Swami Vivekanand University, Sagar (M.P.)

As per model syllabus of U.G.C. New Delhi, drafted by Central Board of Studies and Approved by Higher Education and the Governor of M.P.

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Faculty of Science

Syllabus & Prescribed Books

Subject- Zoology

M.Sc. Semester Examination

2016-18

I to IV Semester

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Swami Vivekanand University, Sagar (M.P.)

COURSEWISE SCHEME

I[st] SEMESTER

1. Course Code	: MSCZOO	5. Total Practical	: 2
2. Course Name	:M.Sc. Zoology	6. Total Practical Marks	: 100
3. Total Theory Subject	: 4	7. Total Marks	: 300
4. Total Theory Marks	: 200	8. Minimum Passing Percentage	: 36

Sub. Code	Subject Name	Theory									Practical		Total	
		Paper					CCE		Total Marks					
		1st	2nd	3rd	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Compulsory														
MSCZOO 101	Biosystematics, Taxonomy & Evolution	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 102	Structure & Function of Invertebrates	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 103	Quantitative Biology, Biodiversity and Wild Life	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 104	Bio Molecules & Structural Biology	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 105	**Practical-I** Related to Theory Paper I & II	0	0	0	0	0	0	0	0	0	50	18	50	18
MSCZOO 106	**Practical-II** Related to Theory Paper III & IV	0	0	0	0	0	0	0	0	0	50	18	50	18

Swami Vivekanand University, Sagar (M.P.)

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

Semester wise Syllabus for Postgraduates

As recommended by Central board of Studies and
Approved by HE the Governor of M.P.

M.Sc. Zoology Semester I
Paper I Biosystematics, Taxonomy and evolution

Unit I

Definition and basic concepts of biosystematics taxonomy and classification.
- History of Classification
Trends in biosystematics : Chemotaxonomy cytotaxonomy and molecular taxonomy
Dimensions of speciation and taxonomic characters.
Species concepts : species category, different species concepts, subspecies and other infra-specific categories.
Theories of biological classification: hierarchy of categories.

Unit II

- Taxonomic Characters – Different kinds.
- Origin of reproductive isolation, biological mechanism of genetic incompatibility.
- Taxonomic procedures: Taxonomic collections , preservation ,curetting, process of identification.
- Taxonomic keys,different types of keys, their merits and demerits.
- International code of Zoological Nomenclature (ICZN): Operative principles, interpretation and application of important rules: Formation of Scientific names of various Taxa.

Unit III

- Taxonomic categories.
- Evaluation of biodiversity indices.
- Evaluation of Shannon – Weiner Index.
- Evaluation of Dominance Index.
- Similarity and Dissimilarity Index.

Unit-IV

- Concepts of evolution and theories of organic evolution.
- Neo Darwinism and population genetics:
- A- Hardy-Weinberg law of genetic equilibrium.
- B – A detailed account of destabilizing forces:

- i- Natural selection
- ii- Mutation
- iii- Genetic Drift
- iv- Migration
- v- Meiotic Drive.
- Trends in Evolution
- Molecular Evolution
- a) Gene evolution
- b) Evolution of gene families
- c) Assessment of molecular variation

Unit – V

- Origin of higher categories
- Phylogenetic – gradualism and punctuated equilibrium.
- Major trends in the origin of higher categories
- Micro and macro evolution.

Molecular population genetics

- Pattern of changes in nucleotide and amino and sequence.
- Ecological significance of molecular variations (genetic polymorphism) Genetic & Speciation
- Phylogenetic and biological concept of species.
- Patterns and mechanism of reproductive isolation.
- Modes of speciation (allopatry & sympatry)

Origin and Evolution & Economically important microscopes and animals.

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Department of Higher education, Govt. of M.P.
Semester wise Syllabus for Postgraduates
As recommended by Central board of Studies and
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MSc Previous Subject: Zoology

SEMESTER -I Paper-I List of Books

SUGGESTED READING MATERIAL

1. M. Koto-The. Biology of biodiversity-Springer
2. E.O. Wilson-Biodiversity-Academic Press Washington.
3. G.G.-Simpson-Principle of animal taxonomy Oxford IBH Publication company.
4. E-Mayer-Elements of Taxonomy
5. Bastchelet-F-Introduction to mathematics for life scientists Springer Verlag, Berling.
6. Skoal R.R. and F.J.Rohiff Biometry-Freeman, San-Francisco.
7. Snecdor, G.W. and W.G. Cocharan Statisical Methods of affiliated-East- West Press, New Delhi.
8. Murry J.D. Mathematical Biology-Springer, Verlag, Berlin.

Swami Vivekanand University, Sagar (M.P.)

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Semester wise Syllabus for Post Graduates As recommended by Central board of Studies and Approved by HE the Governor of M.P.

Class	-	M.Sc.
Subject	-	Zoology
Paper Title	-	Paper II STRUCTURE AND FUNCTION OF INVERTEBRATES
Semester	–	I

UNIT –I

1. Origin of metazoa
2. Organization of Coelom
   A. Acoclomates
   B. Pscudocoelomates
   C. Coclomates
3. Locomotion.
   A. Amoeboid flageller and cillary movement in protozoa
   B. Hydrostatic movement in Coelenterata
   C. Annelida and Echinodermata

UNIT –II

A: NUTRITION AND DIGESTON
Patterns of Feeding and digestion in lower metazoa, Mollusea, Echinodermata Filter feeding in polychaeta.
B: Respiration
Organs of respiration : Gills, lungs and trachea, respiratory pigments. Mechanism of respiration.

UNIT – III

EXCRETION
Excretion in lower invertebrates. Excretion in higher invertebrates. Mechanism of Osmoregulation**.**

UNIT – IV

NERVOUS SYSTEM.

A. Primitive Nervous systems-Coelenterata and Echinodermata.
B. Advanced nervous system in Annelida,
Arthropoda (Crustacea and Insecta) and Mollusa (Cephalopoda)

UNIT – V

A. INVERTEBRATES LARVAL FORMS AND THEIR EVOLUTIONARY SIGNIFICANCE.

A. Trematoda and Cestoda
B. Larval forms of Crustacea
C. Larval forms of Mollusea
D. Larval forms of Echinodermata.

B. 1. Structure affinities and life history of the following minor noncoelomate Phyla - A. Rotifera B. Entoprocta

2. Structure affinities and life history of the following minor Phyla

A. Phoronida
B. Ectoprocta

Suggested Reading Material –

1. Hyman, L.H. The invertebrates, Nol. I.protozoa through Ctenophora, McGraw Hill Co., New York
2. Barrington, E.J.W. Invertebrate structure and function. Thomas Nelson anmd Sons Ltd., London.
3. Jagerstein, G. Evolution of Metazoan life cycle, Academic Press, New York & London.
4. Hyman, L.H. The Invertebrates. Vol. 2. McGraw Hill Co., New York.
5. Hyman, L.H. The Invertebrates. Vol. 8. McGraw Hill Co., New York and London.
6. Barnes, R.D. Invertebrates Zoology, III edition. W.B. Saunders Co. Philadelphia.
7. Russel-Hunter, W.D. A biology of higher invertbrates, the Macmillan Co. Ltd., London.
8. Hyman, L.H. The Invertebrates smaller coelomate groups, Vol. V.Mc.Graw Hill Co., New York.
9. Read, C.P. Animal Parasitism. Parasitism. prentice Hall Inc., New Jersey.
10. Sedgwick, A.A. Student text book of Zoology. Vol. I,II and III. Central Book Depot, Allahabad.
11. Parker, T.J., haswell W.A. Text book of Zoology, Macmillan Co., London.

Swami Vivekanand University, Sagar (M.P.)

Department of Higher education, Govt. of M.P.
Semester wise Syllabus for Post Graduates

As recommended by Central board of Studies and
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M.Sc. Previous

I Sem III Paper

Quantitative biology, biodiversity and wildlife

Unit – I Quantitative biology

- Basic mathematics for biologists
- matrices and vectors
- Exponential functions
- Differential equations integration
- Periodic functions
- Sprobability distribution properties and probability theory

Unit – II

- Experimental designing and sampling theory
- Completely randomized design and randomized block design
- Analysis of variance
- Co-relation- types of correlation
- Karl personls coefficient correlation
- Regression

Unit – III Biodiversity

- concept and principal of biodiversity
- causes for the lose of biodiversity
- Biodiversity conservation method
- Medicinal uses of forest plant

Unit – IV Wildlife of India, types of wildlife

- Values of wildlife positive and negative
- Wildlife protection Act
- Conservation of wildlife in India
- Endangered and threatened spices

Unit – V Wildlife and conservation

- National Parks and Sanctuaries
- Project Tiger
- Project Gir lion ang Crocodile breeding project
- wildlife in M.P. with references to Reptiles Birds and mammals
- Biospheres reserves

Suggested Readings Materials

- Bataschelet. E. Introduction to mathematics for site scientist springer-verlag, berling
- Jorgenserr, S.E. Fundamental of Ecological modling E. sevier New York
- Lenderen D. Modelling in behavioral ecology. Chapman & Hall London U.K.
- Sokal, R.R. and F. J. Rohit Biometry Freeman San Francisco
- Snedecor, G.W. and W.G. cochran, statical methods, Affilited East, West Press New Delhi (Indian ed.)
- Muray , J.D. Methamatical Biology, Springer Verlag Berlin
- Pelon, E.C. The interpretation of ecological data : A promer on classification and ordivation.
- A. lewis – Biostatics
- B.K. Mahajan Methods in Biostatics
- V.B. Saharia wildlife in India
- S.K. Tiwari wildlife in central India
- J.D. Murrey Mathematical Biology
- Georgs & Wilians Startical method
- R.K. Tondon Biodiversity Texonomy & Ecology
- M.P. Arora An Introduction to prevantology
- P.C. Kotwal Biodiversity and conservation

Ist Semester Suggested reading materials:

1. M. Koto : The Biology of Biodiversity. Springer.
2. E. O. Wildon : Biodiversity. Academic Press Washington.
3. G.G. Simpson : Principles of Animal Taxonomy. Oxford IBH Publication Company.
4. E. Mayer : Elements of Taxonomy.
5. Dobzansky : Biosystematics.
6. Dallela and Sharma : Animal Taxonomy and Museology.
7. Dodzhansky: The Genetics and origin of species. Columbia University Press.
8. Futuyama D.I. Evolutionary Biology. INC Publishers Dunderland.
9. Jha A.P. : Genes and Evolution – John Publication, New Delhi.

Swami Vivekanand University, Sagar (M.P.)

Department of Higher education, Govt. of M.P.
Semester wise Syllabus for Postgraduates

As recommended by Central board of Studies
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Class: M.Sc. SEMESTER - I
Paper: IVth Paper
BIOMOLECULES AND STRUCTURAL BIOLOGY

Unit – I

Chemical Foundation of bilogy

- PH, PK, acids bases, buffers, weak bonds
- Free energy, resonance, isomerisation
- Acid soluble pool of living tissues – aminoacids,
- monosaccorides, oligosaccharides, nucleotides, peptides.
- Nanoparticles
- Biomaterials

Unit – II

1. Primary, Secondry, tertiary and quaternary structures of proteins, protein folding and denaturation
2. DNA & RNA: Double helical structure of DNA, Structure of RNA, role of RNA in gene expression
3. DNA replication, recombination and repair
4. Functional importance of lipid storage and membrane lipids
5. Membrane channels and pumps

Unit – III

1. Basic concepts of metabolism: Coupled and interconnecting reactions of metabolism cellular energy recources and ATP synthesis
2. Glycolysis and glyconeogenesis
3. Citric acid cycle
4. Oxidative phosphorylation : Protein and it's regulation
5. Fatty acid metabolism: Synthesis and degradation of fatty acids

Unit – IV

1. RNA synthesis and splicing
2. Biosynthesis of amino acids
3. Biosynthesis of nucleotides
4. Biosynthesis of membrane lipids and steroids
5. Protein synthesis

Unit – V

1. Enzymes: Terminologies, classification and basics of enzyme kinetics
2. Mechanism of enzyme catalysis
3. Regulation of enzyme action
4. Concept of free energy and thermodynamic principals in biology
5. Energy rich bonds, compound and biological energy transducers

Suggested Readings:

1. Voet, D. and J.G. Voet. Biochemistry John Wiley & Sons.
2. Freifelder, D. Physical Biochemistry W.H. Freeman & Co.
3. Segal, I.H. Biochemical calculations John Wiley and Sons
4. Creighton, T.E. Protein Structure and Molecular Properties W.H. Freeman & Co.
5. Freifelder, D. Essentials of Molecular Biology
6. Wilson, K. and K.H. Goulding A Biologists Guide to Principals and Techniques of Practical Biochemistry
7. Cooper, T.G. Tools of Biochemistry
8. Hawk, Practical Physiological Chemistry
9. Garret, R.H. and C.M. Grisham. Biochemistry. Saunders college Publishers.

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Department of Higher education, Govt. of M.P.
Semester wise Syllabus for Postgraduates
As recommended by Central board of Studies
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Class: M.Sc. SEMESTER - I
Practical : Ist

1. Spotting – Classification and identification of various phylum.
2. One major dissection of various systems of invertebrates – Squilla, Prawn, Sepia, Loligo.
3. One minor dissection- Grosshopper, Honeybee, Echinus, Starfish, Aplysia.
4. Mounting material - permanent balsum mount
5. Spottings related with Adaptation. Homologics, Analogics and modification of month parts :
6. Viva Voce.
7. Pratical Records, collection

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Class: M.Sc. SEMESTER - I
Practical : IInd

1. Problem based on Biodiversity and wild life.
   Mammals and Fishers group (Spots 5 +5)
2. Exercise on mean, mode, & Median.
3. Cell division preparation of slid on Meiosis & Mitosis.
4. Preparation of different types of chromosomes.
5. Viva – Voce
6. Practical Record and collection.

Swami Vivekanand University, Sagar (M.P.)

COURSEWISE SCHEME

II[nd] SEMESTER

1. Course Code	: MSCZOO	5. Total Practical	: 2
2. Course Name	:M.Sc. Zoology	6. Total Practical Marks	: 100
3. Total Theory Subject	: 4	7. Total Marks	: 300
4. Total Theory Marks	: 200	8. Minimum Passing Percentage	: 36

Sub. Code	Subject Name	Theor									Practical		Total	
		Paper					CCE		Total Marks					
		1st	2nd	3rd	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Compulsory														
MSCZOO 201	General and Comparative animal physiology and endocrinology	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 202	Population Ecology and Environmental physiology	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 203	Tools and techniques in biology	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 204	Molecular cell Biology and Genetics	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 205	**Practical-I** Related to Theory Paper I & II	0	0	0	0	0	0	0	0	0	50	18	50	18
MSCZOO 206	**Practical-II** Related to Theory Paper III & IV	0	0	0	0	0	0	0	0	0	50	18	50	18

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Class: M.Sc. SEMESTER - II
Paper: Ist Paper
GENRAL AND COMPARATIVE ANIMAL PHYSIOLOGY AND ENDOCRONOLOGY

Unit – I

1. Respiratory pigments through different phylogenic groups
2. Transport of oxygen and carbon dioxide in blood and body fluids
3. Regulation of respiration
4. Physiology of impulse transmission through nerves and synapses
5. Autonomic nervous system, neurotransmitters and their physiological functions

Unit – II

1. Patterns of nitrogen excretion in different animal groups
2. Comparative physiology of digestion
3. Osmoregulation in different animal groups
4. Thermoregulation in homeotherms, poikilothermas and hibernation
5. Physiology of pregnancy, placental hormones, pregnancy diagnosis tests, parturition and breast and lactation

Unit – III

1. Comparative study of mechanoreception
2. Comparative study of photoreception
3. Comparative study of phonoreception
4. Comparative study of chemoreception
5. Comparative study of equilibrium reception

Unit – IV

1. Bioliminescence as means of communication among animals
2. Pheromones and other semiochemicals as means of communication among animals
3. Chromatophores and regulation of their function among animals
4. Hormones, their classification and chemical nature
5. Mechanisms of hormone action

Unit –V

1. Phylogeny of endocrine glands (pituitary, pancreas, adrenal, thyroid)
2. Ontogeny of endocrine glands
3. Neuroendocrine sysyem
4. Hormone receptors – signal transaction mechanisms
5. Hormones and reproduction
    a. Seasonal breeders
    b. Continuous breeders

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Semester wise Syllabus for Postgraduates
As recommended by Central board of Studies
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MSc Previous SEMESTER -II
Subject: Zoology
Paper-I List of Books

SUGGESTED READING MATERIAL

1. EJW Barrington-General & comparative Endoctrinology-Oxford, Claredon Press

2. R.H. Williams-Text Book of Endocrinology-W.B. Saunders

3. C.R. Martin- Endocrine Physiology-Oxford University Press.

4. Molecular CellBiology-J. Darnell, H. Lodish and D. Baltimore-Scientific American Book USA

5. Molecular Biology of the cell-B. Alberts, D-Bray, J.Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Pub. New York.

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Semester wise Syllabus for Postgraduates
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M. Sc. Previous Semester II
Zoology Paper II
Population Ecology and Environmental physiology

Unit I

1. Populations and their characters.
2. Demography : Life tables, generation time, reproductive value.
3. Population growth: Growth of organisms with non-overlapping generations,stochastic and time lag models of population growth, stable age distribution.
4. Population regulation: Extrinsic and intrinsic mechanisms.

Unit II

1. Adaptations : Levels of adaptions, significance of body size.
2. Aquatic environments : Fresh water, marine, shores and estuarine environments.
3. Eco-physiological adaptations to fresh water environments.
4. Eco-physiological adaptations to marine environments.
5. Eco-physiological adaptations to terrestrial environments.

Unit III

1. Environmental limiting factors.
2. Inter and intra-specific relationship.
3. Predatory- prey relationship, predator dynamics, optimal foraging theory (patch choice, diet choice, prey selectivity, foraging time).
4. Mutulism , evolution of plant pollinator interaction.

Unit IV

Environmental poliution and human health.

1. Conservation management of natural resources .
2. Environmental impact assessment.
3. Sustainable development.

Unit V

1. Concept of homeostasis.
2. Endothermi and physiological mechanism of regulation of the body temperature.
3. Physiological response to oxygen deficient stress.
4. Physiological response to body exercise.
5. Meditation, yoga and their effects.

Suggested Readings:

1. Cherrett,J.M. Ecological Concepts. Blackwell Science Publication, Oxford, U.K.
2. Elseth,B.D. and K.M. Baumgartner,population Biology,Van Nostrand Co., New York.
3. Jorgensen,S.E. Fundamentals of ecological modeling. Elsevier, New York.
4. Krebs, C.J. Ecology. Harper and Row, New York.
5. Krebs,C.J. Ecological Methodology. Harper and Row , New York.
6. Eckert, R. Animal Physiology: Mechanism and Adaptation. W.H. Freeman and Co., New York.
7. Hochachka, P.W. and G.N., Somero. Biochemical adaptation. Priceton, New Jersey.

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Class: M.Sc.
SEMESTER - II
Paper: IIIrd Paper
Tools and techniques in Biology

Unit – I

1. Microsocopy, principle & applications
- Light microscope and phase contrast microscope
- Fluorescence microscope
- Electron microscope
- Confocal microscopy
2. General Principle and applications of
- Colorimeter
- Spectrophotometer
- Ultra centrifuge
- Flame photometer
- Beer and Lambert's law.
3. Microbiological techniques
- Media Preparation and sterilization
- Inoculation and growth monitoring.
- Microbial assays.
- Microbial identification (cytological staining methods for bacterial and fungal strains)
- Use of fermentors

Unit – II

1. Computer aided techniques for data presentation data analysis, statistical techniques.
2. Cryotechniques
- Cryopreservation of cells, tissues, organs and organisms.
- Cryosurgery
- Cryotomy
- Freeze fracture and freeze drying.
3. Separation techniques. Chromatography, principle type and applicants.
- Electrophoresis, Principles, types and applications PAGE and agarose gel electrophoresis.
- Organelle separation by centrifugation.

Unit – III

1. Radioisotope and man isotope techniques in biology.

a. Sample preparation for radioactive counting
b. Autoradiography.

2. Immunological techniques
- Immunodiffusion (Single & Double)
- Immuno electrophoresis
3. Techniques immuno detection
- Immunocyto / histochemistry
- Immunioblotting, immunodetection, immunofluroscence.
4. Surgical techniques.
- Organ ablation (eg. Ovariactomy, adrenalectomy)
- Perfusion techniques
- Stereotaxy
- Indwelling cathethers
- Biosensors.

Unit –IV

1. Histological techniques
- Principles of tissue fixation
- Microtomy
- Staining
- Mounting
- Histochemistry
2. Cell culture techniques.
- Design and functioning of tissue culture laboratory
- Culture media, essential components and Preparation
- Cell viability testing.

Unit – V

1. Cytological techniques
- Mitotic and meiotic chromosome preparations from insects and vertebrates.
- Chromosome banding techniques (G.C.Q. R. banding)
- Flowcytometry.
2. Molecular cytological techniques
- In site hybridization (radio labeled and non-radio labeled methods)
- Fish
- Restriction banding
3. Molecular biology techniques
- Southern hybridization
- Northern hybridization
- DNA Sequencing
- Polymerase chain reaction (PCR)

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MSc Previous
Subject Zoology
SEMESTER -II
Paper-III Tools & Technique Books

SUGGESTED READING MATERIAL

1. Introduction to instrumental analysis-Robert Braun-McGraw Hill.
2. A biologist Guide to principles and Techniques of Practical Biochemistry- K, Wilson and K.H. Goulding ElBS Edn.
3. Clark & Swizer. Experimental Biochemistry. Freeman, 2000.
4. Locquin and Langeron. Handbook of Microscopy. Butterwaths, 1983
5. Boyer. Modern Experimental Biochemistry. Benjamin, 1993
6. Freifelder. Physical Biochemistry. Freeman, 1982.
7. Wilson and Wlaker. Practical Biochemistry. Cambridge, 2000.
8. Cooper. The Cell-A Molecular Approach. ASM, 1997
9. John R.W. Masters. Animal Cell culture- A practical approach. IRL Press.
10. Robert Braun. Introduction to instrumental analysis. McGraw Hill

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M.Sc. Previous Zoology

II Sem IV Paper

Topic – Molecular Cell Biology and genetics

Unit – I Biomembrane

- Molecular composition arrangement and functional consequences
- Transport across cell membrane diffusion active transport, pumps, uniports, symports and antiports
- Micro filaments and microtubules structure and dynamics
- Cell movements intracellular transport, role of kinesis and dynein

Unit – II Cell – Cell signaling

- Cell surface receptors
- Second messenger system
- Signaling from plasma membrane to nucleus
- Gap junctions and connexius
- Entegrius

Unit – III Cell – Cell adhesion and communication

- Ca^{++} depandant homophilic cell – cell ahension
- Ca^{++} indepandant homophilic cell – cell ahension
- Gap junctions and connexius
- Genome organization, hierarchy in organization
- Chromosomal organization of genes and non-coding DNA

Unit –IV Sex determination

- Sex determination in dtosophila
- Sex determination in mammals
- Basic concept of dosage compensation
- Cytogenetic of humen chromosoms
- Human genome project (HGP) purpose 2 Implicatic

Unit – V Genetic Diseases and Genomics

- Human gene therapy
- Prenatal diagnosis & genetic counseling
- Genetic screening

- Structural Genomics
- Functional Genomics
- Gene libraries
- Trasgenic animals & their applications

Suggested Readings

- J. Darnell, H. Lodish and D. Baltimore molecular cell biology scientific American book. Inc. USA
- B. Alberts D. Bray, J. Lewis, M. raff, K. roberts and J.D. Wattson. molecular biology of the cell. Garland Publishing Inc. New York.
- John R. W. animal cell culture A practical approach masters. Irl. Press
- Alberts et. all Essentials cell biology garland publishing Inc. New York 1998
- J.M. Barry molecular biology
- Philip E. Hartman Gene Action
- L.C. dunn, principals of Genetics
- A.M. Winchester genetics
- Edgar Alterbrg Genetics
- L.C. Dunn genetics and the oregin of species
- Bengt A. Kihlman actions of chemicals of dividing cells

Swami Vivekanand University, Sagar (M.P.)

Department of Higher education, Govt. of M.P.
Semester wise Syllabus for Postgraduates
As recommended by Central board of Studies and
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Class: M.Sc. SEMESTER - II
Practical : Ist

General & Comarative Physiology and Endocrinology
Population Ecology and Environmental Physiology.

Exercise :

1. Experiment on Hematology Blood group, Total and different counts.
2. Demonstration of Enzyme Action, and chromatography
3. Estimation of pH.
4. Detection of protein carbohydrate and fats.
5. Endocrinological spots comments on prepared histological slides.
6. Detection of Nitrogenous products in given samples.
7. Viva Voce
8. Practical Records and collection.

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Class: M.Sc. SEMESTER - II
Practical : IInd

Tools and Techniques for biology.
Molecular cell Biology and Genetics

1. Comments upon the structure and application of analytical instruments
   i. Colorimeter
   ii. Sectrophotometer
   iii. Ultacentrifrige
   iv. ESR and NMR spectrometer
   v. Microtomy
   vi. Chymographic Instruments

2. Problem and based on genetics
3. Estimation techniques based for RNA and DNA
4. Estimation of Gene and Genotypic frequencies in light of hardy weinbecey law based on facial traits.
5. Demonstration of chromosome polymorphism isozyze polymorphism in some insect population.
6. Viva – Voce
7. Practical Record

Swami Vivekanand University, Sagar (M.P.)

COURSEWISE SCHEME
III[rd] SEMESTER

1. Course Code	: MSCZOO	5. Total Practical	: 2
2. Course Name	:M.Sc. Zoology	6. Total Practical Marks	: 100
3. Total Theory Subject	: 4	7. Total Marks	: 300
4. Total Theory Marks	: 200	8. Minimum Passing Percentage	: 36

Sub. Code	Subject Name	Theory									Practical		Total	
		Paper					CCE		Total Marks					
		1st	2nd	3rd	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Compulsory														
MSCZOO 301	Comparative anatomy of vertebrates	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 302	Limnology	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 303	Ecotoxicology	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 304	Aquaculture	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 305	**Practical-I** Related to Theory Paper I & II	0	0	0	0	0	0	0	0	0	50	18	50	18
MSCZOO 306	**Practical-II** Related to Theory Paper III & IV	0	0	0	0	0	0	0	0	0	50	18	50	18

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Subject - Zoology

Class : **M.Sc**
Semester : **III**
Subject : **Zoology**
Title of Subject Group : **Comparative Anatomy of Vertebrates**
Paper No. : **Paper- I**

Unit-1	1. Origin of Chordata: Concept of Protochordata 2. Development, structure and functions of integument and its derivatives (glands, scales, feathers and hairs) 3. Respiratory system : Characters of respiratory tissue, external and internal respiration. Comparative account of respiratory organs. 4. Comparative account of Digestive System.
Unit-2	1. Evolution of heart. 2. Evolution of aortic arches and portal systems. 3. Blood circulation in various vertebrates groups. 4. Comparative account of jaw suspensorium and vertebral column.
Unit-3	1. Evolution of urinogenital system in vertebrates. 2. Comparative account of organs of olfactory and taste. 3. Comparative anatomy of brain and spinal cord (CNS). 4. Comparative account of peripheral and autonomous nervous system.
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 Ostracoderms . 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 Crossoptergii.

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. Malcom Jollie, Chordata morphology. East – West Pres Pvt. Ltd., New Delhi.
5. Milton I lildergrand. 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. McGraw Hall Book Co., New York.

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Subject - Zoology

Class : **M.Sc**
Semester : **III**
Subject : **Zoology**
Title of Subject Group : **Limnology**
Paper No. : **Paper- II**

Unit-1	1.Limnology – Definition, historical development and scope of Limnology. 2.Types of freshwater habitats and their ecosystem - (a) Ponds, Streams and rivers. (b) Lakes – Origin and classification. 3.Morphpmetry – 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. (c) Physico – Chemical characteristics of freshwater with special reference to different parameters- Turbidity, dissolved gases(Oxygen, Carbon dioxide, 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 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

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Subject – Zoology

Class : **M.Sc**
Semester : **III**
Subject : **Zoology**
Title of Subject Group : **ECO- TOXICOLOGY**
Paper No. : **Paper- III**

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. Kinds of environmental 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, Principles and various types of toxicological agents. 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. Important heavy metals and their role in environment. 3. Agrochemical use and misuse, alternatives. 4. Occupational Health Hazards and their Control.

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

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Subject - Zoology

Class : **M.Sc**
Semester : **III**
Subject : **Zoology**
Title of Subject Group : **Aquaculture**
Paper No. : **Paper- IV**

Unit-1	1. Aquaculture: history, definition, scope & importance. 2. Fishery resources of India in general & Madhya Pradesh in particular. 3. Abiotic & biotic factors of water necessary for fish life. 4. Ecological characteristics of lakes & rivers. 5. General ecological characteristics of reservoirs of India.
Unit-2	1. Fish culture :- Mono, Poly, mixed and composite Fish culture. 2. Fresh water prawn culture and its prospects in India. 3. Culture of Mussels , clams,oysters & pearl culture. 4. Sewage fed fish culture, paddy cum fish culture 5. Frog culture.
Unit-3	1. Fish breeding in natural conditions , bundh breeding, hypophysation & stripping. 2. Transport of live fish & seed. 3. Different types of crafts & gears used for fish catching. 4. Plankton- its definition, culture & indentification. 5. Common weeds of fish ponds and methods of their eradication.

Unit-4	1. Fresh water fish farm engineering: selection of site, construction of fish farm & soil chemistry. 2. Designing, layout & construction of different types of fish ponds. 3. Setting and management of fresh water aquarium. 4. Preservation & processing of fish. 5. By products of fish Industry & their utility.
Unit-5	1. Water pollution, its effects on fisheries and methods of its abatment. 2. Common fish diseases & their control. 3. Biochemical composition and nutritional value of fish. 4. Fisheries economics and marketing. 5. Fisheries managements and extension.

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 : Sustanibility & Management of Aquaculture & Fisheries
7. A.J.K. Mainan : Identification of fishes
8. R. Sanatam : A Manual of fresh water Aquaculture
9. S.K. Gupta : Fish & Fisheries
10. P.D. Pandey : Fish & Fisheries
11. K.P. Vishwas : Fish & Fisheries

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Subject - Zoology

Class : **M.Sc**

Semester : **III**

Subject : **Zoology**

Practical I : **Related to I & II Theory Papers**

1. Study of Specimens, slides and bones related to theory papers.
2. Major Dissection- Various systems of Labeo , Wallago, Torpedo
3. Minor Dissection-
   (a) Accessory respiratory organs of Anabas, Clarias, Heteropneustes.
   (b) Herdmania
   (c) Amphioxus.
4. Estimation of DO, chloride, BOD,COD,Hardness, pH and Alkalinity of water.
5. Study of fresh water ecosystem.

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.	Practical Record	05 Marks
6.	Viva Voce	05 Marks
7.	Collection	04 Marks
	Total	**50 Marks**

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Subject - Zoology

Class : **M.Sc**
Semester : **III**
Subject : **Zoology**
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.
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.

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Subject - Zoology

Class : **M.Sc**
Semester : **III**
Subject : **Zoology**
Practical II : **Related to III & IV Theory Papers**

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.	Maintenance of aquarium	05
5.	Practical Record	04
6.	Viva Voce	05
7.	Collection	05

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COURSEWISE SCHEME
IVth SEMESTER

1. Course Code	: MSCZOO	6. Total Practical Marks	: 100
2. Course Name	:M.Sc. Zoology	7. Project Marks	: 50
3. Total Theory Subject	: 4	8. Total Marks	: 350
4. Total Theory Marks	: 200	9. Minimum Passing Percentage	: 36
5. Total Practical	: 2		

Sub. Code	Subject Name	Theory									Practical		Total	
		Paper					CCE		Total Marks					
		1st	2nd	3rd	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Compulsory														
MSCZOO 401	Animal Behavior and Neurophysiology	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 402	Gamete Biology, Development and Differentiation	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 403	Icthyology (Fish) Structure and Function	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 404	Pisci Culture and Economic Importance of Fishes (Icthyology)	42	0	0	42	15	8	3	50	18	0	0	50	18
MSCZOO 405	**Practical-I** Related to Theory Paper I & II	0	0	0	0	0	0	0	0	0	50	18	50	18
MSCZOO 406	**Practical-II** Related to Theory Paper III & IV	0	0	0	0	0	0	0	0	0	50	18	50	18
MSCZOO 407	**Project work**	0	0	0	0	0	0	0	50	18	0	0	50	18

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Subject - Zoology

Class	: **M.Sc**
Semester	: **IV**
Subject	: **Zoology**
Title of Subject Group	: **ANIMAL BEHAVIOUR AND NEUROPHYSIOLOGY**
Paper No.	: **Paper- I (Compulsory)**

Unit-1	1. Introduction: - Ethology as a branch of biology. - Animal psychology, classification of behavioral patterns, analysis of behaviour (ethogram) 2. Reflexes and complex behaviour. 3. Perception of the environment: mechanical, electrical, chemical, olfactory, auditory and visual. 4. Evolution and ultimate causation: Inheritance behaviour 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, aggregation. 4. Communication: Chemical, visual, light and audio, evolution of language (primates).

Unit-3	1. Ecological aspects of behaviour: Habitat selection, food selection, optimal foraging theory, anti-predator defenses, aggression, homing territoriality, dispersal, hostparasite relations. 2. Biological rhythms: Circadian and circannual rhythms, orientation and navigation, migration of fishes, turtles and birds. 3. Learning and memory: Conditioning, habituation, insight learning, association learning and reasoning.
Unit-4	1. Reproductive behaviour. Evolution of sex and reproductive strategies, mating systems, courtship, sexual selection. parental care. 2. Social behaviour. aggregations, schooling in fishes, flocking in birds, herding in mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness, social organization in insects and primates.
Unit-5	1. Thermoregulation: Homeothermic animals, poikilotherms & Hiberhnation. 2. Receptor physiology a comparative study – Mechano receptor Photo receptor Phono receptor Chemo receptor Equilibrium receptor 3. Bioluminescence

Suggested Readings -

1. Eibl-Eibesfeldt, I. Ethlogy. The biology of Behaviour. Holt, Rineheart & Winston, New York.
2. Gould, J.L. The mechanism and 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. McGraw Hill, New York.
5. Alcock, J. Animal Behaviour : 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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Subject - Zoology

Class : **M.Sc**
Semester : **IV**
Subject : **Zoology**
Title of Subject Group : **Gamete Biology, Development and differentiation**
Paper No. : **Paper- II (Compulsory)**

Unit-1	1. Comparative account of differentiation of gonads in mammals and invertebrate. 2. Spermatogenesis : Morphological basis in rodents and in any invertebrates. Gamete specific gene expression and genomics 3. Biochemistry of Semen : Semen composition and formation, assessment of sperm function. 4. Fertilization : Prefertilization events Biochemistry of fertilization post fertilization events.
Unit-2	1. Ovarian follicular growth and differentiation : morphology, endocrinology, molecular biology oogenesis and vitellogenesis, ovulation and ovum transport in mammals. 2. Biology of sex determination and sex differentiation a comparative account. 3. Multiple ovulation and embryo transfer technology : in vitro oocyte maturation, superovulation.
Unit-3	1. Hormonal regulation of ovulation, 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.
Unit-4	1. Cell commitment and differentiation. 2. Germ cell determinants and germ cell migration. 3. Development of gonands. 4. Melanogenesis.

Unit-5	1.	Creating new cell types, the basic evolutionary mystery.
	2.	Cell diversification in early Amphibian embryo, totipotency and pleuripotency.
	3.	Embryonic stem cells, renewal by stem cells, epidermis.
	4.	Connective tissue cell family
	5.	Haemopoietic stem cells : Blood cells formation, stem cell disorders.

Suggested Readings :

1. Long J.A. Evan H.M. 1922 : the oestrous cycle in the Rat and its associated phenomenon.
2. Nalbandou. A.C. – Reproductive physiology
3. Prakash A.S. 1965-66 Marshall's, Physiology Reproduction (3 Vol.)
4. Gilbert, S.F. Developmenal Biology , Sinauer Associated Inc. Massachulsetts.
5. Ethan Bier, the cold Spring. The cold spring Harbor laboratory Press, New York.
6. Balinsky B.I. Introduction to Embryology sanders, Phliedelphia.
7. Berril N.J. and Karp. G. Development Biology. McGraw Hill New York.
8. Davidson, E.H. Gene Activity During Early Development. Academic Press, New York.

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Subject - Zoology

Class	:	**M.Sc**
Semester	:	**IV**
Subject	:	**Zoology**
Title of Subject Group	:	**General Practical-I**
Paper No.	:	**Paper- I & II (Compulsory)** **Animal behavior and gamete biology**

1. **Exercise on Animal behavior**
   - **a. Taxes**
   - **b. Reflexes**
   - **c. Biological clocks**
   - **d. Social behavior**
   - **e. Learning behavior**
   - **f. Reproductive behavior**

2. **Developmental Biology**
   - **Study of embryological slides**
   - **Study of gametes of frog and chick**
   - **Study of fate maps**
   - **Study of different stages of spermatogenesis and oogenesis**

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Subject - Zoology

Class	:	**M.Sc**
Semester	:	**IV**
Subject	:	**Zoology**
Title of Subject Group	:	**General Practical-I**
Paper No.	:	**Paper- I & II (Compulsory)** **Animal behavior and gamete biology**
Max Marks	:	**50**

Scheme for Practical Examination

1.	**Exercise based on animal behavior**	**20**
2.	**Exercise based on developmental biology**	**16**
3.	**Practical record**	**05**
4.	**Viva Voce**	**04**
5.	**Collection**	**05**
	Total	**50 Marks**

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केंद्रीय अध्ययन मण्डल द्वारा अनुशंसित तथा म. प्र. के राज्यपाल द्वारा अनुमोदित

Subject - Zoology

Class : **M.Sc**
Semester : **IV**
Subject : **Zoology**
Title of Subject Group : **Icthyology (Fish) Structure and Function**
Paper No. : **Paper- III**

Unit-1	1. Origin and evolution of fishes 2. Classification of fishes as proposed by Berg 3. Fish integument 4. Locomotion
Unit-2	1. Alimentary canal and digestion 2. Accessary respiratory organs 3. Air bladder and its functions 4. Weberian ossicles their homologies and functions
Unit-3	1. Excretion and osmoregulation 2. Acoustico-lateral line system 3. Luminous organs 4. Colouration in fishes
Unit-4	1. Sound producing organs 2. Deep sea adaptions 3. Hill stream adaptions 4. migration in fishes
Unit-5	1. Sexual cycle and fecundity 2. parental care in fishes 3. Early development and hatching 4. Poisonous and venomous fishes.

Swami Vivekanand University, Sagar (M.P.)

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.
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Class	:	**M.Sc**
Semester	:	**IV**
Subject	:	**Zoology**
Title of Subject Group	:	**Pisci Culture and Economic Importance of Fishes (Icthyology)**
Paper No.	:	**Paper- IV**

Unit-1	1. Collection of fish seed from natural resources. 2. Dry bundh breeding of carps. 3. Wet bundh breeding of carps. 4. Hypophysation and breeding of Indian major camps.
Unit-2	1. Drugs useful in induced breeding of fish 2. Types of ponds required for fish culture farms 3. Management of hatcheries, nurseries and rearing ponds 4. Management of stocking ponds
Unit-3	1. Composite fish culture 2. Prawn culture and pearl industries in India. 3. Fisheries resources of MP 4. Riverine fishries.
Unit-4	1. Costal fishries in India 2. Offshore and deep sea fishery's in India 3. Role of fishries in rural development 4. Sewage fed fishries
Unit-5	1. Methods of fish preservation 2. Marketing of fish in India. 3. Economic importance and by product of fishes 4. Shark liver oil industry in India 5. Transport of live fish &fish seed.

Suggested Readings : Paper III & IV

1. JR. Norman - The History of fishes.
2. Nagaraja Rao - An introduction to fisheries.
3. Lagler Ichthyology.
4. Herclen Jones Fish migration.
5. Marshal The life of fishes.
6. Thomas - Diseases of fish.
7. Greenwood - Inter relationship of fishes.
8. Gopalji, Srivastava - Freshwater fishes of U.P. and Bihar.
9. Brown -Physiology of fishes Vol. I & II.
10. Hoar and Randall -Fish physiology of fishes Vol. 1 & IX.
11. Gunther Sterba C.N.H.-Freshwater fishes of the world
12. W. Lanharn -The Fishes.
13. G.V. Nikolsky -The ecology of Fishes,
14. Borgstram -Fish as food Vol. I & II.
15. Nilsson -Fish physiology -Recent Advances.
16. P.B. Myle and J.J. Cech Fishes An Introduction to Ichthyology.
17. Carl E. Bond -Biology of fishes.
18. M. Jobling -Environmental Biology of fishes.
19. Santosh Kumar & Manju Ternbhre -Fish and Fisheries.
20. S.K. Gupta -Fish and Fisheries
21. K.P. Vishwas -Fish and Fishries.
22. Jhingaran -Fish and Fishries.

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M.Sc. IV sem. Icthyology practical examination scheme based on paper III and IV

Zoology
Practical II (Special Paper)
Ichthyology (III & IV)

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

1. Major dissection Nervous system of Walago, Mystus, Labeo, Toredo		10
2. Minor dissection of internal ear, accessory, respiratory, organ, pituitary glands, webrian ossicles.		03
3. Mounting preparation of permanent slides.		03
4. Age determination of fish with the help of scales		03
5. Identification of fish		08
6. Spotting of museum specimen slides and bones.		08
7. Viva Voice.		05
8. Practical record, collection.	5+5	10
Total		50