

Department of Higher Education, Govt. of M.P.

Post Graduate Semester wise Syllabus

As recommended by Central Board of Studies and approved by the Governor of M.P.

M.Sc. III Sem- Zoology

Session- 2018 -19

Number & Title of the Course	Max. Marks	Min.Marks for Passing	Min. Aggr.Marks For Passing
(A)THEORY PAPERS			
IX – Comparative Anatomy of Vertebrates	35	12	
X - Limnology	35	12	
XI - Ecotoxicology	35	12	
XII - Aquaculture	35	12	
(B)PRACTICALS			
I (based on Course XI&X)	50	20	
II (based on Course XI&XII)	50	20	
(C)INTERNALASSESSMENT			
CCE *4WrittenTestbasedoneach course(each of 15 marks)	60	5 in each test	
Project/Assignment/Seminar	50	20	
TOTAL	350	-----	140

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Session 2018-19

CORE COURSE

Paper I- Comparative anatomy of Vertebrates

Max.M-35

Unit-1	<ol style="list-style-type: none">1. Origin of Chordata : Concept of Protochordata2. Development,structure and functions of integument and its derivatives (glands,scales,feathers and hairs) in Vertebrates.3. Respiratory system :Characters of respiratory tissue, External and Internal Respiration.4. Comparative account of Respiratory Organs.
Unit-2	<ol style="list-style-type: none">1. Evolution of heart.2. Evolution of aortic arches and portal systems (Renal and hepatic).3. Blood circulation in various vertebrates groups.4. Comparative account of Jaw suspensorium5. Vertebral column of Amphibia ,Reptile, Bird and Mammal.
Unit-3	<ol style="list-style-type: none">1. Evolution of urinogenital system in vertebrates (Reptile, Bird and Mammal).2. Comparative account of organs of olfaction and taste (Reptile, Bird and Mammal).3. Comparative anatomy of brain and spinal cord (CNS) (Reptile, Bird and Mammal).4. Comparative account of peripheral and autonomous nervous system in mammal.
Unit-4	<ol style="list-style-type: none">1. Comparative account of lateral line system.2. Comparative account of electroreception.3. Flight adaptations in vertebrates.4. Aquatic adaptations in birds and mammals.
Unit-5	<ol style="list-style-type: none">1. Origin,evolution general organization and affinities of Ostracoderm.2. General organization,specialized,generalized and degenerated characters of Cyclostomes.3. Origin, evolution general organization of early Gnathostomes.4. General account of Elasmobranchi, Holocephali, Dipnoi and Crossopterygii.

SUGGESTED READINGS:

1. Carter, G.S. Structure and habit in vertebrate evolution—Sedgwick and Jackson, London.
2. Kingsley, J.S. Outlines of Comparative Anatomy of Vertebrates, Central Book Depot. Allahabad,
3. Kent, C.G. Comparative anatomy of vertebrates
4. Malcom Jollie, Chordata morphology. East–West Pres Pvt. Ltd., New Delhi.
5. Milton Illidge and. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc., New York.
6. Smith, H.S. Evolution of Chordata structure. Hold Rinchart and Winstoin Inc. New York.
7. Sedgwick, A.A. Students Text Book of Zoology, Vol. II.
8. Walter, H.E. and Sayles, L.D. Biology of vertebrates, MacMillan & Co. New York.
9. Romer, A.S. Vertebrate Body, IIIrd Ed. W.B. Saunders Co., Philadelphia
10. Young J.Z. life of vertebrates. The Oxford University Press, London
11. Parker & Haswell to III Rev. by Marshall willians latested Macmillan Co. Ltd.
12. Young J.Z. Life of mammals. The Oxford University Press, London
13. Weichert, C.K. and Presch, W. Elements of chordate anatomy, 4th Edn. McGrawHall Book Co., New York.

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CORE COURSE

Paper II-Limnology

Max.M-35

Unit-1	<p>1.Limnology–Definition ,historical development and scope of Limnology.</p> <p>2.Types of fresh water habitats and their Ecosystem-</p> <p>(a) Ponds, Streams and rivers.</p> <p>(b)Lakes–Origin and classification.</p> <p>3.Morphometry–Use of various morphometric parameters and Zonation.</p>
Unit-2	<p>Physico–Chemical Characteristics-</p> <p>1. Light and Temperature-</p> <p>(a) Light as an ecological parameter in freshwater.</p> <p>(b) Temperature-Radiation, Stratification and Heat Budget.</p> <p>2. (a)Dissolved Solids–Carbonate, Bicarbonates, Phosphate and Nitrate.</p> <p>(b) Physico–Chemical characteristics of fresh water with special reference to different parameters-Turbidity, dissolved gases (Oxygen, Carbondioxide, Hydrogen Sulphide), seasonal changes in dissolved gases and pH.</p>
Unit-3	<p>1. Study of Biota-</p> <p>(a) Phytoplankton, Zooplankton and their inter-relationship.</p> <p>(b) Aquatic insects, birds and their environmental significance.</p> <p>2. Ecological classification of aquatic fauna.</p> <p>3. Higher aquatic plants and their significance.</p>
Unit-4	<p>1. Methods of water quality testing BOD and COD.</p> <p>2. Sewage– Definition, composition and its treatment.</p> <p>3. Bioindicators - Aquatic flora and fauna in relation to water quality in an aquatic environment.</p>

Unit-5	<ol style="list-style-type: none"> 1. Causes of pollution of Aquatic Resources, their management and conservation. 2. Resource Conservation–Aquatic pollution, control, legislation, regulation on discharge of industrial effluents and domestic wastes in rivers and reservoirs. 3. Use and misuse of inland waters.
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Suggested Readings:

- Anathakrishnan : Bioresources Ecology
- Goldman : Limnology
- Odum : Ecology
- Pawlosuske : Physico-chemical methods for water
- Wetzel : Limnology
- Trivedi&Goyal : Chemical and biological methods for water pollution studies
- Welch : Limnology Vols.I-II
- Perkins : Ecology
- Arora : Fundamentals of environmental biology
- Ghoshe : Toxicology
- Sood : Toxicology

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CORE COURSE

Paper III - Ecotoxicology

Max M-35

Unit-1	<ol style="list-style-type: none">1. General principles of Environmental Biology with emphasis on ecosystems.2. Abiotic and biotic factors of ecosystems.3. Communities of the environment, their structure & significance.4. Energy flow in environment: Ecological energetics.
Unit-2	<ol style="list-style-type: none">1. Productivity, Production and analysis.2. Recycling and reuse technologies for solid and liquid wastes and their role in environmental conservation.3. Remote Sensing–basic concepts and applications of remote sensing techniques in environmental conservation.4. Environmental indicators and their role in environmental balance.
Unit-3	<ol style="list-style-type: none">1. Air and Water pollution and their control methods.2. Radioactive compounds and their impact on the environment.3. Vehicular exhaust pollution, causes and remedies.4. Noise pollution.
Unit-4	<ol style="list-style-type: none">1. Toxicology-Basic concepts, toxicological methods.2. Toxicity testing principles, hazards, risks and their control methods.3. Food toxicants and their control methods.4. Public Health Hazards due to environmental disasters.

Unit-5	<ol style="list-style-type: none">1. Pesticides, types, nature and their effects on environment.2. Important heavy metals and their role in environment.3. Agrochemical use and misuse, alternatives.4. Occupational Health Hazards and their Control.
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SUGGESTED READINGS:

1. Clark : Elements of ecology
2. Odum : Fundamentals of Ecology
3. South Woods : Ecological methods
4. Trivedi and Goel : Chemical and biological methods for water pollution studies
- 5 Ghoshe : Toxicology
- 6 Sood : Toxicology

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CORE COURSE

Paper IV – Aquaculture

Max M: 35

Unit-1	<ol style="list-style-type: none">1. Aquaculture: history, definition, scope & importance.2. Inland Fisheries resources of MP- wsr Narmada3. Riverine fisheries- Ecology and fishes of major river systems, Ganga, Brahmaputra, East coast river system, Godavari and Cauvery river system.4. Cold water fisheries , Coastal fisheries in India5. General ecological characteristics of reservoirs of India.
Unit-2	<ol style="list-style-type: none">1. Fish culture :- Mono, Poly, mixed and composite Fish culture.2. Fresh water prawn culture and its prospects in India.3. Culture of oysters & pearls.4. Frog culture.
Unit-3	<ol style="list-style-type: none">1. Overview of Integrated fish culture2. Paddy cum fish culture3. Sewage fed fish culture.4. Brackish water culture.5. Cage Culture
Unit-4	<ol style="list-style-type: none">1. Fresh water fish farm engineering :Selection of site, Designing, layout & construction of fish farm & soil chemistry.2. Different types of fish ponds.3. Setting and management of fresh water aquarium.4. Aquarium fishes –Types and characteristics, Breeding of aquarium fishes.5. Different types of crafts and gears in fisheries
Unit-5	<ol style="list-style-type: none">1. Water pollution, its effects on fisheries and methods of its abatement.2. Common fish diseases & their control.3. Biochemical composition and nutritional value of fish.4. Nutrigenomics and immune function in fishes.

Suggested Readings:

1. C.B.L.Shrivastava : Fishes of India
2. Jhingaran : Fish and fisheries of India
3. S.S.Khanna : An Introduction to fishes
4. R.S.Rath : Fresh water Aquaculture
5. Gopalji Shrivastava : Fishes of U.P.& Bihar
6. H.D.Kumar : Sustainability & Management of Aquaculture & Fisheries
7. A.J.K.Mainan : Identification of fishes
8. R.Sanatam : A Manual of freshwater Aquaculture
9. S.K.Gupta : Fish & Fisheries
10. P.D.Pandey : Fish & Fisheries
11. K.P.Vishwas : Fish & Fisheries

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Post Graduate Semester wise Syllabus
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M.P.
M.Sc. III Sem- Zoology
Session– 2018 -19
Practical I: Related to I & II Theory Papers

1. Study of Specimens, slides and bones related to theory papers.
2. Major Dissection- General anatomy of cranial nerves of Labeo, Wallago.
3. Minor Dissection- Accessory respiratory organs of Clarias, Heteropneustes.
4. Estimation of DO, chloride, BOD, COD, Hardness, pH and Alkalinity of water.
5. Study of fresh water ecosystem, Bioindicators .

Scheme for Practical Examination M.M.50

1. Major Dissection	10 Marks
2. Minor Dissection	04 Marks
3. Spotting	12 Marks
4. Limnological exercise	10 Marks
5. Comment upon bioindicators	04 Marks
6. Practical Record	05 Marks
7. Viva Voce	05 Marks
Total	50Marks

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Practical II: Related to III & IV Theory Papers

1. Study of plankton.
2. Preparation and Maintenance of Aquarium.
3. Study of common weeds of fish ponds.
4. Methods of culture related to theory papers.
5. Study of abiotic factors of water related to fish life (Turbidity, Conductivity)
6. Determination of different toxic chemicals in water /soil /air sample.
7. Toxicological testing methods, General tests, acute toxicity test and LD₅₀ test.
8. Identification and comments on Aquaculture animals:
Coral-Acropora millipora, Prawn , Crab, Pila, Unio, Labeo, Catla, Wallago, Cirrhina reba,
Rana tigrina .

Scheme of practical examination

M.M.50

1. Spotting	16
2. Exercise on toxicology	10
3. Study of culture methods related to theory	05
4. Experiment on conductivity/turbidity	10
5. VivaVoce	04
6. Practical Record/ Collection	05

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Post Graduate Semester wise Syllabus

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M.Sc. IV Sem- Zoology

Session– 2018 -19

Number and title of the course	Maximum marks	Minimum marks for passing	Minimum aggregate marks for passing
A. THEORY PAPERS			
Course XIII- Animal Behaviour and Neurophysiology (Compulsory paper)	35	12	
Course XIV- Gamete Biology, Development and Differentiation (Compulsory paper)	35	12	
Course XV – (Any 01) <ul style="list-style-type: none"> • Pure and Applied fisheries • Molecular Endocrinology and Vertebrates Immune System (Optional Paper) 	35	12	
B. DISSERTATION			
Language	05		
Review of literature	05		
Methodology	05		
Analysis and interpretation	10		
Presentation	10		
Viva	15		
TOTAL OF DISSERTATION	50	20	
C. PRACTICALS			
I. Based on course XIII and XIV	50	20	
2. Based on course XV	50	20	
D. INTERNAL ASSESSMENT			
<ul style="list-style-type: none"> • Written test based on course XIII , XIV and XV 	45 (each of 15 marks)	5 in each test	
E. INTERNSHIP / PROJECT			
	100	40	
GRAND TOTAL	400		160

M.Sc. Zoology IV Semester

Session 2018-19

CORE COURSE

Paper I- Animal Behaviour and Neurophysiology

Max.M.-35

Unit-1	<p>1.Introduction:</p> <ul style="list-style-type: none">- Ethology as a branch of biology.- Animal psychology, classification of behavioral patterns, analysis of behavior (ethogram) <p>2. Reflexes and complex behaviour.</p> <p>3. Perception of the environment wsr mechanical, electrical, chemical, olfactory, auditory and visual receptors .</p> <p>4. Evolution of proximate and ultimate causation wsr inheritance of behavior and relationships.</p>
Unit-2	<p>1. Neural and hormonal control of behaviour.</p> <p>2. Genetic and environmental components in the development of behaviour.</p> <p>3. Motivation: Drive,timing and interaction of drives, physiological basis of motivation, hormones and motivation, aggregation.</p> <p>4. Types of Communication: Chemical,visual,light and audio communication.</p> <p>5. Evolution of language(primates).</p>
Unit-3	<p>1.Ecological aspects of behaviour: Habitat selection, food selection, Optimal foraging theory, anti-predator defenses, aggression, homing territoriality, dispersal, host parasite relations.</p> <p>2.Biological rhythms: Circadian and circannual rhythms, orientation and navigation, migration of fishes, turtles and birds.</p> <p>3.Learning and memory: Association learning wsr conditioning, habituation, insight learning and reasoning</p> <p>4 .Memory –Basic concept and types</p>

Unit-4	<p>1.Reproductive behaviour.Evolution of sex and reproductive strategies,mating systems,courtship,sexual selection., Parental care in fishes .</p> <p>2.Social behaviour. aggregations,schooling in fishes,flocking in birds,herding in mammals, group selection,</p> <p>3. Kin selection.</p> <p>4. Social organization in insects and primates.</p>
Unit-5	<p>1. Human Ethology</p> <ul style="list-style-type: none"> -Ethological concept and human behavior. -Concept of sign stimuli. -Concept of imprinting. -Kinships of human social systems -Human Pheromones. <p>2. Territorial behavior, bird song.</p> <p>3. Aggressive behavior.</p> <p>4. Altruism</p>

Suggested Readings-

- 1.Eibl-Eibesfeldt, I.Ethlogy.The biology of Behaviour.Holt, Rineheart & Winston, NewYork.
- 2.Gould, J.L. The mechanismand Evolution of Behaviour.
- 3.Kerbs,J.R.and N.B.davies:Behaviourable Ecology.Blackwell,Oxford, U.K.
- 4.Hinde, R.A. Animnal Behaviour: A Synthesis of Ethology and Comparative Psychology. McGrawHill, NewYork.
- 5.Alcock, J. AnimalBehaviour :An Evolutionary approach.Sinauer Assoc.Sunderland, Massachsets,USA.
- 6.Bradbury, J.W. and S.L. Vehrencamp. Principles of Animal Communication.Sinauer Assoc.Sunderland,Massachsets,USA.

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CORE COURSE

Paper-II -(Compulsory)-Gamete Biology, Development and differentiation

M.M-35

Unit-1	<ol style="list-style-type: none">1. Differentiation of gonads in mammals and its genetic basis.2. Spermatogenesis: Morphological basis in rodents.3. Gamete specific gene expression and genomics4. Biochemistry of Semen: Semen composition and formation, assessment of sperm function.5. Fertilization: Prefertilization events biochemistry of fertilization post fertilization events.
Unit-2	<ol style="list-style-type: none">1. Ovarian follicular growth and differentiation : morphology, endocrinology, molecular biology of oogenesis2. Vitellogenesis in amphibia .3. Hormonal regulation of ovulation and ovum transport in mammals.4. Multiple ovulation and embryo transfer technology wsr in vitro oocyte maturation, superovulation and elementary idea of IVF.
Unit-3	<ol style="list-style-type: none">1. Hormonal regulation of pregnancy and parturition.2. Hormonal regulation of development of mammary gland and lactation.3. Endocrinology and Physiology of placenta.4. Cryopreservation of gametes and Embryo.5. Teratological effects of xenobiotics on gametes.6. Melanogenesis.
Unit-4	<ol style="list-style-type: none">1. Cell commitment and differentiation.2. Germ cell determinants and germ cell migration.3. Early development of fish upto gastrulation4. Types of morphogenetic movements in Frog.5. Concept of totipotency and pleuropotency.6. Competence and Induction, primary and secondary inducers7. Primary neurulation .

Unit-5	<ol style="list-style-type: none"> 1. Stem cell concept: Potency definition of stem cells ,Embryonic and adult stem cell. 2. Adult stem cell niches . 3. Mesenchymal stem cells. 4. Epidermal stem cell culture. 5. Connective tissue cell family 6. Haemopoietic stem cells: Blood cells formation, 7. Stem cell disorders.
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Suggested Readings:

1. Long J.A.EvanH.M.1922: The oestrous cycle in the Rat and its associated phenomenon.
2. Nalbandou.A.C.–Reproductive physiology
3. PrakashA.S.1965-66Marshall’s,Physiology Reproduction(3Vol.)
4. Gilbert,S.F.Developmenal Biology,SinauerAssociated Inc.Massachulsetts.
5. EthanBier,the cold Spring.The cold spring Harbor laboratory Press,NewYork.
6. BalinskyB.I.Introduction to Embryology sanders,Phliedelphia.
7. Berril N.J.and Karp.G.Development Biology.McGrawHill NewYork.
8. Davidson,E.H.Gene Activity During Early Development.Academic Press,New York.

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CORE COURSE

Paper III: Pure and Applied fisheries (Optional Paper)

MM: 35

Unit-1	<ol style="list-style-type: none">1. Origin and outline of evolution of fishes2. Classification of fishes as proposed by Berg3. Structure of fish integument, development of placoid scale and types of Scales.4. Growth studies wsr age determination .5. Elementary idea of morphometric and meristic characters of fishes.6. Locomotion in fishes
Unit-2	<ol style="list-style-type: none">1. Alimentary canal and digestion in Elasmobranch [Scoliodon] and teleost fish [Clarias].2. Accessory respiratory organs wsr in clarias , Anabas and Heteropneustes.3. Air bladder , Weberian ossicles and their functions4. Structure of heart and arrangement of blood vessels in gills.5. Excretion and osmoregulation
Unit-3	<ol style="list-style-type: none">1. Nervous system in fishes.2. Venomous fishes.3. Deep sea adaptations ,Hill stream adaptations4. Migration in fishes5. Sexual cycle and fecundity
Unit-4	<ol style="list-style-type: none">1. Collection of fish seed from natural resources.2. Dry and wet bundh breeding of carps , Hypophysation3. Importance of genetic engineering in fishes with examples.4. Quarantine measures- Fish quarantine procedure.5. Basic varieties of fish feed.
Unit-5	<ol style="list-style-type: none">1. Management of hatcheries, nurseries and rearing pond.2. Management of stocking ponds3. Common aquatic weeds and control4. Methods of fish preservation,by product of fishes.5. Transport of live fish & fish seed and marketing of fish in India.

Unit-1

1. Chemical nature of hormones.
2. Mechanism of hormone action.
3. Regulation of T₃ & T₄ hormone concentration in blood
4. Hormonal Control of Gene Expression wsr Glucocorticoid
5. Eicosanoids and their hormone action.

Unit-2

1. Bioassay of Androgen wsr androgen doping
2. Hormonal regulation of energy metabolism.
3. Hormone receptor antagonist and antihormone therapy
4. Hypothalamic nuclei and their physiological function.
5. Extraction of Gonadotrophin from urine

Unit-3

1. Tissues of Immune system- Primary lymphoid organs (Thymus), Secondary lymphoid organs (Spleen).
2. Immune cells wsr lymphocytes, macrophages and natural killer cells
3. Antigen processing and presentation
4. B-cell and T-cell receptor
5. B-cell and T-cell activation

Unit . 4

1. Structure and types of Immunoglobulin
2. Gene model for Immunoglobulin gene structure wsr Two Gene Model of Dreyer and Bennett
3. Autoimmune diseases wsr autoimmune haemolytic anaemia
4. Antibody dependent cytotoxic reaction.
5. Delayed type cell mediated hypersensitivity type IV reaction.

Unit .V

1. Immunodiagnosics with special reference to –
 - a) Immunostaining wsr Immunohistochemistry
 - b) Immunoblotting / western blot
 - c) Immunochromatography.
2. Immunization .

Suggested Readings :

1. Principles of Anatomy and Physiology, Gerard J. Tortora,
2. Benjamin Lewin – Genes VII/ VIII, oxford University press.
3. Lodishetal- Molecular Cell Biology.
4. Zarrow, M.X., Yochin J.M. and Machrthy, J.L. – Experimental Endocrinology.
5. Chatterji C.C.- Human Physiology (Vol- II).
6. Bentley, P.J. – Comparative Vertebrate endocrinology.
7. Hadley Mac. E.- Endocrinology.
8. Chinoy, N.J. Rao, M.V., Desarai, K.J. and High land, H.N. – Essential techniques in reproductively physiology and Endocrinology.
9. Norris, D.O. – Vertebrate Endocrinology.
10. Kuby, Immunology, W.H. Freeman, U.S.A.
11. W. Paul. Fundamentals of Immunology.
12. I.M. Roitt. Essential Immunology, ElBS Edition.

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Practical-I

M.M.:50

1. Exercise on Animal behavior

- a) Taxes – Hydrotaxis ,Chemotaxis ,Geotaxis , Phototaxis
- b) Reflexes
- c) Social behavior
- d) Learning behavior- Trial and error learning using step maze

2. Developmental Biology

- a) Study of embryological slides [Frog & chick]
- b) Preparation of permanent chick mount
- c) Study of different stages of spermatogenesis(slides of meiosis)
- d) Semen analysis –sperm count and sperm motility

Scheme for Practical Examination

1.	Exercise based on animal behavior	20
2.	Exercise based on developmental biology	15
3.	Practical record / Collection	10
4.	Viva Voce	05

Total 50 Marks

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Practical-II

Max.M- 50

1. Major dissection Nervous system of Wallago /Labeo,.
2. Minor dissection of weberian ossicles (Labeo /Wallago).
3. Age determination of fish with the help of scales
4. Identification of fish(10 fishes)
5. Spotting of museum specimen, slides and bones of fishes.
6. VivaVoce.
7. Practical record & survey of local fish market.

Scheme for Practical Examination

Time: 5 hour

M:M 50

1. Major dissection Nervous system of Wallago / Labeo,.	10
2. Minor dissection of weberian ossicles (Labeo /Wallago).	06
3. Age determination of fish with the help of scales	05
4. Identification of fish	06
5. Spotting of museum specimen, slides and bones.	08
6. VivaVoice.	05
7. Practical record & survey of local fish market.	10
Total	50