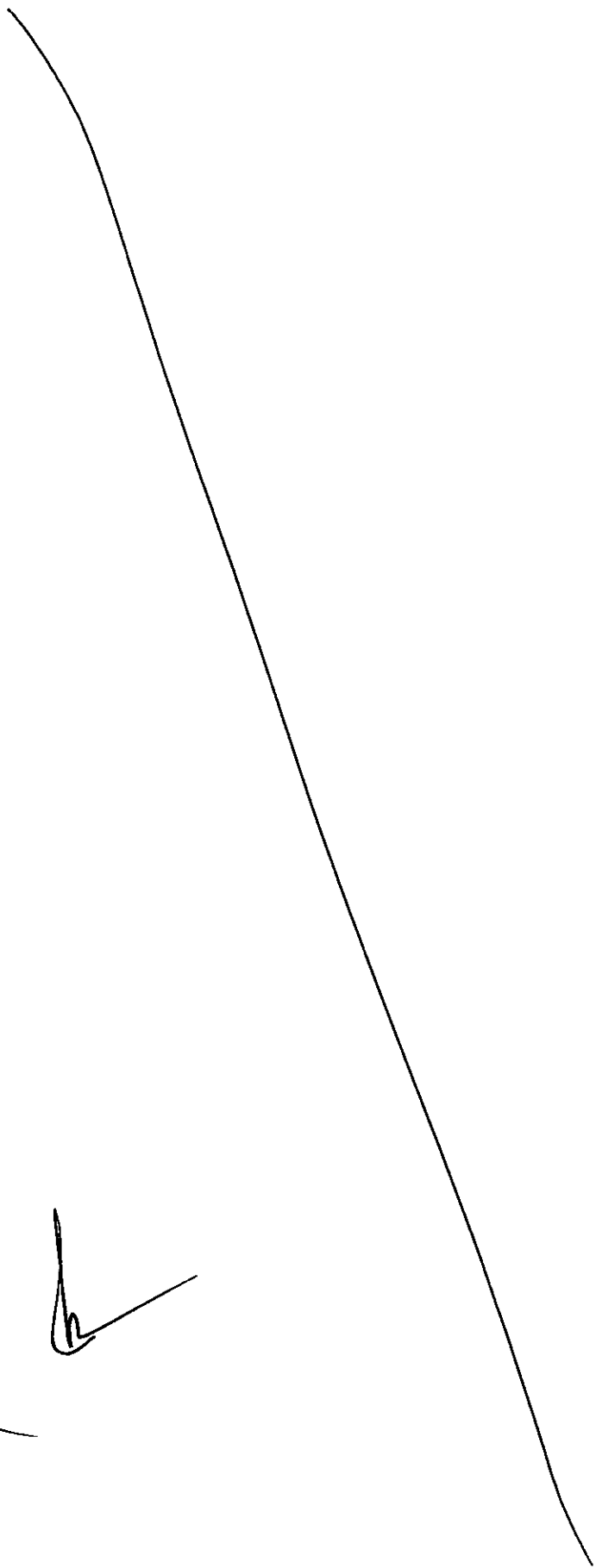
3. Use of animal for dissection and practical work is subject to the conditions that they are not banned under the wildlife protection act
4. External features and anatomy should be studied by digital techniques and the alternatives. Wherever live animals is studies it should be either pest or culturable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

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BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester II

Zoology Practical

Lab-course II

Time-08 Hours

Max. Marks-200

Distribution of marks in practical exam.

1. Dissection of Endocrine glands Take out any five/virtual		(10)
2. Spotting (Endocrine glands, mitosis and meiosis) Tools and techniques	(20)	
3. Cytological preparation/preparation of estrogen cycle		(20)
4. Chromatography		(20)
5. Colorimetric estimation		(20)
6. Application of different instruments		(20)
7. Microtomy	(20)	
8. Preparation of egg window and Blastodisc		(10)
9. Viva		(20)
10. Sessional		(40)

Total = 200

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BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester III
Zoology

M.Marks= 100

Theory = 80

Internal = 20

PAPER I COMPARATIVE ANATOMY OF VERTEBRATES (60 LECTURES)

Unit I (15 Lectures)

- Origin of Chordates- Amphibians, Reptiles, Birds and Mammals
- Classification of vertebrates up to orders with examples.

Unit II (15 Lectures)

- Vertebrate Integument and its derivatives. Development and general structure and function of skin and its derivatives. Glands, Scales, Horns, Claws, Nails, Hoofs, Feathers and Hairs.
- Evolution of Heart, Evolution of aortic arches.

Unit III (15 Lectures)

- Respiratory system : Comparative account of respiratory organs.
- Skeletal system : Comparative account of Jaw Suspensorium, Vertebral column- Development of vertebra and vertebral column, types of vertebra, Limbs and Girdles.

Unit IV (15 Lectures)

- Comparative account of Urinogenital system in vertebrate series.
- Comparative account of Brain and Spinal cord in vertebrate series.
- Sensory receptors

Suggested Reading Material

1. Alexander, R.M. The Chordata. Cambridge University Press, London
2. Bourne,, G.H. The structure and functions of nervous tissue. Academic Press, NY
3. Carter, G.S. Structure and habit in vertebrate evolution - Sedgwick & Jackson, London
4. Kingsley, J.S. Outlines of Comparative Autonomy of Vertebrates, Central Book Depot, Allahabad.
5. Malcom Jollie, Chordata morphology, East-West Press Pvt., New Delhi.
6. Milton Hilderbrand. Analysis of vertebrate structure. IV Ed. John Wiley, NY
7. Tansley, K. Vision in Vertebrate. Chapman and Hall Ltd., London.
8. Walters, H.E. and Sayles, L.D. Biology of Vertebrates. Macmillan & Co., NY
9. Romer, A.S. Vertebrate Body, Illrd Ed. W.B. Saunders Co., Philadelphia.
10. Young, J.Z. Life of Vertebrates. Oxford University Press, London.
11. Montagna, W. Comparative anatomy. John Wiley & Sons Inc.
12. Andrews, S.M. Problems in Vertebrate Evolution. Academic Press, NY
13. Waterman, A.J. Chordata structure and function. Macmillan Co., New York
14. Lovtrup, S. The Phylogeny of Vertebrate, John Wiley & Sons, London.

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BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester III
Zoology

M.Marks= 100

Theory = 80

Internal = 20

Paper II Biosystematics and Taxonomy (60 Periods)

Unit 1 (15 Lectures)

- **Definition and basic concepts of biosystematics and taxonomy.**
 - Historical resume of systematics
 - Importance and applications of biosystematics in biology
- **Trends in biosystematics concepts of different conventional and newer aspects**
 - Chemotaxonomy
 - Cytotaxonomy
 - Molecular taxonomy

Unit 2 (15 Lectures)

- **Dimensions of speciation and taxonomic characters**
 - Mechanisms of speciation in panmictic and apomictic species
 - Species concepts and species category
 - Theories of biological classification
 - Taxonomic characters and different kinds

Unit 3 (15 Lectures)

Procedure keys in taxonomy

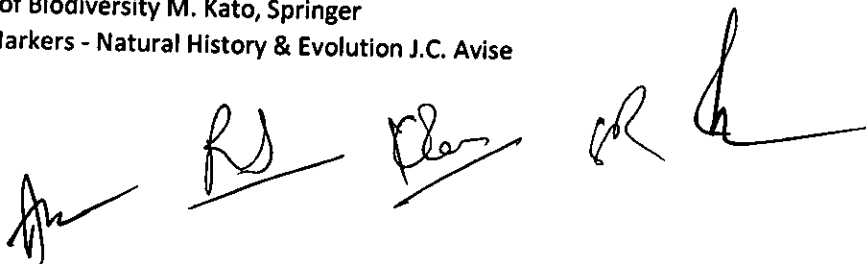
- Taxonomic procedures-taxonomic collections, preservation, curation
- Taxonomic keys-different kinds of taxonomic keys, their merits and demerits
- Process of typification and different Zoological types
- International code of Zoological Nomenclature (ICZN)

Unit 4 (15 Lectures)

- **Biodiversity**
 - Types of Biodiversity
 - Hot spots of Biodiversity
 - Threats to Biodiversity
 - Conservation of Biodiversity
- **Evaluation of biodiversity indices**
 - Shannon-Weiner index

Suggested reading materials-

1. Biosystematics & Taxonomy Dr.R.C.Tripathi, University Book House JAIPUR
2. Theory & Practice of Animal Taxonomy V.C. Kapoor, 5th Edition Oxford & IBH Publishing Co.
3. Principle of Animal Taxonomy G.G. Simpson, Oxford & IBH Publishing Co
4. Elements of taxonomy Earnst Mayer
5. Biodiversity E.O. Vilson, Academic Press Washington
6. The Biology of Biodiversity M. Kato, Springer
7. Molecular Markers - Natural History & Evolution J.C. Avise



BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester III
Zoology

M.Marks= 100

Theory = 80

Internal = 20

Paper III Immunology and developmental Biology (60 Periods)

UNIT- I (15 Lectures)

- (1) Innate and Acquired immunity
- (2) Cell and Organs of Immune System
 - (a) Organization and Structure of Lymphoid organs
 - (b) Cells of the immune system & their differentiation
 - (c) Lymphocyte traffic
- (3) Nature of Immune response
- (4) Nature of Antigens
 - (a) Antigenicity and Immunogenicity
 - (b) Factor influencing immunogenicity
 - (c) Antigenic determinates/epitopes and heptens

UNIT- II (15 Lectures)

- (5) Antibodies (Immunoglobulins)
 - (a) Structure & Function of antibodies
 - (b) Immunoglobulin Classes & Subclasses
- (6) Antigen- Antibody interaction
- (7) B Cell Maturation, Activation and Differentiation
 - (a) B- Cell Receptors
 - (b) B- Cell Activation and Proliferation
 - (c) Humoral Immune Response Kinetics
- (8) T- Cell maturation activation and differentiation
 - (a) T- Cell Receptors
 - (b) T- Cell Activation and Proliferation
 - (c) T- Cellular Immune Response

UNIT- III (15 Lectures)

- (9) Compliment System
 - (a) Complement Component
 - (b) Regulation of Compliment System
 - (c) Consequence of Compliment Activation
- (10) Major and Minor Histo- compatibility Complex



- (a) Inheritance of HLA System, Location and Function
 - (b) Structure of MHC molecule
 - (c) Peptide interaction with MHC molecule
 - (d) Cellular distribution and regulation of MHC expression
 - (e) MHC & Susceptibility to infections disease
 - (f) MHC & Susceptibility to infections disease
- (11) Hyper sensitivity and immune responses to infection agents especially intra cellular parasites

UNIT- IV (15 Lectures)

- (12) The development of Primitive Embryonic form
- (a) Cleavage (Segmentation) and Blastulation
 - (b) Chordate Blastula and its Significance
 - (c) The late Blastula in relation to Certain Innate Physiological Conditions :Twinning.
 - (d) Gastrulation
 - (e) Tubulation and extension of the Major Organ- forming Areas: Development of Primitive body form
 - (f) Basic Feature of Vertebrate Morphogenesis
- (13) Histogenesis and Morphogenesis of the Organ System
- (i) The Cardio Vascular System
 - (ii) The Nervous System

Suggested Reading Materials –

0 Immunology

Kuby, W. H. Froeman USA

0 Fundamental of Immunology

W. Paul

0 Essential Immunology

M. Rohit, ELBs Edition

0 Immunology

Richard M. Hyde, Robert A. Patnode, A Wiley Medical Publications

0 Reproductive Physiology

Gayton

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BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester III

Zoology

M.Marks= 100

Theory = 80

Internal = 20

Paper IV Population Genetics and Evolution (60 Periods)

Unit I

Concept of Evolution and theories of Organic Evolution with an emphasis on Darwinism, Neutral Theory of Evolution

- Neo-Darwinism -
 - Hardy-Weinberg Law of genetic equilibrium.
 - A detailed account of destabilizing forces –
 - (i) Natural Selection
 - (ii) Mutation
 - (iii) Genetic drift
 - (iv) Migration
 - (v) Melotic drive.

Unit II

- Genetics of speciation.
 - Models of speciation (Allopatric, Sympatric and Parapatric).
 - Patterns and mechanisms of reproductive isolation.
- Genetics of Quantitative traits in population.
 - Analysis of quantitative traits.
 - Inbreeding depression and heterosis.

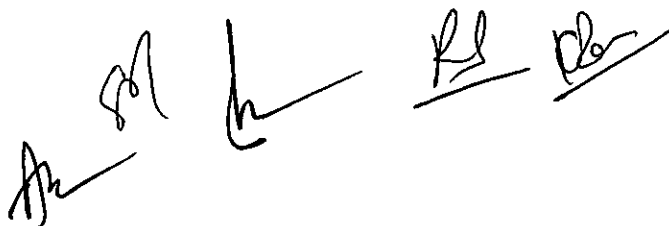
Unit III

- Molecular Evolution
 - Gene Evolution
 - Origin of Higher categories
 - Major trends in origin of higher categories.
 - Macro and micro Evolution
- Molecular phylogenetics.
 - How to construct Phylogenetic trees ?
 - Amino acid sequence and phylogeny
 - Molecular Clock.

Unit IV

- Quantifying genetic variability
 - Genetic structures of natural population
 - Phenotypic variation
- Molecular population Genetics
 - Patterns of change in nucleotide and amino acid sequence
 - Emergence of non Darwinism- Neutral theory
 - Genotype environment interaction
- Population Genetics and ecology
 - Metapopulations
 - Why small populations become extinct
 - Conservation of genetic resources in diverse taxa

Suggested Reading Material



1. Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press.
2. Dobzhansky, Th., F.J.Ayala, G.L.Stebbins and J.M.Valentine. Evolution. Surjeet Publication, Delhi.
3. Futuyama, D.J. Evolutionary Biology, Suinaer Associates, INC Publishers, Dunderland.
4. Hartl, D.L. A Primer of Population Genetics. Sinauer Associates Inc., Massachusetts.
5. Jha, A.P. Genes and Evolution, John Publication, New Delhi.
6. King, M. Species Evolution - The role of chromosomal change. Cambridge University Press, Cambridge.
7. Merrel, D.J. Evolution and Genetics. Holt, Rinchart and Winston Inc.
8. Smith, J.M. Evolutionary Genetics. Oxford University Press, New York.
9. Strikberger, M.W. Evolution. Jones and Bartett Publishers, Boston, London

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BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester III

Zoology Practical
Lab-course

(Comparative Anatomy)

1. Dissection of animals :- Amphioxus, Scollodon, Electric ray, Sting ray, Calotis, Bird head, Rat (Subject to availability of material) / study through alternative methods of dissection.
2. Micro preparation of suitable and available material.
3. Study of the representative examples of different classes of Chordates.
4. Study of permanent slides showing whole mount or section as per Theory syllabus, including embryological slides of Frog and Chick.
5. Osteology of Amphibia, Reptile, Bird, Mammal.
6. Study of animal diversity by field trip and excursion, Extension activity to spread health awareness.

Students have to submit project report.

BiOsystematics, taxonomy & Biodiversity

1. Study of biodiversity among various invertebrates and vertebrates (Listing of all the animals found in and around your house and also try to find out their Zoological names)
2. Collection of various insect species
3. Visits to a local animal park or zoo to identify and study the captive fauna and preparation of report
4. Study of adaptive characteristics of various invertebrates and vertebrates in different climate
5. Taxonomic key formation and conversion
6. Study of biodiversity in grassland and pond water by using Shannon -Weiner index .

Immunology and developmental Biology

1. Dissection of Primary and secondary Immune organ from mice
 - a. Preparation of single suspension from bone marrow
 - b. Cell counting and vigbilly testing of the spleenocytes prepared
2. Preparation and study of phagocytosis by splenic peritoneal macrophase.
3. Raising polyclonal antibody in mice, serum collecton and estimating antibody titre in serum by following method-
 - a. Ouchterlony (double diffusion) assay for antigen-antibody specificity and titre.
 - b. ELISA
4. Antibody purification from the serum collected from immunized mice, affinity purification chromatography
5. Blood group testing A, B ,O ,AB AND Rh factor
6. Indused Breeding in Frog
7. Culture of chick Embryo in Vitro .
8. Study of chick embryos by vital staiting
9. The Technique for the whole mount preparation of chick embryo
10. Demonstration of Cell death
11. Study of Mitosis (a) Techniques for chromosomes preparation (b) Preparation of Meiotic chromosomes for Grosshopper testies (c) Auto Rediography

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Population Genetics and Evolution

- a. i. An experiment related to quantitative genetics, genotypic frequencies in light of Hardy-Weinberg law
- ii. ABO blood group data
- b. Numeric exercise related to-
 - i. Natural selection
 - ii. Changing gene frequency

Chromosomal Polymorphism

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BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester IV

Zoology

M.Marks= 100

Theory = 80

Internal = 20

Paper- I Neuro Physiology & General Physiology

UNIT – I (15 Lectures)

- (1) Central Nervous System Gross Anatomy of Brain & Spinal Cord.
- (2) Histological structure and Origin of Nervous tissue Neurons and Neuroglia & its function.
- (3) The Meninges, Neurotrophins & Cerebro spinal Fluid (CSF) and its function.
- (4) Physiological Properties of nerve fibres and mechanism of conduction of Nerve Impules in Non-medullated and medullated Nerve fibre.
- (5) Nerve endings (Bio-Analyzers)
- (6) Electrical activity of Brain (EEG) (Electic Encephalography) and its Physiological basis.

UNIT – II (15 Lectures)

- (7) Synapse – structure, Properties and its reuptake mechanism.
- (8) Neuro transmitters : Classification, structure, receptors, function and metabolism.
- (9) Spinal cord and the ascending descending tracks.
- (10) The Cranial and spinal Nerves.
- (11) Autonomic Nervous system: Sympathetic and parasympathetic system with special comparison to hormonal mechanism of transmission through autonomic nerves system .
- (12) Reflex action and sensation.

UNIT – III (15 Lectures)

- (13) Feeding Mechanism and comparative Physiology of Digestion.
 - (a) Various digestive juices, its composition, function and mechanism of secretion.
 - (b) Physiology of digestion for carbohydrate, Protein, fat & Nucleic acid and its absorption.
- (14) Circulation of Body Fluid and its regulation.
 - (a) Structure of Heart.
 - (b) Structure, function, synthesis & composition of Blood & lymph.
 - (c) Blood group system.
 - (d) Blood Cougulation & De-fibrinisation.
 - (e) Cardiac cycle and pressure and volume changes in heart and blood vessels during Cardiac Cycle.
 - (f) Heart sound and ECG.
- (15) Respiratory system and Physiology of Respiration .
 - (a) Structure of respiratory track.
 - (b) Breathing Physiology.
 - (c) Transport of Gases
 - (i) Oxygen carriage



(II) Carriage of Carbon di-oxide.

(d) Tissue Respiration .

(e) Respiratory diseases: Asphyxia, Hyperpnea, Anoxia etc.

UNIT – IV (15 Lectures)

- (16) Contractile elements and its Physiology .
- (a) Properties of Skeletal, Smooth & Cardiac Muscle.
 - (b) Structure of Muscle.
 - (i) Ultra & Molecular of Structure of Muscle.
 - (ii) Structure of Sarcoplasmic reticulum & its role in Muscle Contraction.
 - (c) Theories and Physiology of muscle contraction.
 - (d) Changes during muscle contraction.
 - (e) Enzyme used in muscle contraction.
- (17) Pattern of Nitrogen Excretion and its Physiology.
- (a) Excretory Substance .
 - (b) Physiology of liver for excretion.
 - (c) Structure of kidney and its Excretory Physiology.
 - (d) Fromation of Urine and Micturition.
- (18) Regulation of body temperature.
- (a) Pyraxia
 - (b) Hypothermia.

Suggested Reading Materials

1. The Brain : Our Nervous System by Seymour Simon
2. Mass Action in the Nervous system by Walter J. Freeman
3. Human Anatomy and Physiology with Interactive physiology 10-system Suite, 8th Edition by Elaine N. Marieb and Katja N. Hoehn (Jan 10, 2010)
4. Neuroanatomy by H. G. Snell
5. Clinical Neurophysiology- Guide for Auther- Slsevier
6. Foundations of cellular Neurophysiology (Bradford Books) Daniel Johnston
7. Medical physiology by Ganong
8. Medical physiology by Gyaton
9. Human Anatomy and Physiology by Tor Tora
10. Human Physiology by G. C. Chatterji

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BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester IV

Zoology

M.Marks= 100

Theory = 80

Internal = 20

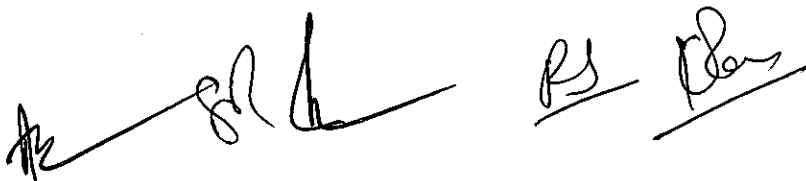
Paper II Biochemistry , Metabolic Regulation and Cell Function (60 Periods)

UNIT- I (15 Lectures)

- (1) Water the solvent of life
 - (d) Chemistry of water
 - (e) Function and regulation of water balance
- (2) General Structure of Monosaccharide
 - (a) Nomenclature, Definition and Classification
 - (b) Formation of Monosaccharide – Formation of glucose
 - (i) Linear form
 - (ii) Ring form
 - (iii) Hawarth perspective formate
- (3) Occurrence, Chemistry, Properties & hydrolysis of Oligosaccharides
(Sucrose, Lactose, Maltose, Cellobiose, Isomaltose & Trehalose)
- (4) Structure of Polysaccharides (Starch, Glycogen, Cellulose, Hyaluronic acid, Chondroitin and Heparin)
- (5) Metabolism of Carbohydrate
- (6) General Structure, Classification and function of Lipids
- (7) Lipid Metabolism.

UNIT- II (15 Lectures)

- (8) Biosynthesis of Amino Acids and Structure & Properties
 - (c) Chemical bond – Peptide Bond
 - (d) Secondary bond – Disulfide ,Hydrogen, Non polar or hydrophobic and Ionic or Electrostatics bond
 - (e) Characteristic of Chemical bond
- (9) Protein Configuration
 - (a) Primary Structure (b) Secondary Structure (c) Tertiary Structure (d) Quaternary Structure
- (10) Biological function and metabolism of Protein
- (11) Metabolism of Inorganic elements

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- (d) Macro- Minerals
- (e) Micro – Minerals

UNIT- III (15 Lectures)

(12) Nucleic Acid

- (d) Chemistry of DNA & RNA
- (e) Nucleo Proteins
- (f) Metabolism of Nucleic Acid (Anabolism & Catabolism)
- (g) Biological importance of Nucleic Acid

(13) Eicosanoids

(14) Vitamin

- (a) Water & Fat Soluble Vitamin
- (b) Chemistry, Occurrence and Physiological role of Vitamins

UNIT- IV (15 Lectures)

(15) Enzymes

- (g) Nomenclature and Classification
- (h) Co- enzyme, Isoenzyme or Isozyme & Lysozyme
- (i) Biological role of enzyme
- (j) Properties and Characteristics of enzyme
- (k) Three Dimensional Structure of enzyme
- (l) Enzyme Inhibitors and activators
- (m) Mechanism of enzyme action

(16) Biological Oxidation

- (iii) Mitochondrial Electron Transport Chain
- (iv) Oxidative Phosphorylation
- (v) Utilization of Krebs Cycle
- (vi) Enzyme & Co – enzyme involved in oxidation & reduction

Suggested Reading Materilas-

1. Lehninger Principles of Biochemistry, Fourth Edition
David L. Nelson, Michael M. Cox Publisher : W. H. Freeman
2. Biochemistry
Donald Voet, Hardcover : 1616 Pages Publisher : Wiley, 3rd Edition
3. Principles of Biochemistry with a Human Focus
Reginald H. Garrett, Charles M. Grisham Publisher : Brooks Cole
4. The Molecular Basis of Cell Cycle and Growth Control
Gray S. Stein (Editor), Renato Baserga, Antonio Giordano, David T. Denhardt,
Publisher : Wiley- Liss
5. Experiments in Biochemistry : A Hands – on Approach
Shawn o. Farrell, T. Ranallo Publisher : Brooks Cole
6. Analysis of CD Effect on liver, Stomach and Intestine of Carp Fish by Hundet, A.
7. Histological and Histochemical staining techniques by Homason



BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester IV

Zoology

M.Marks= 100

Theory = 80

Internal = 20

Optional Group I : Paper III Fish (Ichthyology) Structure and Function (60 Periods)

Unit 1 (15 Lectures)

- Origin and evolution of fishes
- Classification of fishes as proposed by Berg
- Fish Integument
- Locomotion
- Alimentary canal and digestion

Unit 2 (15 Lectures)

- Accessory respiratory organs
- Air bladder and its functions
- Weberian ossicles their homologies and functions
- Excretion and osmoregulation
- Acoustic-lateral line system

Unit 3 (15 Lectures)

- Luminous organs
- Colouration in fishes
- Sound producing organs
- Deep sea adaptations
- Hill stream adaptations

Unit 4 (15 Lectures)

- Migration in fishes
- Sexual cycle and fecundity
- Parental care in fishes
- Early development and hatching
- Poisonous fishes.

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BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester IV

Zoology

M.Marks= 100

Theory = 80

Internal = 20

Optional Group I : Paper IV Applied Fisheries (60 Periods)

Unit 1 (15 Lectures)

- Introduction
- Colouration in fishes
 - Physical colors, chemical colors, mixed color factors (temperature stimulation, light adaptive significance)
- Common diseases of fishes and their care
 - Skin parasites and diseases, diseases of gills, diseases caused by bacteria and viruses
- Economic value of fishes
 - Fishes as human food, fish for cattle, fish manure, fish glue and insinglass fish leather
- Luminous organs

Unit 2 (15 Lectures)

- Fresh water fishes of Chhattisgarh and their culture
- Maintenance of nursery rearing and stocking ponds
- Marine fisheries
 - Deep sea, coastal, and off shore fisheries
- Fishing method in sea coast
 - Crafts of east and west coast, other methods(Nets and Gears, electric fishing, light fishing)
- Riverine and cold water fisheries

Unit 3 (15 Lectures)

- Reservoir fisheries-
 - Distribution of reservoir fisheries
- Lacustrine fisheries-
 - Lake types , principle lake fisheries
- Estuarine fisheries
- Fish farming
- Principal cultivable fishes

Unit 4 (15 Lectures)

- Larvivorous fishes
- Exotic and transplanted fishes
- Planktons-its role in pollution of water and fisheries
- Preparation and maintenance of aquarium
- Induced breeding

Suggested reading materials

1. Zingron-Fish and fisheries in India
2. Gavelander-Fish biology
3. KarkLegler-Fresh water fisheries
4. Nikolaski-Fish biology
5. Identification of fishes-Days fauna
6. E.Khanna-Introduction to fish

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7. Parihar-Fish biology
8. Norman-Introduction to fishes
9. Mishra-Identification of fishes in India

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BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester IV

Zoology

M.Marks= 100

Theory = 80

Internal = 20

Optional Group II : Paper III Cell Biology (60 Periods)

Unit-1 (15 Lectures)

- Molecular organization of eukaryotic chromosomes
 - structure of nucleosome particles and higher order compaction of mitotic chromosomes, chromatin re-modelling
- specialized chromosomes:
 - structural organization and functional significance of polytene chromosomes
- DNA methylation and DNA Aase-1 Hypersensitivity in relation to gene activity and chromatin organization.
- specialized chromosomes II
 - structural organization and functional significance of lamp brush chromosome.
- Organisation and significance of heterochromatin.

Unit-2 (15 Lectures)

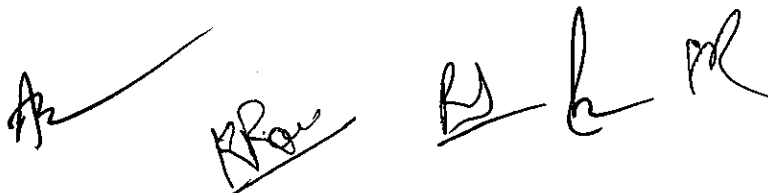
- Structural organization of Eukaryotic genes, interrupted genes and overlapping genes and their evolution
- Gene families:
 - Organization, evolution and significance
- Transposable genetic elements of prokaryotes and eukaryotes Gene Imitation and molecular mechanism of occurrence of mutation repair mechanism
- Organisation of eukaryotic transcriptional machinery promoter enhancers transcription factors polymerase activators and repressors.
- DNA binding domains of transcription apparatus zinc finger steroid receptors hemeo domains HELIX-loop, Helix and Leucine Zipper

Unit-3 (15 Lectures)

- Eukaryotic transcription of Eukaryotic transcriptional control
- Environmental modulation of gene activity (stress response) stress genes and stress proteins
- Molecular basis of thalasemias muscular dystrophy cystic fibrosis
 - DNA rearrangement
 - Amplification during development with special response to
 - (a) Ciliates (b) Chlorine gene (c) 58 RNA genes

Unit-4 (15 Lectures)

- Drosophila development
 - (a) Cleavage (b) Gastrulation Origin of Anterior –Posterior (Maternal effect genes and segmentation genes
- Drosophila development II origin of dorsal ventral polarity
- Basic idea of homoetic selector genes and homeotic mutation
- Basic idea of organization of homeoboxes
- Evolutionary significance of homeoboxes

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Suggested Reading Materials:

1. Robertis, De and Robertis Cell and molecular biology Lea and Febiger.
2. Watson Hopkis Roberts Steitz Welner, Molecular Biology of the Gene the Benjamin, Cummings Publishin Company inc.
3. Bruce A; berts Bray ewis Raff Roberts Watson Molecular Biology of the Cell, Garland Publishing Inc.
4. Watson Gilman WitkowskiZoller Recombinant DNA Scientific American Books
 - a) Karp Gerald Cell Biology
 - b) LewinB., Genes VII
 - c) King Cell Biology
 - d) Kaniel L. Hartl, Elizabeth W. Jones. Genetics Principals and Analysis, Jones and Bartlett Publishers.
5. Kuby, Immunology, W.H. Freeman and Company
6. Roitt Male Snustad Immunology.

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BILASPUR UNIVERSITY, BILASPUR

M.Sc. Semester IV

Zoology

M.Marks= 100

Theory = 80

Internal = 20

Optional Group II : Paper IV Cellular and Molecular Organisation (60 Periods)

Unit-1 (15 Lectures)

- General organization and characterizes of viruses (Examples SV 40 and HIV)
- Yeast
 - Structure, reproduction and chromosome organization
 - Basic ideas of its applications as vectors for gene cloning
- Molecular organization of reolratry chain assemblies, ATP / ADP Translocase and FOF1 AT pase
- Cell cycle
 - Cell cycle control in mammalian cells and xenopus
- Cytochemistry of Golgin complex and its role in cell secretion

Unit-2 (15 Lectures)

- Peroxisomes and training of paroxysmal proteins
- Nucleolus
 - Structure and Biogenesis and functions of lysosomes
- Intracellular digestion
 - Ultra structure and function of lysosomes
- Synthesis and targeting of mitochondrial proteins
- Secretary pathways and translocation of secretary proteins across the EPR membrane

Unit-3 (15 Lectures)

- Genome complexity
 - C- value [paradox and cot value]
- DNA sequences of different complexity
- Difference between normal cells and cancer cells
 - Biochemical changes
 - Cytoskeleton changes
 - Cell surface changes
- Genetic basis of human cancer

Unit-4 (15 Lectures)

- Chromosomal abnormalities in human cancer
- General idea of onchogens and proto onchogens
- Onchogenec and cancer
- Transforming Agents
- TumorSupressorgeanes
- Receptor – Ligand interaction and signal transduction. Cross – talk among various signaling pathways.

Suggested Reading Materials:

1. DeRobertis and De Robertis Cell and Molecular Biology. Lea and Febiger

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2. We Watson Hopkingrebertsstelts, Weiner molecular biology of the gene, the Benjamin / Cummings Publishin Company Inc.
3. Bruce alberts, Bray, Lewis, Raff, Roberts, Watson molecular Biology of the cell garland publishing Inc.
4. P.K. Gupta, Molecular Cell Biology Rastogi Publication.
5. Watson Gilman Witkowski, Zoller Recombinant D.N.A. scientific American Books
6. Gerald Karp. Cell Biology
7. Lewin B. Genes VII
8. King Cell Biology
9. Baniel L. Hartl Elizabeth W. Jones, Genetics Principles and analysis . Jones and Bartlett Publisher.
10. Lodish, Berk Zipursky, Matsudaira Baltimore Dernel Molecular Cell Biology W.H.Freeman and company
11. J. Travers Immunology current Biology limited
12. Kubey Immunology W.H. Freeman and Company
13. Riott, Male Snustad Principles of genetics John Weley and sons Inc.

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Optional Group III : Paper III Entomology (Morphology and Physiology of Insects) (60 Periods)

Unit I (15 Lectures)

Cephalisation and theories about cephalisation

Head capsule, types of antennae and types of mouth parts

Thorax, legs in locomotion and functional modification of legs

Integument- Sclerotization and moulting

Wing variation- General and in the orders- Lepidoptera, Diptera, Hymenoptera, Coleoptera and Hemiptera

Unit II (15 Lectures)

Digestive system and physiology of digestion

Excretory organs, excretion and osmoregulation

Respiratory structure and respiration

Respiratory adaptation in aquatic and endoparasitic insects

Circulation, Haemocytes and blood coagulation

Unit III (15 Lectures)

Nervous system- Principle modifications

Photoreception, mechanoreception chemoreception

Sound producing structure and functions

Bioluminescence, reproduction and metamorphoses and Diapause

Unit IV (15 Lectures)

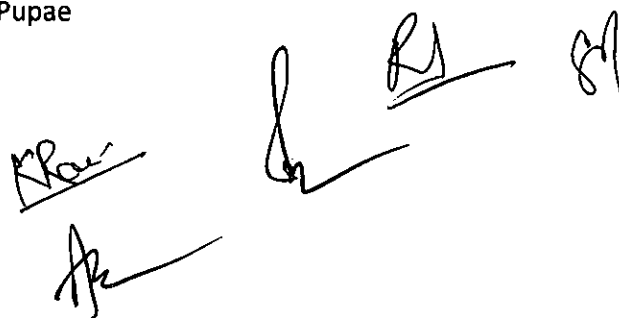
Internal and external organization of reproductive organs

Endocrine control of reproduction and metamorphoses

Development- Embryonic and Post embryonic

Types of Larvae

Types of Pupae



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M.Sc. Semester IV

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Optional Group III : Paper IV Entomology (Taxonomy, Economic Entomology and Pest Control) (60 Period

UnitI (15 Lectures)

History of Insect classification, Basis of classification

Brief concept of all insect orders

Characters and classification upto principal families of following orders-

- | | | |
|--------------|------------------|----------------|
| a. Thysanura | b. Collembola | c. Orthoptera |
| d. Hemiptera | e. Mallophaga | f. Lepidoptera |
| g. Diptera | h. Hymenoptera & | i. Coleoptera |

(Insect classification as per Essigs's College entomology)

Unit II (15 Lectures)

Classification, life cycle, Control measures, and Economic Importance of the following-

- Important pests of Paddy
- Important pests of Sugarcane
- Important pests of Pulses in the field eg Gram, Pea, Arhar,
- Important pests of Vegetables- Bringel, Cabbage, Cauliflower, Lady finger and cucumber

UnitIII (15 Lectures)

- Classification, Life cycle, economic importance and control measures of stored grain pests- namely: Sitophilous oruzae, Corcyre cephalonica, Tregederma granarium, Tribolium castaneum, Callosobruchus chinensis, Stotroga cerellela
- Life cycle Bionomics, Damage potential and control measures of Aphids and its phases
- Phases of Locust- Schistocerca gregarine, Phase theory of locust
- Social life in Insects
- Parasitism in Insects

Unit IV (15 Lectures)

Pest Control

- Physical and cultural control
- Chemical control
- Biological control
- Integrated pest control

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M.Sc. Semester IV

Zoology

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Optional Group IV : Paper III Wildlife Conservation (60 Period)

Unit-1 (15 Lectures)

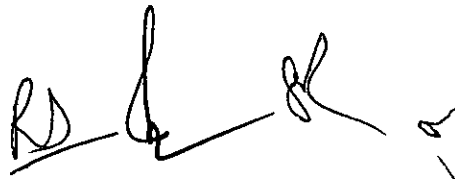
- **Wild life –**
 - Values of wild life - positive and negative
 - Our conservation ethics
 - Importance of conservation
 - Causes of depletion
 - World conservation strategies.
- **Habitat analysis, Evaluation and management of wild life.**
 - Physical parameters - Topography, Geology, Soil and water
 - Biological Parameters - food, cover, forage, browse and cover estimation
 - Standard evaluation procedures - remote sensing and GIS.
- **Management of habitats –**
 - Setting back succession
 - Grazing logging
 - Mechanical treatment
 - Advancing the successional process
 - Cover construction
 - Preservation of general genetic diversity

Unit-2 (15 Lectures)

- **Population estimation.**
 - Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation
 - Faecal analysis of ungulates and carnivores - Faecal samples, slide preparation, Hair identification, Pug marks and census method.
- **National Organization**
 - Indian board of wild life
 - Bombay Natural History Society
 - Voluntary organization involved in wild life conservation
- **Wild life Legislation - Wild Protection act - 1972, its amendments and Implementation.**
- **Management planning of wild life in protected areas.**
- **Estimation of carrying capacity**

Unit-3 (15 Lectures)

- **Eco tourism / wild life tourism in forests**
- **Concept of climax persistence.**
- **Ecology of perturbation.**
- **Management of excess population & translocation**
- **Bio- telemetry.**
- **Care of injured and diseased animal.**

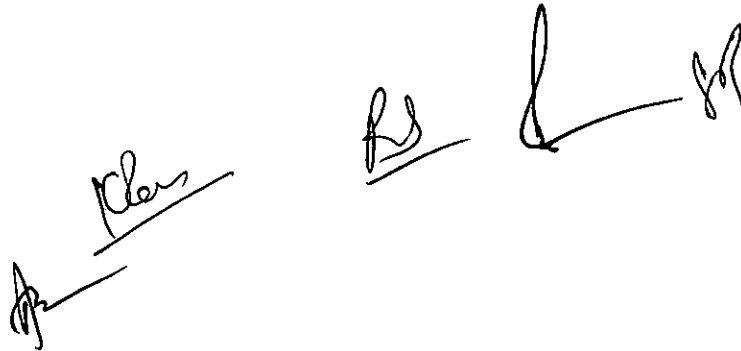


Unit-4 (15 Lectures)

- Quarantine.
- Common diseases of wild animal
- Protected areas National parks & sanctuaries, Community reserve
- Important features of protected areas in India.
- Tiger conservation - Tiger reserve in M.P, in India.
- Management challenges in Tiger reserve.

Suggested Reading Materials:

1. . Gopal Rajesh : Fundamentals of wild life management
2. Agrawal K.C : Wild life India
3. Dwivedi A.P (2008) : Management wild life in India
4. Asthana D.K : Environment problem and solution
5. Rodgers N.A & Panwar H.S : Planning of wild life / Protected area Network in India vol. the report, wild life Institute of India Dehradun
6. Odum E.P : Fundamentals of Ecology
7. Saharia V.B : Wild life in India
8. Tiwari S.K : Wild life in Central India 9. E.P Gee : Wild life of India
9. Negi S.S : Wild life conservation (Natraj Publishers)

The image shows several handwritten signatures and initials in black ink. On the left, there is a signature that appears to be 'A' followed by a horizontal line. To its right is another signature that looks like 'K. S.' with a horizontal line underneath. Further right, there are two more signatures: one that looks like 'R.S.' and another that is more stylized and less legible, possibly 'S.P.' or similar. These signatures are scattered across the lower half of the page.

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M.Sc. Semester IV

Zoology

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Optional Group IV : Paper IV Environment and biodiversity conservation (60 Period)

Unit 1 (15 Lectures)

- Basic concept of Environmental Biology Scope and Environmental Science
- Biosphere and Biogeochemical cycles
- Environmental monitoring and impact assessment
- Environmental and sustainable development
- Water conservation, rain water harvesting, water shed management

Unit 2 (15 Lectures)

- Cause, effects and remedial measure of Air pollution, Water pollution
- Noise, radioactive and thermal pollution
- Agriculture pollution
- Basic concepts of Bioaccumulation
- Solid waste management

Unit 3 (15 Lectures)

- Global warming and disaster management
- Cause of global warming
- Impact of global warming – acid rains and ozone depletion, green house effect
- Control measures of global warming
 1. Afforestation (b) reduction in the use of CFCS
- Disaster management -floods, earthquake, Cyclones landslides
- Environmental legislation

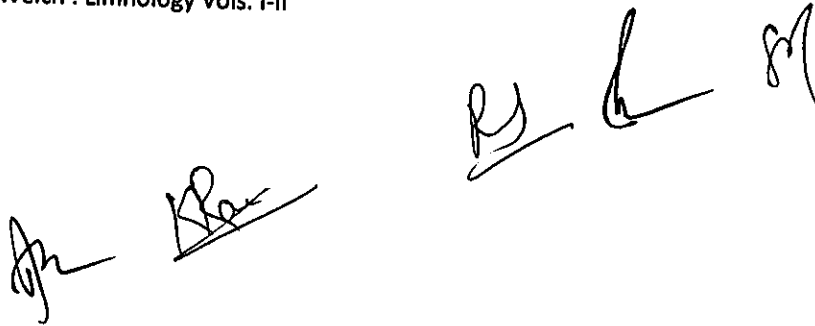
Unit 4 (15 Lectures)

- Natural Resources:-
 - Forest
 - ii. Use and over exploitation of forests
 - iii. Timber extraction
 - Land
 - i. Land degradation. Landslides
 - ii. Soil-erosion and desertification
 - Water
 - i. Use and over utilization of surface and ground water
 - ii. Floods
 - iii. Drought dams- benefits and problems
 - Mineral
 - i. Use and exploitation
 - ii. Environmental effect of extracting and using mineral resources
 - Food
 - i. World food problem
 - ii. Effects of modern agriculture and overgrazing
 - Energy

- i. Conventional and nonconventional energy resources
- ii. Using of alternate energy sources
- iii. Role of an individual in conservation of natural resources
- iv. Equitable use of resources for sustainable life
- v. Biodiversity crisis – habitat degradation poaching of wild life
- vi. Socio economic and political causes of loss of biodiversity
- vii. In situ and ex-situ conservation of biodiversity
- viii. Value of biodiversity

Suggested Reading Materials:

1. Arora : Fundamentals of environmental biology
2. Anathakrishnan : Bio-resources ecology
3. Bottain : Environmental studies
4. Bouhey : Ecology of populations
5. Clark : Elements of ecology
6. Dowdoswell : An introduction to animal ecology
7. Goldman : Limnology
8. Kormondy : Concepts of ecology
9. May : Model ecosystems
10. Odum : Ecology
11. Perkins : Ecology
12. Simmons : Ecology of estuaries and costal water
13. Pawlosuske : Physico-chemical methods for water
14. South Woods : Ecological methods
15. Trivedi and Goel : Chemical and biological methods for water pollution studies
16. Willington : Fresh water biology
17. Wetzal : Limnology
18. Welch : Limnology Vols. I-II

Handwritten signatures and initials are present below the list of reading materials. On the left, there are two signatures: one that appears to be 'A' and another that is more complex, possibly 'K'. To the right, there are three distinct initials or signatures: 'RS', 'L', and 'M'.

IV Semester Practical

Lab course

A. Practical based on Paper I and Paper II as per Theory

1. Estimation of Protein by the Biuret, Lowry, Bradford and Eosine-a comparison
2. Determination of N-terminal Amino acids by the Sangers reagent (FDND)
3. Paper chromatographic separation of Amino acids
4. Quantitative estimation of Protein, carbohydrate, Mucosaccharide, Lipids and Enzyme (Bromphenol blue, PAS, Alcian blue, aldehyde fucsin, Acetylcholinestrerase technique)
5. Identification of hypothalamic nuclei histological, histochemical and Immunocytochemical method
6. Isolation and characterization of Pituitary cell
7. Estimation of MAC, MCH and MCHC
8. Total count of WBC and RBC
9. Differential count of WBC
10. Haemoglobin estimation and PCV estimation or ESR estimation
11. Quantitative estimation of blood serum by Colorimetry (I) Blood Urea (II) Blood glucose (III) Blood Calcium (IV) Blood Creatine (V) Blood cholesterol (VI) Blood Protein (VII) Blood Albumin
12. Blood clotting time
13. ECG Recording
14. Blood Pressure estimation
15. EEG

Practical (Special Paper Fishes)

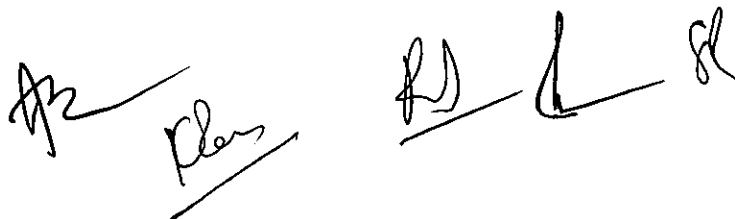
1. Anatomy of different systems of Fresh water Fishes through dissections
2. Osteology of Fishes
3. Microscopic Preparation
4. Taxonomic study of Fishes through Museum specimen and collection
5. Identification of Fresh water Fishes of Chhattisgarh up to species level
6. Field work/ Industry visit and preparation of Record

Practical (Special Paper – Group II Cytology)

1. Examination of different cell types in Vertebrate tissue
2. Contrast Microscopy
3. Photomicrography
4. Study of permanent cytological preparation
5. Squash preparation of chromosomes and preparing karyotype
6. Preparation of Giant Chromosomes and demonstration of puffs
7. Golgi material and Mitochondrial preparation
8. Demonstration of Barr body and drums stic
9. Histochemical demonstration of RNA DNA phospholipid and emzyme
10. Microbial culture media preparation and microbial growth
11. Molecular separation by chromatography and Electrophoresis

Practical (Special Paper – Group III Entomology)

1. Collection, Preservation and classification of the insects of order :- Thysanura, Collembola, Orthoptera, Hemiptera, Lepidoptera, Mallophaga, Diptera, Hymenoptera and Coleoptera

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2. Dissection of Grasshopper, Cockroach, Cricket, wasp, and honey bee, with special reference to their Nervous system, Salivary gland, Endocrine gland, Sting apparatus, of honey bee, reproductive organs of Grasshopper and cockroach.
3. Whole mounts of small insects eg Collembola, Thysanura, bedbug, louse, stored grain pests
4. Whole mount of different types of legs, antennae, wings, mouth parts, salivary glands and scales
5. Microtomy of Insect materials
6. Simple experiment on Insect Physiology
7. Identification of common insect pests
8. Collection of life cycle of the pest of any economic crop

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Group IV wild life conservation

- (1) Project work
 - (2) Practical Based on theory Paper
- Chandra