

MASTER OF SCIENCE  
**General Information for Students**

**PROFILE OF ZOOLOGY DEPARTMENT**

Jai Narain Vyas University right from its inception in 1962 continued to transfuse its academic vision at the hands of eminent faculty, till today. We take pride and feel honoured that our University was inaugurated by the then President of India, Dr. Sarvappaly Radhakrishnan. Distinguished Professor B. N. Jha took the reins in his hands as the first Vice Chancellor and since then, all the subsequent Vice Chancellors with their vision and wisdom steered this University to its academic summits.

Jodhpur, being the oasis of Rajasthan carries a long heritage of bravery , courage and known for its communal harmony on one side and progressing, forming an identity as an educational hub, on the other, with Medical College, Law University, Ayurveda University , Engineering College, CAZRI, AFRI, DMRC ,AIMS ,ZSI and BSI. As the state University, Jai Narain Vyas University has become the centre for graduate and postgraduate courses in all the faculties besides catering to the needs of students of Western Rajasthan, it offers job-oriented Courses like physical education, defence studies, BBA,BCA,MCA,B.Ed. M.Ed There is a facility of self -finance courses in 35 subjects also.

Established in 1963, the Department of Zoology has been imparting knowledge to youth and triggering research in vital fields like Entomology, Fisheries and Cell Biology. During seventies Parasitology and Environmental Science were included to the curriculum of M. Sc. This Department is perhaps the first in the country that initiated intensive teaching and research on different facts of environment concerning the Great Indian Desert. Commenting on the environmental teaching and research acumen of our department, the V<sup>th</sup> Five Year Plan Visiting Committee of UGC asserted that “this department is pioneer in the country to have included environmental sciences in the teaching and research” Likewise, the Department is a premier institution in the country on Insect Taxonomy, morphology, physiology, Sericulture studies besides lower Primate ecology and behaviour with dozens of Ph. Ds, hundreds of papers, books and monographs published in the last 50 years, besides developing a long range of bilateral collaborative programmes with Germany and the U. S. A.

The Department is nurtured by a highly talented faculty comprising of 23 teachers. We teach about 2000 undergraduate and 70 postgraduate students per annum. Our faculty supervisors guide around 15-20 research scholars every year for their Ph. D. degrees. The researches conducted by the faculty are in the fields of diabetes, atherosclerosis, primate behavior, aquaculture, bee & bats taxonomy and biology, silviculture, water pollution, insect pests and their control, bioinformatics and reproductive physiology of mammals.

This Department has organized several academic congregations from regional to international level. These events have been shared by several international and national dignitaries of Zoology. It has played quite active collaborative role in the events organized by other institutes of this area such as Desert Medicine Research Centre, Zoological Survey of India, Forest Research Institute, Central Arid Zone Research Institute and many non-governmental – social service organizations.

The Faculty of this Department has represented in several national and international academic bodies and policy formulation committees at home and abroad. Many faculty members have been invited to participate in national and international assemblies during this period. A large number of publications have come out from the department in national and international journals. The department got two UGC Scheme i.e Centre with Potential for Excellence in Particular Ares (CEPA) and DRS-I.

## ACADEMIC STAFF WITH SPECIALIZATION

<b>Faculty Members</b>	<b>Specialization</b>
1. Dr. Ashok Purohit, Prof. & Head	Physiology & Ecology
2. Dr. G. Tripathi, Professor	Physiology & Eco-toxicology
3. Dr. L. S. Rajpurohit, Professor	Behaviour
4. Dr. Rajiv Kumar Gupta, Assoc. Prof	Entomology
5. Dr. (Mrs.) Seema Trivedi, Assoc. Prof.	Cell Biology
6. Dr. Naresh Vyas, Assoc. Prof.	Parasitology
7. Dr. Anil Choudhary, Assoc. Prof.	Fisheries
8. Dr. (Mrs.) Kavita Naruka, Assoc. Prof.	Physiology
9. Dr. (Mrs.) Vimla Sheron, Assoc. Prof.	Cell Biology
10. Dr. (Ms.) Divya Chowdhary, Asstt. Prof.	Parasitology
11. Dr. Pankaj Nama, Asstt. Prof.	Limnology & Parasitology
12. Dr. Dharendra Chowdhary, Asstt. Prof	Cell Biology
13. Dr. Heera Ram, Asstt. Prof	Fisheries & Physiology
14. Dr. B.R.Jaipal, Asstt.Prof	Environmental Biology
15. Dr. Geeta Meena Asstt. Prof	Entomology
16. Dr. Meenakshi Meena	Entomology
17. Dr. G. R. Parihar, Asstt. Prof	Environmental Biology
18. Dr. Afreen Anjum, Asstt. Prof	Parasitology
19. Dr. Ram Prakash Saran, Asstt. Prof.	Cell Biology
20. Dr. Lekhu Gehlot Asstt, Prof.	Entomology
21. Dr. Hem Singh Gehlot Asstt, Prof.	Environmental Biology
22. Dr. Poonam Punia, Asstt, Prof.	Environmental Biology
23. Dr. Shanker Lal Nama, Asstt, Prof.	Parasitology

## COURSES OFFERED

Besides teaching Zoology to undergraduate students, the department is imparting knowledge to postgraduates in five major disciplines of Zoology namely, Cell Biology, Entomology, Parasitological, Fish, Fisheries & Limnology and Environmental Biology.

The Department carries research in various fields from biology, experimental physiology, primate ecology and behaviour, zoo- and phytoplankton studies, water pollution, insect pest management, , histo-chemistry , bat ecology ,bioinformatics and wildlife studies. All these fields figure out very well in the departments' research agenda.

The examination for the degree of Master of Science in Zoology will consist of two examinations (i) The previous Examination, and (ii) The Final Examination.

The examination will be through theory papers/practicals. Pass marks for the previous and final examination are 36% of the aggregate marks in all the theory papers and practical and not less than 25% marks in an individual theory paper. A candidate is required to pass in the written and the practical examinations separately.

Successful candidates will be placed in the following division on the basis of the total marks obtained in previous and final examinations taken together.

First division 60%, Second division 48% and Third division 36%, No student will be permitted to register himself /herself simultaneously for more than one post-graduate course.

Note: Special paper will be allotted on merit-cum-choice basis with equal number of students in each paper

## **ATTENDANCE**

1. For all regular candidates in the faculties of Arts, Education and Social Science, Science, Law and Commerce the minimum attendance requirement should be that a candidate should have attend at least 75% of the lectures delivered and tutorials held taken together from the date of her/his admission.
2. The shortage of attendance upto the limits specified below may be condoned.
  - (i) Upto 3% of the total (a) Lectures delivered and tutorials held (taken together), and (b) Practicals of Practicals and Sessionals subject-wise condonable by the Dean/Director/Principal on the recommendation of the Department concerned.
  - (ii) Upto 6% including (i) above by the Syndicate on the recommendation of the Dean/Director/Principal.
  - (iii) Upto further 5% attendance in all subjects/papers/practicals and sessionals(taken together) by the Vice Chancellore inspecial cases, on the recommendation of the Dean/Director/Principal.
3. The N.C.C. cadets sent out to parades and camps and such students who are deputed by the University to take part in games, athletics or cultural activities may, for purpose of attendance, be trated as present for the days of their absence in connection with aforesaid activities and that period shll be added to their total attendance subject to the maximum of 20 days.
4. Advantage of fraction while calculating the attendance, shall be given to the candidate.

## **M.Sc. (Previous) Zoology Examination, 2015**

*Note:* Each theory paper is divided in three parts i.e. Section-A, Section –B and Section –C.

Section-A: Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited up to 30 words. Each question will carry of 2 marks.

Section –B: Will consist of 10 questions. Each unit will be having two questions; students will answer one question from each Unit. Answer of each question shall be limited up to 250 words. Each question carry 7 Marks.

Section-C: Will consist of total 05 questions. Students will answer any 03 questions and answer of each question shall be limited up to 500 words. Each question carries 15 Marks.

### **Paper I**

#### **Zool. 401 – Invertebrate Structure and Function**

##### **Unit 1**

Organization of coelom: Acoelomates, Pseudocoelomates, Coelomates: Protostomia and Deuterostomia

Locomotion: Movement in Ciliates, Flagellata, Coelentrata, Annelida and Echinodermata

##### **Unit 2**

Nutrition: Feeding and digestion in lower and higher invertebrates.

##### **Unit 3**

Respiration: Organs of Respiration: Aquatic and aerial respiration; respiratory pigments; Mechanism of respiration; Excretion: Organs of excretion: Coelom, coelomoducts, nephridia and malphigian tubules, coxal gland, Kaber's organ, Bojanus organ; Mechanisms of excretion and osmoregulation.

##### **Unit 4**

Nervous system: Coelenterata, Platyhelminthes, Nematoda, Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda) and Echinodermata; Trends in neural evolution.

## Unit 5

Invertebrate larvae: Larval forms of free-living invertebrates; larval forms of parasites, Strategies and Evolutionary significance of larval forms. Minor phyla: Concept and significance, Organization and general characters of Nemertini, Nematomorpha and Rotifera.

## **Paper II**

### **Zool. 402 - Biosystematics and Quantitative Biology**

#### Unit 1

Science of Taxonomy: Definition, Concepts, History, Scope and Applications of biosystematics. Biological species category; Code of Zoological Nomenclature and Operative Principles. Applications of Important rules Formation of Scientific names. Neotaxonomy: Chemotaxonomy, Cytotaxonomy, Molecular taxonomy.

#### Unit 2

Taxonomic procedure – collection, preservation, curation, identification. Taxonomic characters; Quantitative & qualitative analysis of variation; Taxonomic keys, their kinds, merits & demerits; Taxonomic decision on the species level; Procedure of Classifying; Taxonomic publications; Different kinds of Types and their significance.

#### Unit 3

Methods in field Biology and estimating population density of Animals, ranging patterns through direct, indirect and remote observations, habitat characterization- ground and remote sensing methods.

#### Unit 4

Introduction to Biostatistics; Collection of data and their presentation such as Graphs, Bar diagrams, Histograms, Line diagrams, Pie diagrams; Measures of Central tendency -

mean, median and mode; Analysis of variance and standard deviation. Probability theory, distribution and their properties.

#### Unit 5

Hypothesis testing, Chi-square( $X^2$ ) test, students't – test, experimental design and sampling theory; Evaluation of Species indices: Shannon-Weinner index, Dominance index, Similarity and dissimilarity index, Association index.

## **Paper III**

### **Zool. 403 - Vertebrate Physiology**

#### **Unit 1**

Biochemical process of food digestion, absorption and assimilation. Different types of vitamins, their physiological functions and effects of their deficiency.

Respiration – kinds of respiratory pigments, mechanism of breathing and gaseous exchange. Cellular respiration.

#### **Unit 2**

Cardio vascular systems, comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG- its principle and significance Cardiac cycle, heart as a pump, blood pressure neural and chemical regulation of all above.

#### **Unit 3**

Structure and types of nephrons, counter-current mechanism of urine formation, urea cycle physiology of osmoregulation in marine and fresh water vertebrates, structure of eye, ultrastructure of rod and cone cells, molecular physiology of vision.

#### **Unit 4**

Types of muscle, their ultrastructure and physiology of contraction; Structure and function of various endocrine glands, abnormalities and endocrine regulation.

Mechanism of action of peptide and steroid hormones.

#### **Unit 5**

Nerve conduction, types of neurotransmitters and their mode of action; cholinergic mechanisms; Thermoregulation, hibernation, bioluminescence, chromatophores and colour change.



## Paper IV

### **Zool. 404 – Ecology and animal behavior**

- Unit 1 Ecological energetic: energy flow, primary production and estimation of primary productivity in terrestrial and aquatic ecosystem.  
Concept of community, its nature, structure, species diversity and its measurement.  
Ecological succession: types, mechanism and concept of climax.
- Unit 2 Population ecology: Characteristic of population, population growth curves, population regulation, life history strategies (r and k selection), concept of meta population- demes and dispersal, interdemic extinctions, age structure and life tables.  
Interspecific and intra specific interaction.
- Unit 3 Applied ecology: Global environmental changes, biodiversity status, monitoring and documentation, major drivers of biodiversity changes, biodiversity management approaches, principles of conservation.
- Unit 4 Approaches and methods in study of behaviors, developments of behavior: Instinct, learned behavior, learning imprinting, kineses, taxes, reflexes and Lorenz's psychohydraulic model of motivation behaviour, motivation and its phases.
- Unit 5 Role of brain in animal behavior, hormones and reproductive behaviour in insects and mammals, social behaviour with special reference to insects, fish, birds and mammals, social organization and communication.

### Practicals

Time : 8-12 hours

Max. Marks : 200

Min. Pass Marks : 72

(Two days for each Board)

Min. Pass Marks for each Board

Board I : Covering Papers I and II of Theory

Board II : Covering Paper III and IV of Theory

36 Marks

Max Marks 100

Max Marks 100

## **Practicals**

### **Board I**

1. Dissections
2. Microscopic Preparations
3. Identifications / Comment up on Spots (8)
4. Assessment of Biodiversity in Habitat
5. Influence of Climatic Factors on Biodiversity index in Desert
6. Preparation of models showing the status of certain taxa/species in a particular habitat
7. Biostatistics problems:-
  - i) To drive mean, mode and median
  - ii) Derivation of standard deviation
  - iii) Problem on correlation and regression
  - iv) Application of Chi-square ( $X^2$ ) test
  - v) Analysis of level of significance
8. Collection tour report.

### **Marking Scheme**

#### **Board I**

	Marks: 100
	(Min. Pass Marks: 36)
1. Dissection (s)	18
2. Preparations (s)	06
3. Identification and comments on spots (eight) / Systematics	24
4. Biostatics problem (s)	10
5. Year work and internal assessment:	
Practical records	10
Submission of slides	04
6. Tour of presentation of its report	18
7. Viva-voce	10
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Total Marks	100
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For ex-student, the marks of year work, internal assessment and tour reports may be readjusted by the examiners by raising the marks in items 1 to 4 according to the set parameters.

#### **Board II**

1. Detection of carbohydrate, proteins and lipids in milk
2. To demonstrate salivary digestion
3. To determine the respiratory rate of rat
4. Total R.B.C. Count

5. Total W.B.C. Count
6. Differential leukocyte count (DLC)
7. Estimation of haemoglobin content in mammalian blood
8. Packed Cell Volume (PCV)
9. Blood sugar estimation
10. To detect and separate amino acids with paper chromatography
11. Separation and detection of carbohydrate with paper chromatography
12. Demonstration of reflex action
13. To determine the total amount of water in a rat
14. To determine the percentage of fat in a mammal
15. To study the temperature variation at various points in a body of mammal
16. Qualitative test for urea, creatinine, and chloride in urine
17. Water analysis of CO<sub>2</sub>, O<sub>2</sub>, HCO<sub>3</sub>, pH, hardness, study of water bodies to identify zoo planktons and making their permanent preparations
18. Soil composition and classification
19. Estimation of water holding capacity and moisture content of soil
20. Air: Measurement of climatic factors like temperature, rainfall, humidity, pressure and wind speeds, etc.
21. Garden snail habituation to vibration
22. Investigation of nest structure in pigeon
23. Simple measure of dominance in rats/mice
24. Practical Records
25. Microtomy of different tissues

### Marking Scheme

Board II

	Max. Marks: 100		(Min. Pass Marks: 36)
1.	Physiological Experiments	(i) Major	15
		(ii) Minor	10
2.	Ecological Experiments	(i) Major	15
		(ii) Minor	10
3.	Permanent Preparation		08
4.	Microtomy		15
5.	Year work and internal assessment:		
	Practical record & slides		10
	Microtomy slides		07
6.	Viva-voce		10
	<b>Total Marks</b>		<b>100</b>

For ex-student, the marks of year work and internal assessment may be readjusted by the examiners by raising the marks in items 1 to 4 according to the set parameters.

## Suggested Reading Material (All latest editions)

1. M. Kato: The Biology of Biodiversity, Springer.
2. J.C. Avise. Molecular Markers, Natural History and Evolution, Chapman & Hall, New York.
3. E.O. Wilson. Biodiversity, Academic Press, Washington.
4. G.G. Simpson. Principle of animal taxonomy, Oxford IBH Publishing Company.
5. E. Mayer. Elements of Taxonomy, Tata McGraw Hill, N. Delhi.
6. E.O. Wilson. The Diversity of Life (The College Edition), W.W. Northem & Co.
7. B.K. Tikadar. Threatened Animals of India, ZSI Publication, Calcutta.
8. Batschelet, E. Introduction to mathematics for life scientists. Springer-Verlag, Berling.
9. Jorgensen, S.E. Fundamentals of ecological modeling. Elsevier, New York.
10. Swartzman, G.L., and S.P.O. Kaluzny. Ecological simulation primer. Macmillan, New York.
11. Lendren, D. Modelling in behavioral ecology. Chapman & Hal, London, UK.
12. Sokal, R.R. and F.J. Rohlf. Biometry. Freeman, San Francisco.
13. Snedecor, G.W. and W.G. Cochran. Statistical methods. Affiliated East-West Press, New Delhi (Indian ed.).
14. Green, R.H. Sampling design and statistical methods for environmental biologists. John Wiley & Sons, New York.
15. Murray, J.D. Mathematical biology, Springer-Veriag. Berlin.
16. Pielou, E.C. The interpretation of ecological data : A primer on classification and ordination.
17. Hyman, L.H. The invertebrates. Vol. I. Protozoa through Ctenophora. McGraw Hill Co., New York
18. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson and Sons Ltd., London
19. Jagerstein. G. Evolution of Metazoan life cycle. Academic Press, New York & London.
20. Hyman, L.H. The Invertebrates. Vol. 2. McGraw Hill Co., New York
21. Hyman, L.H. The Invertebrates. Vol. 3. McGraw Hill Co., New York
22. Hyman, L.H. The Invertebrates. Vol. 4. McGraw Hill Co., New York
23. Hyman, L.H. The Invertebrates. Vol. 5. McGraw Hill Co., New York
24. Hyman, L.H. The Invertebrates. Vol. 6. McGraw Hill Co., New York
25. Hyman, L.H. The Invertebrates. Vol. 7. McGraw Hill Co., New York
26. Hyman, L.H. The Invertebrates. Vol. 8. McGraw Hill Co., New York
27. Hyman, L.H. The Invertebrates. Vol. 9: Aves. McGraw Hall Co., New York and London
28. Barnes, R.C. Invertebrate Zoology, III edition. W.B. Saunders Co., Philadelphia.
29. Russel-Hunter. W.D. A biology of higher invertebrates. The Macmillan Co. Ltd., London
30. Read, C.P. Animal Parasitism. Prentice Hall Inc., New Jersey
31. Sedgwick, A.A. Student Text Book of Zoology, Vol. I, II and III. Central Book Depot., Allahabad.
32. Parker, T.J., Haswell, W.A. Text book of Zoology Vol. I, Macmillan Co., London.

28. Molecular Cell Biology, J. Darnell, H. Lodish and D. Baltimore Scientific American Book, Inc., USA.
29. Molecular Biology of the Cell, B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J.D. Watson. Garland Publishing Inc., New York.
30. Dobzhansky, Th. Genetics and Origin of Species, Columbia University Press.
31. Dobzhansky, Th. F.J. Ayala, G.L. Stebbins and J.M. Valentine. Evolution. Surjeet Publication, Delhi.
32. Futuyama, D.J. Evolutinary Biology, Suinuaer Associates, INC Publishers, Dunderland.
33. Hartl, D.L. A Primer of Population Genetics. Sinauer Associates, Inc, Massachusetts.
34. Jha, A.P. Genes and Evolution. John Publication, New Delhi.
35. King, M. Species Evolution – The role of chromosomal change. The Cambridge University Press, Cambridge.
36. Merrel, D.J. Evolution and Genetics. Holt, Rinchart and Winston, Inc.
37. Smith, J.M. Evolutinary Genetics. Oxford University Press, New York.
38. Strikberger, M.W. Evolution. Jones and Bartett Publishers, Boston London.
39. Austen, C.R. and Short, R.V. Reproduction in animals
40. Schatten and Schatten. Molecular biology of fertilization.
41. F.T. Longo. Fertilization, Chapman & Hall.
42. R.G. Edwards. Human Reproduction.
43. Animal Cell Culture – A practical approach, Ed. John R.W. Masters, IRL Press.
44. Introduction to Instrumental analysis, Robert Braun. McGraw Hill International Editions.
45. Biologists Guide to Principles and Techniques of Practical Biochemistry, K. Wilson & K.H. Goulding, ELBS Edn.
46. Eckert, R. Animal Physiology: Mechanisms and Adaptation. W.H. Freeman and Company, New York.
47. Hochachka, P.W. and Somero, G.N. Biochemical Adaptation. Princeton, New Jersey.
48. Hoar, W.S. General and Comparative Animal Physiology, Prentice Hall of India.
49. Schiemdt Nielsen. Animal Physiology: Adaptation and Environment. Cambridge
50. Strand, F.L. Physiology: A regulatory Systems Approach. Macmillan Publishing Co., New York.
51. Pummer, L. Practical Biochemistry, Tata McGraw-Hill.
52. Prosser, C.L. Environmental and Metabolic Animal Physiology. Wiley-Liss Inc., New York.
53. Wilson K. and Walker, J., Practical Biochemistry.
54. Willmer, P.G. Stone, and I. Johnson. Environmental Physiology. Blackwell Sci. Oxford, UK, 644pp.
55. Newell, R.C. (ed.) 1976. Adaptation to environment. Essays on the physiology of marine animals. Butterworths, London, UK, 539pp.
56. Townsend, C.R. and P. Calow. Physiological Ecology: An evolutionary approach to resource use. Blackwell Sci. Publ., Oxford, UK.
57. Alexander, R.M.N. Optima for animals. Princeton Univ. Press, Princeton, NJ.
58. Dejours, P., L. Bolis, C.R. Taylor and E.R. Weibel (eds.), Comparative Physiology: Life in Water and on Land. Liviana Press, Padova, Italy.

59. Johnston, I.A. & A.F. Bennett (eds.). *Animals and Temperature : Phenotypic and evolutionary adaptation*. Cambridge Univ. Press, Cambridge, UK.
60. Louw, G.N. *Physiological animal ecology*. Longman Harlow, UK.
61. E.J.W. Barrington. *General and Comparative Endocrinology*, Oxford, Clarendon Press.
62. P.J. Bentley. *Comparative Vertebrate Endocrinology*. Cambridge University Press.
63. R.H. Williams. *Text Book of Endocrinology*, W.B. Saunders
64. C.R. Martin, *Endocrine Physiology*. Oxford Univ. Press.
65. A. Gorbman et al. *Comparative Endocrinology*, John Wiley & Sons.

## **M.Sc. (Final) Zoology Examination, 2016**

*Note:* Each theory paper is divided in three parts i.e. Section-A, Section –B and Section –C.

Section-A: Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited up to 30 words. Each question will carry of 2 marks.

Section –B: Will consist of 10 questions. Each unit will be having two questions; students will answer one question from each Unit. Answer of each question shall be limited up to 250 words. Each question carry 7 Marks.

Section-C: Will consist of total 05 questions. Students will answer any 03 questions and answer of each question shall be limited up to 500 words. Each question carries 15 Marks.

### **Paper I**

#### **Zool. 409 - Biology of Chordata**

##### Unit 1

Classification of Protochordata and Cyclostomata; evolution, affinities and phylogeny of protochordates. Structure, function and life histories of *Pyrosoma*, *Doliolum*, *Salpa* and *Oikopleura*. Evolution and affinities of Cyclostomata.

##### Unit 2

Classification, origin, evolution and deep sea adaptations in fishes, Parental care; offensive and defensive mechanism; sensory, hydrostatic and lateral line system in fishes.

##### Unit 3

Classification, origin and adaptive radiation in Amphibia, extinct amphibians, parental care in Amphibia

Classification, origin and adaptive radiations in Reptile. Evolutionary significance of Sphenodon, Dinosaurs, types and causes of their extinction. Biting mechanism, identification of snake bite by wounds, symptoms and treatment. Snake venoms, anti sera and their production.

##### Unit 4

Classification (up to orders), origin and evolution of birds, migration of birds, types of palate, aquatic and flight adaptation in birds, *Archcopteryx*, Wild life sanctuaries and National Parks of Rajasthan with reference to birds.

## Unit 5

Classification (up to orders) and, origin and evolution of Mammals, primitive mammals (prototheria and metatheria), salient adaptive radiation in eutheria, dentition in mammals, old and new world monkeys. Ancestry of horse and man.

## **Paper II**

### **Zool. 410 – Developmental Biology, evolution and population genetics**

#### Unit 1

Gametogenesis, egg and sperm structure, fertilization, biochemical aspects of fertilization, penetration and activation of egg and early development, fate maps, embryonic induction and differentiation.

#### Unit 2

Organogenesis in mammals: brain, eye, alimentary canal, kidney and gonads. Parthenogenesis, limb development and regeneration in amphibia, brief idea of insects metamorphogenesis.

#### Unit 3

History of evolutionary thoughts, Lamarckism and neo-Lamarckism, Darwinism and neo-Darwinism, mutation and synthetic theory of evolution, adaptation, isolation and speciation.

#### Unit 4

Hardy-Weinberg's law of genetic equilibrium, detailed account of destabilizing forces: natural selection, mutation, genetic drift, migration, meiotic drive. Genetic structure of natural population, phenotypic variation, factors affecting human diseases frequency.

#### Unit 5

Genetics of quantitative traits in population: analysis of quantitative traits, quantitative traits and natural selection, estimation of heritability, genotype-environment interactions, inbreeding depression and heterosis, molecular analysis of quantitative traits.



## Practicals

1. Study of museum specimens and permanent slides
2. Dissections  
Fish: Cranial nerves of *Wallago attu* and *Labeo rohita*, *Chirrhinus mriagla*, Weberian apparatus, accessory respiratory organs in *Heteropneustes*, *Clarias*, *Ophiocephalus* and *Anabas*, electric organs in Electric Ray.  
  
Fawl : Air sacs, blood vascular system. Flight muscles.  
Rat : Cranial nerves, ear ossicles.
3. Permanent preparation of microscopic slides.
4. Osteology of representative vertebrate classes: Amphibia, Reptilia, Aves & Mammalia; Disarticulated bones of various skulls.
5. Study of Embryology, in situ.
6. Study of permanent slides and preparation of slides of gametogenesis and developmental stages of fish and chick.
7. Estimation of gene and genotypic frequencies in the light of Hardy and Weinberg Law based on facial traits.
8. *Drosophilla* culture and identification of mutants.
9. Preparation of salivary gland chromosomes
10. Study of sperm motility.

## Marking scheme

Max Marks	100	Min Pass Marks	36
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### **Board I**

1.	Dissection: Two	25
2.	Preparations (including embryology) 4+4	08
3.	Comments up on the following spots (8): [Museum specimens 2; Bones 2; Slides: histological 2; Embryological and genetics 2].	24
4.	Viva-voce	10
5.	Year work and internal assessment Practical record	10
	Submission of slides	05
6.	Tour report, presentation of collection	18

**Total**

**100 Marks**

For ex-student, the marks of year work and internal assessment and tour reports may be readjusted by the examiners by raising the marks in items 1 to 4 according to the set parameters.

## Suggested Reading Material

1. Colbert, E.H. (1970): Evolution of Vertebrates, 535 pp., Wiley Eastern Pvt. Ltd., New Delhi
2. Parker, T.J. & Haswell, W.A. (1943) : A Text Book of Zoology, Vol. II 789 pp., Macmillan & Co., London.
3. Sedgwick, A. (Reprinted 1966) : Student's Textbook of Zoology, Vol. II 705 pp., Central Book Depot, Allahabad
4. Arey, L.B. (1961) : Developmental Anatomy, 680 pp., Asia Publ. House, Mumbai
5. Gharpurey, K.G. (1962) : Snakes of India and Pakistan, 156 pp., Popular Prakashan, Mumbai
6. Huettner, A.F. (1958) : Fundamental of Comparative Embryology of Vertebrates, 309 pp., Macmillan & Co., New York
7. Nelson, O.E. (1953) : Comparative Embryology of the Vertebrates, Balkiston Co., Inc., New York
8. Romer, A.S. (1969) : The Vertebrate Body, 627 pp., Vakils Feffers & Simont Pvt. Ltd., Mumbai
9. Young, I.Z. (1962) : The Life of Vertebrates, 820 pp., Oxford University Press, London
10. Alexander, R.M. The Chordata, Cambridge University Press, London
11. Carter, G.S. Structure and habit in vertebrate evaluation – Sedgwick and Jackson, London
12. Walters, H.E. and Sayles, L.D. Biology of Vertebrates. MacMillan & Co., New York
13. Schatten and Schatten : Molecular Biology of Fertilization
14. Hyman, L.H. The Aves. McGraw Hill Co., New York.
15. Read, C.P. Animal parasitism. Prentice Hall Inc. New Jersey.
16. Alexander, R.M. The Chordata. Cambridge University Press, London.
17. Barrington, E.J.W. The Biology of Hemichordata and Protochordata. Oliver and Boyd, Edinburgh.
18. Bourne, G.H. The structure and functions of nervous tissue. Academic Press, New York.
19. Eccles, J.C. The understanding of the brain. McGraw Hill Co., New York and London.
20. Malcom Jollie, Chordata morphology. East-West Press Pvt. Ltd., New Delhi.
21. Milton Hilderbrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., New York.
22. Monielli, A.R. The chordates. Cambridge University Press, London.
23. Smith, H.S. Evolution of chordata structure. Hold Rinehart and Winstoin Inc., New York.
24. Sedgwick, A. A Student's Text Book of Zoology, Vol. II.

25. Tansley, K. Vision in vertebrate. Chapman and Hall Ltd., London.
26. Walters, H.E. and Sayles, L.D. Biology of vertebrates. MacMillan & Co., New York.
27. Wolstenholmf, E.W. and Knight, J. (Ed.). Taste and Smell in vertebrates, J&A Churchill, London.
28. Young, J.Z. Life of vertebrates. The Oxford University Press, London.
29. Colbert, E.H. Evolution of the vertebrates, John Wiley and Sons Inc., New York.
30. Clark, W.E. History of the Primates IV Edn. University of Chicago Press, Chicago.
31. Weichert, C.K. and Presch, W. Elements of chordate anatomy. 4<sup>th</sup> Edn. McGraw Hall Book Co., New York.
32. Montagna, W. Comparative anatomy. John Wiley and Sons Inc.
33. Andrews, S.M. Problems in vertebrate evolution. Academic Press, New York.
34. Joysey, K.A. and T.S. Kemp. Vertebrate evolution. Oliver and Boyd, Edinbrough.
35. Smyth. Amphibia and their ways. The McMillan Co., New York.
36. Harper & Shipley, The Chordates [volumes Protochordata, Pisces, Amphibia, Reptilia, Aves & Mammalia], Cambridge Natural History Society, Series. CNH Publications, London.

## **Group A: Entomology-1**

### **Zool. 411: Entomology-1**

#### **Paper III** **Structure, Function and Development**

##### Unit 1

Structure, Composition and functions of integument and biochemistry of sclerotization. Functional morphology of Head, Thorax and abdomen and head segmentation and associated appendages.

##### Unit 2

Digestive system: Alimentary canal and modifications and physiology of digestion including special foods.  
Excretory system: Excretory organs and their modifications including cryptonephridial arrangement and physiology of excretion and regulation of water balance.

##### Unit 3

Respiratory system: Structure and physiology of respiratory organs including endoparasitic forms. Adaptations for aquatic respiration circulatory system; Structure and physiology of circulatory organs composition and functions of haemolymph.

##### Unit 4

Nervous system : Morphology and Physiology of Brain.  
Sense, organs: Mechanoreceptor, Chemoreceptor, Auditory organs, sound and light production organs, visual organs and physiology of vision.

##### Unit 5

Reproduction system: structure and function of reproductive organs, Parthenogenesis, paedogenesis, Post-embryonic development (Metamorphosis) Role Post embryonic development(Metamorphosis) Role of pheromones in reproduction, types of larvae and pupae.

## Zool. 412: Entomology-2

### Paper IV

#### Systematics, Ecology and Applied Entomology

##### Unit 1

Elementary idea of Primitive insects (Apterygotes) Habit, Habitats and distinguishing characters of various insect orders Classification and free living orders of economic importance up to important families- Orthoptera, Hemiptera, Isoptera, Lepidoptera, Diptera, Hymenoptera and Coleoptera.

##### Unit 2

Ecology of Insects: Effects of various ecological factors (Abiotic and biotic). Dynamics of population, host plant insects interaction, biochemical adaptation of environmental stress (Hibernation, aestivation, diapauses, polymorphism, swarming)

##### Unit 3

Biology, nature, extent of damage and control of agriculture, forests, medical and veterinary pests; Polyphagous Pest : *Schistocera gregaria*, *Locusta migratoria*, *Hieroglyphus* spp., *Odontotermes obesus*, *Microtermes obesus*, *Amsacata* spp.  
Pests of maize and millets : *Chilo zonellus*, *Sasamia inferens*  
Pests of pulses : *Heliothis armigera*, *Agrotis ypsilon*, *Prodenia litura*  
Pests of oil seeds: *Lipaphis crysimi*, *Athalia proxima*, *Bagrada cructferarum*.  
*Holotrichia consanguinea*, *Achaea janata*, *Euproctis lumata*

##### Unit 4

Pests of vegetable : *Docus cucurbitae*, *Aulacophora* spp., *Lecinodes orbonalis*, *Epilachno* spp.  
Pests of fibre crops : *Earias* spp., Pink ballworm, *Oxycarenum idetus*, *Dysdercus koenigii*, *Uttcheisa pulchella*  
Pests of paddy : *Leptocorisa varicornis*, *Hispa armipera*, *Spodoptera* spp.  
Pests of sugarcane : *Sciropophaga nivella*, *Pyrilla* Spp., *Emmalocera depressella*, *Aleurolobus barodensis*.  
Pests of sorghum : *Atherigona varia*, *Colicoris angustatus*.  
Pests of wheat : *Mythimna separata*, *Microsiphum miscanthi*;  
Pests of fruits : *Ophiders* spp., *Papilio demoleus*  
Pests of storage products : *Sitophilus* spp., *Rhizopertha dominica*, *Trogaderma granarium*, *Sitotraga cerealella*, *Collosobruchus* spp.  
Pests of medical and veterinary importance : *Anopheles* spp., *Culex* spp., *Aedes* spp., *Musca* spp., *Tabonus*, *Stomoxys*, *Xenspsylla*, *Hypoderma*

Pests of interest of forestry : *Sinoxylon*, *Dinoderus*, *Hyplocerambyx*  
Beneficial insects : *Laccifer lacca*, *Bombyx mori*, *Philosoma ricini*, *Anthera mylitta*, *Apis* sp., *Megachile* sp.  
Forensic entomology with special reference to man and wild life.

### Unit 5

Basic idea of insect control.

Various methods of insect control: Prophylactica and cultural methods, Legar control and Quarantine regulation, Physical control, Biological control, Integrated pest management (IPM)

Principles of insect control by chemicals.

Classification of insecticides, Preaution and antidotes Developpment of resistance in insects to insecticides.

Insecticide formulation.

A brief idea of appliances used for application of insecticides.

### **Practicals**

1. Permanent preparation of different types of mouthparts
2. Study of different types of wing venation
3. Study of different types of modification of legs
4. Study of different patterns of external genitalia
5. Study of developmental stage of any insect (egg, larva & pupa)
6. Dissections of insects : Grasshopper, cockroach, honeybee and wasp so as to expose alimentary canal, trachea, excretory and nervous system
7. Identification of different orders of insects upto families by using the dichotomous keys
8. Effect of temperature and humidity and photoperiod on developmental stages of insects
9. Application of plant protection equipments (sprayers & dusters) on crops
10. Formulation and dilution of any insecticide on per hectare basis
11. To study the population dynamics and assessment of losses caused by insect pest on crop
12. Project work
13. Practical Record
14. Viva-voce.

### **Marking Scheme**

**Max. Marks: 100**

**(Min.Pass Marks:36)**

- |   |    |
|---|----|
| 1. Dissection (Major) one               | 20 |
| 2. Experiment or Dissection (Minor) one | 08 |
| 3. Preparation                          | 07 |
| 4. Systematics & spotting               |    |

[Two insects for identification with the help of dichotomous

	Keys 8 marks & 6 Spots for 12 marks]	20
5.	Project work	15
6.	Year's Record of work: Practical Record Submission of slides and collection of insects	20
7.	Viva-voce	10

**Total: 100 Marks**

### **Books Suggested**

1. Mani, M.S. (1968) : General Entomology, 501 pp., Oxford and I.B.H., Mumbai and New Delhi
2. Ross, H. : A Text Book on Entomology, John Wiley & Sons, London
3. Reay, R.C. (1969) : Insect and Insecticides, 152 pp., Oliver and Bopd, Edinburgh
4. Snoderass, R.E. : Principal of Insect Morphology, 667 pp., McGraw Hill Co., New York
5. Ayyar, T.V.R. (1940) : Hand Book of Economic Entomology of South India, 528 pp., Govt. Press, Chennai
6. Beeson, C.F.C. (1951) : The Ecology and Control of the Forest Insects of India and the Neighbouring Countries, 1007 pp., Govt. India Press.
7. E. O. Essig : College Entomology.
8. A. D. Imms, Entomology, Part I & Part II.
9. R. F. Chapman, Structure & Function of Insects.
10. D. S. Hill, Insect Pests of Tropical and subtropical regions of the World.
11. Metcalf & Flint, Destructive and useful insects and their control.

## **Group B: Parasitology-1**

### **Zool. 411 Biology of parasitism-1 Paper III**

Systematics up to Genera, Gross Morphology, Life history, Epidemiology, Pathogenicity and Management of Protozoan, helminth and Arthropod parasites of medical, veterinary and agricultural importance.

#### **Unit 1**

Protozoa: *Trypanosoma*, *Lieshmania*, *Plasmodium*, *Entamoeba*, *Babesia*, *Criardia*, *Giardia* and *Trichomonas*

#### **Unit 2**

Trematoda : *Fasciola*, *Schistosoma*, *Fasiolopsis*, *Paragonimus*, *Dicro-coelium* and *Cotylophoron*.

#### **Unit 3**

Cestoda : *Taenia*, *Echinococcus*, *Hymenolepis*, *Dipyllidium*, *Rallietina* and *Cotugnia*.

#### **Unit 4**

Nematoda : *Ancylostoma*, *Haemonchus*, *Ascaridia*, *Wuchereria*, *Trichinella*, *Dracunculus*, *Enterobius*, *Meloidogyne*, *Heterodera* and *Entomopathogenic nematodes*.

#### **Unit 5**

Arthropoda : *Argas*, *Ixodes*, *Sarcoptes*, *Simulium*, *Anopheles*, *Culex*, *Pediculus*, *Cimex*.



**Zool. 412 – Biology of Parasitism-2**  
**Paper IV**

**Unit 1**

Animal Association: Homospecific and Heterospecific Parasitism, Characteristics of Parasites, Origin and evolution of Parasitism, host-parasite relationship, host specificity.

**Unit 2**

Ecology of Parasite: Parasite population growth and changes, extrinsic and intrinsic factors influencing parasite population, dispersal and location of host, dispersal of parasite within a host-parasite system.

**Unit 3**

Immunology: Concept of immune reaction, immunoglobulin, antigen-antibody interaction, hypersensitivity, auto-immune diseases.

**Unit 4**

Epidemiology: Principles of epidemiology, epidemiologic approach and concept of disease, methods of survey, evaluation of data.

Physiology: Principles of parasite physiology, as evident in nematodes of the following: feeding and digestion, osmoregulation, excretion, hatching and moulting.

**Unit 5**

Control: Principles of control of parasites and parasitic diseases, mode of action of anthelmintic drugs.

Toxicology: Principles of toxicology with special reference to arthropod parasites, history and action of insecticides.

**Practicals**

The practicals and marking scheme be as under:-

Epidemiological studies in common local parasitic infection.

Experimental demonstration of some physiological aspects.

Influence of the sex, age and food of host on parasitism.

### **Marking Scheme:**

**Max. Marks: 100**

**(Min. Pass Marks: 36)**

1.	Dissection and/or preparation	25 marks
2.	Physiology and/or Histochemistry	10 marks
3.	Spots (a) Systematics (b) General	20 marks
4.	Project work	15 marks
5.	Collection of parasites, Practical record, submission of Slides	20 marks
6.	Viva-voce.	10 marks

Total 100 marks

### **Books Suggested:**

1. Hyman, L. H. (1951) :The invertebrates, Vol. IIIrd, Mc Graw Hill Book Company, Inc.
2. CHATTERJEE, K. D. (1980):Parasitology, Twelfth Edition, Calcutta
3. Smyth, J.D. (1962):Introduction of Animal Parasitology, London (English Univ. Press)
4. Dogiel, V.A. (1964) :General Parasitology (revised) by Polyanski and Khelsin, 516 pp., Edinburg (Oliver & Boyd)
5. Southey, J.F. (1965) :Plant Nematology, her majesty's stationary office, London, pp– 282.
6. Cheng, T.C. (1964):The Biology of Animal and Parasites. 727 PP, London (W.B. Sunder Co.).
7. SOULSBY, E.J.L. (1966) :Biology of Parasites, 454 PP., New York (Academic Press)
8. CROLL, N.A. (1968):Ecology of Parasites, 136 PP., London (Heinman Educational Book Ltd.)
9. Chandler, C. and Clark, P. : Introduction to Parasitology. John Willey Read. (1961) and Sons Inc., New York and London.
10. Noble, E.R. and Noble, G.A. :The Biology of Animal Parasites, Philadelphia Lea & Fediger.

## **Group C: Environmental Biology**

### **Paper III**

### **Zool. 411: Environmental Biology-1**

#### Unit 1

History of cultural evolution in relation to Environment climate topography & related factors, climatic indices with special reference to aridity, soil formulation, biota profile, fertility & desalination.

Impact of environment at cellular level with special reference to pH, light, temperature & salinity.

#### Unit 2

Environmental physiology: Ecophysiological adaptations with special reference to: Hot & Cold desert, high altitude, lotic and marine environments.

Hibernation & aestivation poikilotherms & Homeotherms and Acclimatization.

#### Unit 3

Desert and desertification: Deserts of the World, Control of desertification, Thar desert; characteristics & biota, Biodiversity of Rajasthan.

#### Unit 4

Wildlife conservation in in-situ; National Parks & Sanctuaries with special reference to Corbett, Ranthambore, Manas, Desert National Park, Tal Chhapar Sanctuary, Keoladeo Ghana National Park. Endangered species.

#### Unit 5

Environmental awareness role of govt. & voluntary organizations in environmental education; environmental legislation in Indian perspective-environmental protection act 1986; Wildlife Protection Act 1972; Biological diversity Act 2002. International Conventions & Treaties.

## **Paper IV**

### **Zool. 412: Environmental Biology-2**

#### Unit 1

Terrestrial ecosystems: Types, characteristic & Biota of grasslands, Forests, deserts, Taiga & Tundra

#### Unit 2

Aquatic ecosystems:

- i) Fresh Water: Lakes classification on different basis & their characteristics; Salt lakes, Ponds, springs, Rivers & Marshes.
- ii) Marine ecosystem: zonation, fauna.
- iii) Estuarine: Ecological peculiarities fauna.

#### Unit 3

Environmental pollution: Definition, types, monitoring, source, effect & control- In respect of following: Water, Air, Land, Thermal, Noise and Radiation

#### Unit 4

Environmental toxicology: Natural & Man made toxicants in the environment & their impact on animal & human life in different ecosystems, remedial measures & monitoring. Biotress formation of exenobiotics.

#### Unit 5

Current environmental issues: Green house effect; ozone layer depletion, trade in wildlife, population explosion, sustainable development. Environmental monitoring bioassay, Bioindicators, environmental impact assessment, environmental auditing.

### **Practicals**

1. Study of fauna in relation to their habitat; terrestrial fauna of grassland and desert
2. Biomass and population density of terrestrial groups, sampling, statistical analysis
3. Recording of temperature rainfall and humidity. Estimation of soil variables: Oxygen, Carbon dioxide, electrical conductance, phosphate nitrates and dissolved carbohydrates
4. Aquatic Environment

5. Physical, chemical and hydrographic studies (temperature, dissolved oxygen, BOD, COD, pH, alkalinity, total solids, phosphates, nitrates, carbon dioxide)
6. Quantitative estimation of aquatic biota: Population density; productivity by oxygen method; phyto and zooplanktons identification and counts
7. Pollution: Identification of pollutants; quantitative estimation of pollutant by spectrophotometric method, live metallic ion

### Marking Scheme

Max. Marks: 100	(Min. Pass Marks: 36)
1. Experiment 1	20
2. Experiment 2	15
3. Preparation	10
4. Project work	15
5. Identification / Estimations	15
6. Year's Record of work	15
7. Viva-voce	10
Total 100 Marks	

### Books suggested

1. Agarwal, V.P. and Dass, P. (1990):Recent Trends in Limnology, Muzzaffarnagar (Society of Biosciences).
2. Agarwal, V.P., Desai, B.N. and Abidi, S.A.H. (1989) : Management of Aquatic Ecosystems, Delhi (Narendra Publishing House).
3. Bandhu, D.S., Chauhan, A. (1977) : Current Trends in Indian Environment, Delhi (Today and Tomorrow Printers and Publishers).
4. Gray, P. (1964) : Environmental Measurement and Interpretation, New York (Nobel Offset Printers, Inc.)
5. Lectruswicz, Mastadyen, A. (1970) : Productivity of Terrestrial Animals – Principles and Methods (I.B.P.) Handbook No. 13, Oxford (Blackwell Scientific Publication).

**Group D – Cell, Molecular Biology and Basic Biotechnology**  
**Paper III**

**Zool. 411 – Cell, Molecular Biology and Basic Biotechnology-1**

- Unit 1. Structure of prokaryotic and eukaryotic cells, organization and function of cell membrane, Centriole and micro tubules, cellular differentiation and interaction, cell ageing and apoptosis.
- Unit 2. Structure and functions of nucleus, ribosomes, endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes, mitochondria and oxidative phosphorylation.
- Unit 3. RNA polymerase and transcription, translation, Gene regulation in prokaryotes; Elementary idea about RNA interference in eukaryotes.
- Unit 4. Organization of prokaryotic and eukaryotic chromosomes, Law of DNA Constancy and C-Value Paradox, Lampbrush and polytene chromosome; DNA replication and polymerase. Sex determination.
- Unit 5. Human karyotype, chromosome banding, genome mapping, numerical and structural changes in chromosome; DNA repair mechanisms.

**Paper IV**

**Zool. 412 – Cell, Molecular Biology and Basic Biotechnology – 2**

- Unit 1. Principles of different types of microscopy, fixation and staining, cell fractionation and biochemical techniques for study of cellular constituents including chromatography, electrophoresis and blot-transfer techniques and autoradiography.
- Unit 2. Primary structure and conformation of proteins, sequencing of protein, DNA and RNA; polymerase chain reaction, molecular markers, interferon and its therapeutic uses.
- Unit 3. Cell cycle and its regulation at molecular level; mitosis, meiosis, principles and methods of cell and tissue culture.
- Unit 4. Principles of recombinant DNA technology and gene cloning; gene therapy; hybridoma technology; application of genetic engineering in human welfare and bioethics.
- Unit 5. Methods of enzyme immobilization, enzyme therapy; biosensors and biochips; application of enzyme technology; problems and opportunities for biotechnology in developing countries.

## PRACTICALS

1. Study of structures of living cell by phase-contrast microscope and vital staining.
2. Temporary and permanent cytological preparations of cell organelles.
3. Histochemical tests of protein, enzymes, lipids, carbohydrates and nucleic acids.
4. Cytological preparation of chromosomes by nonsectioning method for study of karyotypes, meiotic and sex chromosome mechanisms.
5. Cytological preparations for chromosome banding.
6. Study of ultrastructure of cell organelles and DNA from electron micrographs.
7. Experimental study of effects of colchicine on chromosomes.
8. Cytological preparation of ovary to study cell growth.
9. Living study of dynamics of cell division by phase-contrast microscopy.
10. Preparation of standard plot and quantification of proteins.
11. Quantitative estimation of carbohydrates from tissue preparation
12. Estimation of DNA in the given sample.
13. Estimation of RNA in the given sample.
14. Preparation of animal cell culture.
15. Immobilization of enzymes.
16. DNA ladder formation.
17. Chromosome preparation by squash method.

### **Marking Scheme**

Max. Marks: 100

(Min. Pass Marks: 36)

1.	Living study of normal/culture cell	08
2.	Cytological preparation using microtomy	08
3.	Histochemical test	08
4.	Chromosome preparation by nonsectioning / squash method	08
5.	Experimental study of effect of Colchicine	05
6.	Biochemical / biotechnological experiment	08
7.	Identification and comments	10
8.	Project work	15
9.	Year's work and internal assessment (Practical record, submission of slides)	20
10.	Viva-voce.	10

**Total: 100**

### **Books suggested**

1. Burns, G.W. (1983): The Science of Genetics, 5<sup>th</sup> Edition, Macmillan Publishing Co.
2. De Robertis, E.D.P. and Robertis, E.M.P. (1987): Cell and Molecular Biology, 8<sup>th</sup> edition, Lea and Febiger, Philadelphia

3. Gardner, E.J. and Snustad, D.P. (1984) : Principles of Genetics, 7<sup>th</sup> Edition, John Wiley & Sons, New York
4. Sheeler, P. and Bandhi, D.E. (1987) : Cell and Molecular Biology, 3<sup>rd</sup> Edition, John Wiley & Sons, Inc., New York
5. Peters, P. (1993) : Biotechnology – A Guide to Genetic Engineering, WMC, Brown Publishers, Dubuque.
6. Trevan, M.D. (1980) : Immobilized Enzymes : An Introduction and Application in Biotechnology, Chichester, John Wiley.
7. Bruce Albert and Bray : Molecular Biology of the Cell, Garland Publishing House, Taylor and Francis Group
8. Benjamin Lewin : Gene VII, Oxford University press.
9. Robert J. Brooker : Genetics – Analysis and Principles, Addison Wesley Longman Inc.,
10. Snustad, Simmons and Jenkins : Principles of Genetics, John Wiley & Sons Inc.

### **Group E: Fish Biology, Fisheries and Limnology**

#### **Paper III : Zool. 411 – Fish Biology, Fisheries and Limnology-1**

##### Unit 1

Theories of Fish Classification, Evolution phylogeny & distinguishing characters of principal subdivision.

Body form and Locomotion in fishes.

Integument and Exoskeleton : structure,

Modification and functions of fins, theories of origin of median and paired fins.

##### Unit 2

Respiratory system : Air breathing organs, swim bladder, weberian apparatus.

Blood vascular system: Comparative anatomy of heart and blood vessels.

Digestive system: Food Feeding and adaptive modification.

##### Unit 3

Reproductive behaviour, reproduction, development and hatching, viviparity in fishes; Migration of fishes, osmoregulation, endocrine glands, Excretory and Nervous system.

##### Unit 4

Coloration, Bioluminescence, Electric organs, Poisons and Venoms, Sound producing organs, Parental care, Hill stream and cave dwelling and deep sea adaption of fishes. Lateral line system and sense organs



## Unit 5

Survey of principal fisheries of India Fresh water, estuarine and marine with special reference to fisheries development. Biology of Indian major carps, cat fishes, Hilsa, Sardine, Mackerel, sharks.

Exotic fishes and their role in fresh water; Biochemical composition of fish; By product of fishing industry; Fish preservation and processing; Disease of fishes, their symptoms and treatment.

## **Paper IV**

### **Zool. 412 - Fish Biology, Fisheries and Limnology - 2**

#### Unit 1

Transportation of fish seed and breeders, Lay out and management of fish farm, Induced breeding, Bundh breeding. Evolution of fish hatcheries in India with special references to CIFE and Chinese Models.

#### Unit 2

Composite fish culture, Sewage fed fisheries, Conventional fishing gears for inland waters, Unconventional fishing gears (Eco sounder and its use, Electric fishing and light fishing) for inland waters, Weeds and their control in inland waters.

#### Unit 3

Definition and characteristics of Lentic and Lotic water bodies , Origin of lakes, Morphometry of lakes, Lake zonations, Classification of lakes and their origin. Classification of Marine environment.

#### Unit 4

Physical factors, temperature, thermal stratification, turbidity, conductivity and transparency of inland water bodies.

Limnochemistry : pH, alkalinity, hardness, salinity, dissolved gases

Biogeochemical cycle (nutrient cycling organic matter and redox potential)

Biological productivity : Primary and secondary productivity and their estimation

#### Unit 5

Fresh water biota, Ecological classification of fresh water organisms

General account including spatial and temporal distribution of Phytoplankton, zooplankton and benthos.

Aquatic pollution

Ecological factors affecting the life of fishes

## **Practicals**

1. Cranial nerves of a carp (*Labeo / Chirrhinus, Wallago attu* and sting ray)
2. Preparation : Scales, scroll valve, Ampulla of Lorenzini, Weberian apparatus
3. Identification of local fish fauna upto species
4. Accessory respiratory organs of *Saccobranchus, Clarias, Ophiocephalus, Anabas*.  
Internal ear of *Wallago attu*.
5. Electric organs of *Torpedo*
6. Osteology of *Labeo rohita* and *wallago attu*
7. Analysis of water quality: Estimation of pH, Alkalinity, free carbon dioxide, dissolved oxygen, total hardness, chloride, nitrate, phosphate, ammonia and silica
8. Estimation of chlorophyll and primary productivity
9. Collection, preservation and identification of phytoplankton, zooplankton and benthos
10. Soil analysis for pH and texture.
11. Seminar.
12. Practical record.
13. Project.

## **Marking Scheme**

Max. Marks: 100

(Min. Pass Marks: 36)

- |                          |          |
|--------------------------|----------|
| 1. Dissection (s)        | 15 Marks |
| 2. Experiment-1          | 15 Marks |
| 3. Experiment-2          | 05 Marks |
| 4. Project work          | 15 Marks |
| 5. Identifications       | 20 Marks |
| 6. Year's record of work | 20 Marks |
| 7. Viva-voce             | 10 Marks |

**Total**

**100 Marks**

## **Books suggested:**

1. Jhingran, V.G. (1982) : Fish and fisheries of India. Hindustan Publishing Corporation (India).
2. Kristogensson, H. (1983) : Modern fishing Gear of the World fishing New Ltd., London
3. Parihar, R.P.: Fish biology and Indian fisheries. Central Publishing House, Allahabad.
4. Srivastava, C.B.L. (1990) : Fishery science and Indian Fisheries, ICAR, New Delhi.
5. Agarwal, V.P. and Dass, P. (1990) ; Recent trends in Limnology. Society of Biosciences, Muzaffar Nagar

6. Agarwal, V.P., Desai, B.N. and Abidi, S.A.M. (1989) : Management of Aquatic Ecosystem, Delhi. Narendra Publishing House, Muzaffar Nagar
7. Gray, P. (1964) : Environmental measurement and interpretation, New York (Nobel offset Printers Inc.)
8. Lect. Ruswicz, Mastadyam, A. (1970) : Productivity of Terrestrial animals. Principle and methods (IBP). Handbook No. 13. Blackwell Scientific Publication, Oxford.
9. APWA, AWWA, WPCF. (1985) : Standard methods for the examination of water and waste water. Washington. 10<sup>th</sup> edition.
10. The Wealth of India (1962) Raw materials, Vol. IV, Council of Scientific & Industrial Research, New Delhi.
11. Odum, E.P. (1971) : Fundamental of Ecology, 574 pp., W.B. Saunders Co., Philadelphia.
12. Welch, P.S. (1948) : Limnological methods, Philadelphia, Balkiston Co. 381 pp.
13. Cole, G.A. (1978) : Text book of Limnology, 2<sup>nd</sup> edition. C.V. Moeby Company. 426 pp.
14. Wetzel (1975) : Limnology. W.B. Saunders Co. Philadelphia, 743 pp.
15. Gunther, A. (1980) : An introduction to the study of fishes. A and C Black, Edinburgh
16. Lagler, K.F., Bordach, J.E. Miller, R.R., Parsino, D.M. (1977) : Ichthyology (2<sup>nd</sup> Edn.) John Wiley and Sons, New York (1-506)
17. Roamer, A.S. (1959) : The vertebrate story. University of Chicago Press, Chicago.