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 trigging 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 Vth 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**

**Faculty Members Specialization**

1. Dr. L.S. Rajpurohit, Professor & Head Behavior
2. Dr. Ashok K. Purohit, Professor Physiology & Ecology
3. Dr. G. Tripathi, Professor Physiology & Eco-toxicology
4. Dr. Seema Trivedi, Professor Cell Biology
5. Dr. Vimla Sheoran, Professor Cell Biology
6. Dr. Anil Choudhary, Professor Fisheries
7. Dr. Naresh Vyas, Professor Parasitology
8. Dr. Kavita Naruka, Professor Physiology
9. Dr. Divya Choudhary, Assistant Professor Parasitology
10. Dr. Pankaj Nama, Assistant, Professor Limnology
11. Dr. Dhirender Choudhary, Assistant Professor Cell Biology
12. Dr. Gemra Ram Parihar, Assistant Professor. Environmental Biology
13. Dr. Heera Ram, Assistant Professor Fisheries & Physiology
14. Dr. Bhanwaroo Ram Jaipal, Assistant Professor Environmental Biology
15. Dr. Meenakshi Meena, Assistant Professor Entomology
16. Dr. Ram Prakash Saran, Assistant Professor Cell Biology
17. Dr. Lekhu Gehlot, Assistant Professor Entomology
18. Dr. Hem Singh Gehlot, Assistant Professor Environmental Biology
19. Dr. Poonam Poonia, Assistant Professor Environmental Biology
20. Dr. Shanker Lal Nama, Assistant Professor 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 pervious 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 Thrid 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 activitics 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. (Final) Zoology Examination, 2020-21**

*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, Dinasaurs, 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 radation 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

Orgenogenesis 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, Lamarkism and neo-Lamakism, 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

Genetic of quantitative traits in population: analysis of quantitative traits, quantitative traits and natural selection, estimation of heritability, genotype- environment interactions, in breeding depression and hetrosis, molecular analysis of quantitative traits.

### Practicals

1. Study of museum specimens and permanent slides

2. Dissections/ Demonstration of dissection of same invertebrates

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

**Board I**

1. Dissection (s)/diagrammatic presentation of Dissection 25

2. Preparations (including embryology) 4+4 08

3. Comments up on the following spots (8): 24

[Museum specimens 2; Bones 2; Slides: histological 2;

Embryological and genetics 2].

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, Edinbourgh.

18. Bourne, G.H. The structure and functions of nervous tissue. Academic Press, New York.

19. Eecles, 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. Wolstenholnf, 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. 4th 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, Edinbourgh.

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 digenstion including special foods.

Excretry system: Excretory organs and their modifications of including cryptonephridial arrangement and physiology of excretion and regulation of water balance.

Unit 3

Respiratory system: Sturcture and physiology of respiratory organs including endoparastitic forms. Adaptations for aquatic respiration circulatory system; Sturcture 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, paedogensis, 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 ot 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; PolyphagusPest *: 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 ypsillon, 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*.,* Pinkballworm*, Oxycarenus 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, Dinodercus, Hyplocerambys*

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. Beoson, 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.

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**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*, *Wucheresia*, *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, hypersensivity, 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 anthelminthic 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, Twelth 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 majestry’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: Ecophysioligcal 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. Endagered 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:

1. Fresh Water: Lakes classification on different basis & their characteristics; Salt lakes, Ponds, springs, Rivers & Marshes.
2. Marine ecosystem: zonation, fauna.
3. 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 phophorylation.

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 20

(Practical record, submission of slides)

10. Viva-voce. 10

**Total: 100**

**Books suggested**

1. Burns, G.W. (1983): The Science of Genetics, 5th Edition, Macmillan Publishing Co.

2. De Robertis, E.D.P. and Robertis, E.M.P. (1987): Cell and Molecular Biology, 8th edition, Lea and Febiger, Philadelphia

3. Gardner, E.J. and Snustad, D.P. (1984) : Principles of Genetics, 7th Edition, John Wiley & Sons, New York

4. Sheeler, P. and Bandhi, D.E. (1987) : Cell and Molecular Biology, 3rd Edition, John Wiley & Sons, Inc., New York

5. Peters, P. (1993) : Biotechnology – A Guide to Genetic Engineering, WMC, Brown Publishers, Dubuwue.

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, Addition 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, Biolumesence, 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. Dissections/ Demonstration of dissection of same invertebrates 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 carban 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)/diagrammatic presentation of Dissection 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. 10th 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, 2nd 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 (2nd Edn.) John Wiley and Sons, New York (1-506)

17. Roamer, A.S. (1959) : The vertebrate story. University of Chicago Press, Chicago.