St. Aloysius College (Autonomous), Jabalpur

Department of Zoology

M.Sc. ZOOLOGY - III Semester

Choice Based Credit System (CBCS)

Scheme of Examination (w.e.f.Session 2020-21)

Course No.	Course Title	Credits	Marks	
			Max. Marks	Min. Marks For Passing
CORE COURSES				
ZC -301.	Comparative Anatomy of Vertebrates	4	40	14
ZC -302.	Limnology	4	40	14
ZC -303	Ecotoxicology	4	40	14
ZC -304	Aquaculture	4	40	14
ELECTIVE COURSE – (Any 01)				
ZE-305	• Sericulture • Animal Biotechnology	4	40	14
INTERNAL ASSESSMENT				
ZI -306	CCE-Written test (Based on core and elective Courses ZC- 301, 302 ,303, 304 & ZE-305) (Each test of 10 marks)	0	50	20 (04 in each Test)
ZI -307	Project/ Seminar	1	25	09
PRACTICALS				
ZP -308	Practical- I Based on Course ZC -301. & ZC -302.	2	50	18
ZP -309	Practical- II Based on Course ZC -303,ZC -304 & ZE-305.	2	50	18
SKILL BASED COURSE				
ZS-310	Skill Based Course	1	10	4
Total Credits & Total Marks		**26**	**385**	**139**

M.Sc. Zoology III Semester

Session 2020-21

CORE COURSE

Paper I- Comparative Anatomy of Vertebrates

Max.M-40

Unit-1	1. Origin of Chordata : Concept of Protochordata 2. 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	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 Suspensorium in Vertebrates. 5. Vertebral column of Fishes, Amphibia, Reptile, Bird and Mammal.
Unit-3	1. Evolution of urinogenital system in vertebrates (Fishes, Amphibia, Reptile, Bird and Mammal). 2. Comparative account of organs of olfaction and taste (Fishes, Amphibia, Reptile, Bird and Mammal). 3. Comparative anatomy of brain and spinal cord (CNS) (Fishes, Amphibia, Reptile, Bird and Mammal). 4. Comparative account of peripheral and autonomous nervous system in mammal.
Unit-4	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	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 Autonomy of Vertebrates,Central Book Depot. Allahabad,
3. Kent,C.G.Comparative anatomy of vertebrates
4. MalcomJollie,Chordata morphology.East–WestPresPvt.Ltd.,NewDelhi.
5. MiltonIlildergr and.Analysis of vertebrate structure.IV.Ed.JohnWiley and SonsInc.,NewYork.
6. Smith,H.S.Evolution of Chordata structure.Hold Rinchart andWinstoin Inc. NewYork.
7. Sedgwick, A. A. Students : TextBook 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,IIIrdEd.W.B.SaundersCo.,Philadelphia
10. YoungJ.Z.life of vertebrates.The oxfordUniversityPress,London
11. Parker&Haswell to IIIRev.by Marshall willians latestedMacmillanCo.ltd.
12. YoungJ.Z.Life of mammals.TheOxfordUniversityPress,London
13. Weichert,C.K.andPresch,W.Elements of chordate anatomy,4th Edn. McGrawHall Book Co.,NewYork.

M.Sc. Zoology III Semester

Session 2020-21

CORE COURSE

Paper II-Limnology

Max.M-40

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

Unit-5	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.

Suggested Readings:

Anathakrishnan	:	Bioresources Ecology
Goldman	:	Limnology
Odum	:	Ecology
Pawlosuske	:	Physico-chemical methods for water
Wetzal	:	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-40

Unit-1	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	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	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	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	1. Pesticides, types, nature and their effects on environment. 2. Agrochemical use and misuse, alternatives. 3. Important heavy metals and their role in environment. 4. Occupational Health Hazards and their Control.

SUGGESTEDREADINGS:

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

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Session 2019 -20
CORE COURSE
Paper IV – Aquaculture

Max M: 40

Unit-1	1. Aquaculture: history, definition, scope & importance. 2. Inland Fisheries resources of MP- wsr Narmada 3. Riverine fisheries- Ecology and Fishes of Major River Systems wsr Ganga, Brahmaputra, East coast river system, Godavari and Cauvery river system. 4. Cold water fisheries in India. 5. Coastal fisheries in India. 6. General ecological characteristics of reservoirs of India.
Unit-2	1. Fish culture wsr Mono and Poly/ Mixed/ Composite Fish culture. 2. Fresh Water Prawn Culture and its prospects in India. 3. Culture of Oysters 4. Pearl culture and Pearl industry. 4. Frog culture.
Unit-3	1. Overview of Integrated fish culture 2. Paddy cum fish culture 3. Sewage fed fish culture. 4. Brackish water culture. 5 Cage Culture

Unit-4	1. Fresh water fish farm Engineering: Selection of site, soil chemistry of fish farm, designing of fish farm, Layout & construction of fish farm. 2. Types of fish ponds. 3. Setting and management of fresh water aquarium wsr feeding and Nitrogen cycle 4. Aquarium fishes –Types and characteristics, Breeding of aquarium fishes. 5. Different types of crafts and gears in fisheries
Unit-5	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 fishes. 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 waterAquaculture
5. Gopalji Shrivastava	:	Fishes of U.P.& Bihar
6. H.D.Kumar Fisheries	:	Sustanibility & Management of Aquaculture
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

M.Sc. Zoology III Semester
Session 2020-21
ELECTIVE COURSE
Sericulture

Max M : 40

Unit-1	Introduction and Moriculture: 1. Historical background of sericulture. 2. Silk Producing organisms and types of silk. 3. Classification of races of *Bombyx mori.* 4. Life cycle of *Bombyx mori* 4. Propagation of Mulberry plant. 5. Process of Sericulture
Unit-2	Plant Pathology, silkworm diseases and Biology of Bombyx mori wsr: 1. Diseases of mulberry plant. 2. Diseases of silkworms wsr Pebrine (Protozoan disease), Bacterial, Fungal and Viral diseases *3.* Silk gland of *Bombyx mori*. 4. Structure & chemical composition of silk.
Unit-3	Rearing facilities and operation wsr: 1. Rearing house and appliances for rearing of silk worms. 2. Disinfection operation before rearing of silk worms 3. Maintenance of optimum conditions for rearing. 4. Feeding, Bed cleaning and spacing
Unit-4	Moulting and Mounting wsr: 1. Moultanism . 2. Care during Moulting of silk worm. 3. Characteristic features of ripe silk worm 4. Process of mounting of silk worm. 5. Process of spinning & harvesting of cocoons
Unit-5	Cocoon Marketing, Silk Reeling and Non-Mulberry Silk Worm wsr: 1. Cocoon Quality. 2. Testing and grading of cocoon. 3. Silk reeling operation. 4. Non-Mulberry Silk Worm culture wsr Tasar culture, Eri culture and Muga culture.

List of books for Sericulture:

1. Hand book of Silk Worm rearing by Masanori, Shimiza,D. Agri.
2. Sericulture Manual -2
3. Sericulture Manual -3 by S. Kishanaswamy
4. Introduction to Sericulture by Dr. (Mrs.) G. Ganga Dr. (Mrs.) J. Sulochanachetty
5. Principles of Sericulture by HisaoAruga
6. A Manual of non-mulberry Silks Sericulture Vol.-1 by Dr. M.S. Jolly.*et al*
7. Sericulture and Silk Industries by TripurariSharan
8. Sericulture Manual -1 Mulberry cultivation by Dr. G. Rang swami
9. Sericulture Manual -2 Silkworm rearing by Dr. S. Krishnaswami
10. Sericulture Manual -3 Silk reeling by Dr. S. Krishnaswami
11. Mulberry cultivation by Zheng, Ting-Zing
12. Silkworm rearing by Pva Pang- Chesan
13. Silk worm training manual by ScoHotim.

M.Sc. Zoology III Semester
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ELECTIVE COURSE
Animal Biotechnology

Max M : 40

Unit-1	1. Structure and organization of animal cell 2. Elementary idea of equipments and materials for animal cell culture technology. 3. Primary and established cell line cultures. 4. Brief account of balanced salt solution and chemical, physical and metabolic functions of different constituents of commonly used culture mediums. 5. Role of carbon dioxide, serum and supplements in animal cell culture.
Unit-2	1. Serum and protein free defined media and their application, 2. Measurement of viability and cytotoxicity; 3. Biology and characterization of the cultured cells, 4. Measuring parameters of growth. 5. Basic techniques of mammalian cell culture in vitro.
Unit-3	1. Disaggregation of tissue and primary culture. 2. Maintenance of cell culture. 3. Scaling up of animal cell culture 4. Cell separation 5. Cell synchronization 6. Cell cloning and micromanipulation 7. Cell transformation.
Unit-4	1. Embryonic stem cells and their culture. 2. Epithelial stem cells culture. 3. Application of animal cell cultures. 4. Cell culture based vaccines. 5. Somatic cell genetics. 6. Introduction of assisted reproductive technologies for genetic improvement of farm animals.
Unit-5	1. Organ and Histotypic culture. 2. Elementary idea of Cell Senescence and apoptosis 3. Measurement of cell death. 4. Brief account of three dimensional culture and tissue engineering. 5. Culture collection centers for animal cell lines.

Recommended Books

1.Culture of Animal Cells (3 rd Edition), R. lan Freshmney.- Wiley Liss.
2.Animal Cell Culture -Practical Approach, (Ed) John R.W. Masters, Oxford.
3.Cell Growth and Division' A Practical Approach. (Ed.) R. Basega, IRL Press.
4.Cell Culture Lab Fax. (Eds). M. Buller & M. Dawson, Bios Scientific Publication Ltd. Oxford.
5 Animal Cell Culture Techniques. (Ed.) Martin Clynes, Springer.
6.Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods, (Ed.) Jenni P.
7.Mather and David Barnes, Academic Press

M.Sc. III Sem- Zoology

Session– 2020-21

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 ofLabeo,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 freshwater ecosystem.
6. Study of Bioindicators .

Scheme for Practical Examination M.M.50

1.	MajorDissection	10 Marks
2.	MinorDissection	04 Marks
3.	Spotting	12 Marks
4.	Limnologicalexercise	10 Marks
5.	Comment upon bioindicators	04 Marks
6.	PracticalRecord	05 Marks
7.	VivaVoce	05 Marks
	Total	**50Marks**

M.Sc. III Sem- Zoology

Session– 2019 -20

Practical II: Related to III ,IV and Elective Course 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 samples of soil, water and air.
7. Toxicological testing methods, General tests, acute toxicity test and LD**50** test.
8. Identification and comments on Aquaculture animals:

   Coral-Acropora millipora, Prawn , Crab, Pila, Unio, Labeo,Catla, Wallago, Cirrhina reba, Rana tigrina .
9. Identification of Silkmoths / Life cycle of *Bombyx mori*.
10. MTT assay / Invitro Cell viability test

Scheme of practical examination

1.	Spotting	12
2.	Identification and comments upon Silkmoths / Life cycle of *Bombyx mori* / MTT assay / Invitro Cell viability test	04
3.	Exercise on toxicology	10
4.	Study of culture methods related to theory	05
5.	Experiment on conductivity/turbidity	10
6.	VivaVoce	04
7.	Practical Record/ Collection	05
	Total	**50**

St. Aloysius College (Autonomous), Jabalpur

Department of Zoology

M.Sc. ZOOLOGY - IV Semester

Choice Based Credit System (CBCS)

Scheme of Examination (w.e.f. Session 2020-21)

Course No.	Course Title	Credits	Marks	
			Max. Marks	Min.Marks For Passing
CORE COURSES				
ZC-401.	Animal Behaviour and Neurophysiology	4	40	14
ZC - 402.	Gamete Biology, Development and Differentiation	4	40	14
ELECTIVE COURSE - (Any 01)				
ZE -403	• Pure and Applied fisheries • Molecular Endocrinology and Vertebrates Immune System	4	40	14
ZD - 404	**DISSERTATION**			
	Language Review of literature Methodology Analysis and interpretation Presentation Viva	4	05 05 05 10 10 15 50	18
INTERNAL ASSESSMENT				
ZI -405	CCE-Written test (Based on ZC -401, 402 & ZE -403) (Each test of 10 marks)	0	30	12 (04 in each Test)
ZI -406	Internship Project	4	50	18
ZI -407	Comprehensive Viva-Voce	1	50	18
PRACTICALS				
ZP -408	Practical- I Based on Course ZC -401 & ZC-402	2	50	18
ZP -409	Practical- II Based on Course ZE - 403	2	50	18
SKILL BASED COURSE				
ZS-410	Skill Based Course	1	10	4
Total Credits & Total Marks		**26**	**410**	**148**

M.Sc. Zoology IV Semester

Session 2020-21

CORE COURSE

Paper I- Animal Behaviour and Neurophysiology Max.M.-40

Unit-1	1.Introduction: - Ethology as a branch of biology. - Animal psychology, classification of behavioral patterns, analysis of behavior (ethogram) 2. Reflexes and complex behaviour. 3. Perception of the environment wsr mechanical, electrical, chemical, olfactory, auditory and visual receptors . 4. Evolution of proximate and ultimate causation wsr inheritance of behavior and relationships.
Unit-2	1. Neural and hormonal control of behaviour. 2. Genetic and environmental components in the development of behaviour. 3. Motivation: Drive,timing and interaction of drives, physiological basis of motivation, Hormones and motivation. 4. Types of Communication: Chemical, visual, light, audio communication and sonotaxonomy wsr bird call. 5. Evolution of language (primates). 6 Bioluminescence and Colouration in fishes
Unit-3	1.Ecological aspects of behaviour: Habitat selection, food selection, Optimal foraging theory, anti-predator defenses, homing territoriality, dispersal, host parasite relations. 2.Biological rhythms: Circadian and circannual rhythms, orientation and navigation, migration of fishes, turtles and birds. 3.Learning and memory: Association learning wsr conditioning, habituation, insight learning and reasoning 4.Memory –Basic concept and types

Unit-4	1.Reproductive behaviour.Evolution of sex and reproductive strategies,mating systems,courtship,sexual selection., Parental care in fishes . 2.Social behaviour. Aggregations,Schooling in fishes,Flocking in birds,Herding in mammals, Group selection, 3. Kin selection. 4. Social organization in insects and primates.
Unit-5	1. Human Ethology -Ethological concept and human behavior. -Concept of sign stimuli. -Concept of imprinting. -Kinships of human social systems -Human Pheromones. 2. Territorial behavior. 3. Aggressive behavior. 4. Altruism

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.

M.Sc. Zoology IV Semester

Session 2020-21

CORE COURSE

Paper-II - Gamete Biology, Development and Differentiation M.M-40

Unit-1	1. Differentiation of gonads in mammals and its genetic basis. 2. Spermatogenesis: Morphological basis in rodents. 3. Gamete specific gene expression and genomics 4. Biochemistry of Semen: Semen composition and formation, assessment of sperm function. 5. Fertilization: Prefertilization events biochemistry of fertilization post fertilization events.
Unit-2	1. Ovarian follicular growth and differentiation: morphology, endocrinology, molecular biology of oogenesis 2. 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	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 Xenobiotic on gametes. 7. Melanogenesis.
Unit-4	1. Cell commitment and differentiation. 2 Germ cell determinants and germ cell migration. 3 Early development of fish upto gastrulation 4 Types of morphogenetic movements in Frog. 5 Concept of totipotency and pleuropotency. 6 Competence and Induction, primary and secondary inducers. 7 Primary neurulation.

Unit-5	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.

SuggestedReading:

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.

M.Sc. Zoology IV Semester

Session 2020-21

ELECTIVE COURSE

Paper III: Pure and Applied fisheries

Max M.: 40

Unit-1	1. Origin and outline of evolution of fishes 2. Classification of fishes as proposed by Berg 3. Structure of fish integument, development of placoid scale and types of Scales. 4. Growth studies wsr Age determination in fishes. 5. Elementary idea of morphometric and meristic characters of fishes. 6. Locomotion in fishes
Unit-2	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 functions. 4. Structure of heart and arrangement of blood vessels in gills. 5. Excretion and Osmoregulation.
Unit-3	1. Nervous system in fishes. 2. Venomous fishes. 3. Deep sea adaptations in fishes. 4. Hill stream adaptations in fishes. 5. Migration in fishes 6. Sexual cycle and fecundity of fishes
Unit-4	1. Collection of fish seed from natural resources. 2. Dry and Wet Bundh breeding of carps. 3. Method of Hypophysation . 4. Importance of genetic engineering in fishes with examples. 5. Quarantine measures- Fish quarantine procedure. 6. Basic varieties of fish feed.
Unit-5	1. Management of Hatcheries, Nurseries and Rearing Pond. 2. Management of stocking ponds. 3. Common aquatic weeds and control. 4. Methods of fish preservation. 5. By product of fishes. 6. Transport of live fish & fish seeds. 7. Marketing of fishes in India.

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 waterAquaculture
5. Gopalji Shrivastava : Fishes of U.P.& Bihar
6. H.D.Kumar : Sustanibility & 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

M.Sc. Zoology IV Semester
Session 2020-21
ELECTIVE COURSE

Paper III: Molecular Endocrinology and Vertebrates Immune System

Max M. : 40

Unit-1	1. Chemical nature of hormones. 2. Mechanism of hormone action. 3. Regulation of T_3& T_4 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 Gonadotropin 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 haemolyticanaemia 4. Antibody dependent cytotoxic reaction. 5. Delayed type cell mediated hypersensitivity type IV reaction.
Unit-5	1. Immunodiagnostics 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 Lewim – Genes VII/ VIII, oxford University press.
3. Lodishetal- Molecular Cell Biology.
4. Zarrow, M.X., Yochin J.M. and Machrthy, J.L. – ExperimentalEndocrinology.
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.
13. David Randall:Animal Physiology (Eckert's)
14. D.P. Anderson: Text Book of Fish Immunology.
15. Joshi & Osamo : Immunology & Serology
16. David Male: Advanced Immunology

M.Sc. Zoology IV Semester

Session 2020-21

Practical-I

(Based on Core Courses: Paper I & II)

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**

M.Sc. Zoology IV Semester

Session 2020-21

Practical-II

(Based on Elective Course : Paper III)

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. Viva Voce.
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. Viva Voce.	05
7.Practical record & survey of local fish market .	10
Total	**50**

M.Sc. Zoology IV Semester

Session 2020-21

Practical-II

(Based on Elective Course: Paper III)

1. Western Blotting.
2. Widal screening test.
3. Detailed histological structure of Major Lymphoid Organs like spleen, thymus, Bone marrow, lymph nodes and Peyer's patches.
4. Demonstration of antigen and antibody reaction through simple experiments
    a. Agglutination
    b. Immunodiffusion
    c. Immunoelectrophoresis
5. ELISA
6. VivaVoce
7. Practical record & Survey of diseases recorded in local hospitals

Scheme for Practical Examination

Time: 5 hour **M:M 50**

1. Western Blotting.	10
2. Immunodiffusion	06
3. Widal screening test.	05
1. ELISA/ Immunoelectrophoresis	06
2. Spotting based of slides of Major Lymphoid Organs.	08
3. Viva Voice.	05
7. Practical record & Survey of diseases recorded in local hospitals	10
Total	**50**