



Maharaja Surajmal Brij University

Bharatpur (Raj.)

SYLLABUS

M.Sc. (P&F)

ZOOLOGY

Session 2021-22

Only For Session

2020-21

Session 2021-22

अकादमिक प्रभारी
महाराजा सुरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

1.

M.Sc. ZOOLOGY
(Annual Scheme)

Each Theory Paper	3 hrs. duration	100 Marks
Practical (Two days)	5 hrs. duration	300 marks

1. The Number of papers and the maximum marks for each paper and practical shall be shown in the syllabus for the subject concerned. It will be necessary for a candidate to pass in the theory as well as in practical part of a subject/paper separately.
2. A candidate for a pass at each of the previous and the final Examinations shall be required to obtain (i) at least 36% marks in the aggregate of all the papers prescribed for the examination and (ii) at least 36% marks in practical (s) wherever prescribed at the examination, provided that if a candidate fails to secure at least 25% marks in each individual paper at the examination and also in the dissertation/ Survey report/ field work(if any), wherever not withstanding his having obtained the minimum percentage of marks required in the aggregate for that examination. No division will be awarded at the previous examination. Division shall be awarded at the end of the final examination on the combined marks obtained at the previous and the final examination taken together.
3. If a candidate clears any paper(s) Practical(s) Prescribed at the previous and/or final examination after a continuous period of three years, then for the purpose of working his division the minimum pass of marks only viz. 25% (36% in case of practical) shall be taken into account in respect of such papers/practicals.

M.Sc. PREVIOUS (ANNUAL SCHEME)

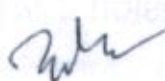
Paper - I	Biosystematics and Taxonomy
Paper - II	Structure & Function of Invertebrates
Paper - III	Molecular biology and Biotechnology
Paper - IV	General Physiology
Paper - V	Biochemistry
Paper - VI	Population Genetics and Statistical methods.
(Laboratory Exercises Seminar Demonstration)	
Practical Day First and Day Second	300 Marks

Note:- In M.Sc. Zoology Previous Examination the theory papers will have the following pattern.

Question papers will have 5 (five) questions in all having equal marks

- (i) Question number I will be compulsory and will have 20 very short answer question of 1 mark each.

Only For Session
Session 2021-22


अकादमिक प्रभारी
महाराजा सुरजमल वृज विश्वविद्यालय
भरतपुर (राज.)

- 2.
- (ii) Question numbers 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
- (iii) Question numbers 4 and 5 will be long answer type questions with internal choice.

Paper-1: BIOSYSTEMATICS AND TAXONOMY

3 Hours duration

Max. Marks: 100

Periods : 80

Theory paper will have the following pattern.

Question paper will have 5 (five) question, having 20 marks each ...

- (i) Question number will be compulsory and will have 20 very short answer question of 1 marks each.
- (ii) Question numbers 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
- (iii) Question numbers 4 and 5 will be long answer type questions with internal choice.
1. Definition and basic concept of biosystematics and taxonomy
 2. Trends in biosystematics: Concept of different conventional and newer aspects
 - 2.1 Chemotaxonomy
 - 2.2 Cytotaxonomy
 - 2.3 Molecular taxonomy
 3. Molecular perspective on the conservation of diversity
 - 3.1 Diversity and ecosystem process: Theory, achievements and future directions.
 4. Dimensions of speciation and taxonomy characters
 - 4.1 Dimensions of speciation - Types of lineage changes: production of additional lineage.
 - 4.2 Mechanisms of speciation, panmictic and apotmictic species.
 - 4.3 Species concept and species category. Different species concepts subspecies and other infra-specific categories.
 - 4.4 Theories of biological classification: hierarchy of categories.
 - 4.5 Taxonomic characters of different kinds, origin of reproductive isolation and biological mechanism of genetic incompatibility, Haldane's rule.
 5. Procedure keys in taxonomy.x
 - 5.1 Taxonomic procedures: Taxonomic collections, preservation, correct process of identification.
 - 5.2 Taxonomic keys: Different kinds of taxonomic keys, their merits and demerits.
 - 5.3 Systematic publications and different kinds of publications.

Session 2021-22

Only For Session



अकादमिक प्रभारी
महाराजा सुरजमल कृष्ण विश्वविद्यालय
भरतपुर (राज.)

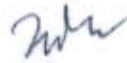
5.4 Process of typification and different Zoological types.

5.5 International Code of Zoological Nomenclature (ICZN) and its operative principles, interpretation and application of important rules. Zoological nomenclature, formation of Scientific names of various taxa.

Suggested Reading Material (All latest editions)

1. Kato, M. The Biology of Biodiversity, Springer.
2. Avise, J.C, Molecular Markers, Natural History and Evolution Chapman & Hall, New York.
3. Wilson, E.O, Biodiversity Academic Press, Washington.
4. Simpson, G.G., Principle of Animal Taxonomy. Oxford, IBH Publishing Company.
5. Mayer, E., Principles of Systematic Zoology, McGraw Hill Book Company, New York.
6. Wilson, E.O., The Diversity of Life. W.W. Northern & Company.
7. Tikadar, B.K., Threatened Animals of India, ZSI Publication, Calcutta.
8. Trigunayat, M.M and Kritika Trigunayat. Introductory Biosystematics & Taxonomy Scientific Publishers, Jodhpur.
9. Southwood, T.R.E. Ecological methods (3rd edition). Blackwell Scientific Publishers.

Session 2021-22
Only For Session
2020-21


अकादमिक प्रभारी
महाराजा सुरजमल बृज विश्वविद्यालय
भरतपुर (राज.)


PAPER-II : STRUCTURE & FUNCTION OF INVERTEBRATES**3 Hours duration****Max. Marks: 100****Periods : 80**

Note: In M.Sc. Zoology Previous Examination the theory paper will have the following pattern.

Question paper will have 5 (five) questions in all having equal marks.

- (i) Question number 1 will be compulsory and will have 20 very short answer question of 1 mark each.
 - (ii) Question numbers 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
 - (iii) Question numbers 4 and 5 will be long answer type questions with internal choice.
1. Organization of Coelom
 - 1.1 Acoelomates
 - 1.2 Pseudocoelomates
 - 1.3 Coelomates: Protostomia and Deuterostomia.
 2. Locomotion
 - 2.1 Flagellar and ciliary movement in Protozoa.
 3. Nutrition and Digestion
 - 3.1 Filter feeding in Polychaeta, Mollusca and Echinodermata.
 4. Respiration
 - 4.1 Organs of respiration: Gills, lungs and trachea.
 - 4.2 Respiratory pigments
 - 4.3 Mechanism of respiration
 5. Excretion
 - 5.1 Organs of excretion: Coelom, Coelomoducts, Nephridia and Malpighian tubules.
 - 5.2 Mechanisms of excretion.
 - 5.3 Excretion and Osmoregulation
 6. Nervous System
 - 6.1 Advanced Nervous system: Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda)
 7. Invertebrate larvae
 - 7.1 Larval forms of free-living invertebrates
 - 7.2 Larval forms of parasites
 - 7.3 Strategies and evolutionary significance of larval forms
 8. Minor Phyla

Session 2021-22
Only For Session
2020-21


अकादमिक प्रभारी
बलरामराज सुरजमल इज विश्वविद्यालय
भरतपुर (राज.)

Suggested Reading Material :

1. Hyman, L.H. The Invertebrates, Vol.I, Protozoa through Ctenophora, McGraw Hill Company, New York.
2. Hyman, L.H., The Invertebrates, Vol.II, Protozoa through Ctenophora, McGraw Hill Company, New York.
3. Hyman, L.H., The Invertebrates, smaller coelomate Groups, vol.,5, McGraw Hill Company, New York.
4. Hyman, L.H., The Invertebrates, Vol.8, McGraw Hill Company, New York.
5. Barington, E.J.W., Invertebrate Structure and Function. Thomas Nelson and Sons Ltd. London.
6. Barnes, R.D., Invertebrate Zoology, W.B., Saunders Co., Philadelphia.
7. Russel-Hunter, W.D., A Biology of Higher Invertebrates, Mc Millan Company Ltd. London.
8. Cad, G.P. Animal Parasitism, Prentice Hall Inc., New Jersey.
9. Sedwick, A. Student Text Book of Zoology, Vol 1, II and III, Central Book Depot, Allahabad.
10. Parker, T.J., Haswell, W.A., Text Book of Zoology, MacMillan Co., London.

Session 2021-22

**Only For Session
2020-21**

Handwritten Signature
अकादमिक प्रभारी
 महाराजा सुरजनल वृज विश्वविद्यालय
 भरतपुर (राज.)

6.
PART-III: MOLECULAR BIOLOGY & BIOTECHNOLOGY

Duration: 3 Hours

Max. Marks : 100

Periods : 80

Note: In M.Sc. Zoology Previous Examination the theory paper will have the following pattern.

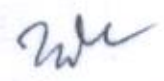
Question paper will have 5 (five) question in all having equal marks.

- (i) Question number 1 will be compulsory and will have 20 very short answer question of 1 mark each.
 - (ii) Question numbers 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
 - (iii) Question numbers 4 and 5 will be long answer type questions with internal choice.
1. DNA replication
 - 1.1 Prokaryotic and eukaryotic DNA replication
 - 1.2 Mechanics of DNA replication
 2. Transcription
 - 2.1 Prokaryotic Transcription
 - 2.2 Eukaryotic transcription
 - 2.3 General and specific transcription factors
 - 2.4 Regulatory elements and mechanisms of transcription regulation
 - 2.5 Transcription termination
 - 2.6 Transcriptional and post-transcriptional gene splicing
 3. Post-transcriptional modifications in RNA
 - 3.1 5'-Cap formation
 - 3.2 End processing and polyadenylation
 - 3.3 Splicing, editing
 4. Translation
 - 4.1 Genetic code
 - 4.2 Prokaryotic and eukaryotic translation
 - 4.3 Mechanisms of initiation, elongation and termination
 - 4.4 Regulation of translation
 5. Recombination and repair
 - 5.1 DNA repair mechanisms
 6. Molecular mapping of genome
 - 6.1 Genetic and physical maps
 - 6.2 Physical mapping and map-based cloning
 - 6.3 Southern and fluorescence, in-situ hybridization for genome analysis

Only For Session
2020-21

Session 2021-22

Session 2021-22


अकादमिक प्रभारी
महाराजा सुरजमल बुज विश्वविद्यालय
भरतपुर (राज.)

6.4 Molecular markers in genome analysis, RFLP, RAPD and AFLD analysis

7. Transgenic animals .

7.1 Production

7.2 Applications

7.3 Embryonic stem cells

8. Assisted reproduction technologies

8.1 ICSI, GIFT etc.

8.2 Cloning of animals by nuclear transfer

Suggesting Reading Material

1. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steiz, J.A., Weinef, A.M.; **Molecular Biology of Gene.** The Benjamin Cummings Pub Co.: Inc., California.
2. Darnell, J., Lodish, H. and Baltimore, D; **Molecular Cell Biology,** Scientific American Books, Inc., USA.
3. Albert, B., Bray, D.D., Lewis, J., Rafif M., Roberts, K, Walson, J.D., **Molecular Biology of the cell.** Garland Publishing company, Inc., New York.
4. Benjamin, Lewin, **Gene VIII,** Oxford University Press, U.K.
5. Meyers, R.A. (ed.), **Molecular Biology and Biotechnology. A Comprehensive Desk Reference.** VCH Publishers, Inc. New York.
6. Sambrook, J., Fritsch, E.f. and Maniatis, T.; **Molecular Cloning: A Laboratory Manual.** Cold Spring Harbor Laboratory Press, New York.
7. Dabre, P.D., **Introduction to Practical Molecular Biology,** John Wiley & Sons Ltd., New York.
8. Brown, T.A. (Ed.), **Molecular Biology Labfax, Vol.I,** Bio Scientific Publishers Ltd. Oxford.
9. Karp, G., **Cell and Molecular Biology, Concepts and Experiments,** John Wiley & Sons, Inc, New York.
10. Botstein, D. **Decoding the language of Genetics.** Cold spring harbor Laboratory Press.
11. Tropp. **Molecular Biology, Genes to Proteins 4/e.** Jones Bartlett (Viva Books)
12. Krebs, Goldstein & Kilpatrik. **Lewin's Genes XI.** Viva Books Pvt. Ltd.

Only For Session
2020-21

Session 2021-22

W
अकादमिक प्रभारी
महाराजा सुरजमल दूज विश्वविद्यालय
भरतपुर (राज.)

PAPER - IV: GENERAL PHYSIOLOGY**Duration: 3 Hours****Max, Marks: 100****Periods: 80**

Note:- In M.Sc. Zoology Previous Examination the theory paper will have the following pattern.

Question paper will have 5 (five) questions in all having equal marks

- (i) Question number 1 will be compulsory and will have 20 very short answer question of 1 mark each.
 - (ii) Question numbers 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
 - (iii) Question numbers 4 and 5 will be long answer type questions with internal choice.
1. Thermoregulation and Cold Tolerance
 - 1.1 Basic principles of metabolism
 - 1.2 Heat balance and exchange
 - 1.3 Endotherms V/s Ectotherms
 - 1.4 Counter-current heat exchanger
 - 1.5 Torpor, hibernation and aestivation
 2. Ionic and osmotic balance
 - 2.1 Osmoregulation V/s Osmocon forming
 - 2.2 Osmoregulation in aquatic and terrestrial, environments
 - 2.3 Kidney function and diversity
 - 2.4 Other osmoregulatory organs
 - 2.5 Nitrogenous waste excretion
 3. Gas Exchange and Acid-base Balance
 - 3.1 Oxygen and Carbon dioxide transport in blood
 - 3.2 The role of hemoglobin
 - 3.3 Responses to altitude and hypoxia
 4. Muscle Function and Movement
 - 4.1 Anatomy of muscle
 - 4.2 Regulation of contraction
 - 4.3 Excitation-contraction coupling
 - 4.4 Molecular theory of muscle contraction
 5. Nervous System
 - 5.1 Anatomy of nervous system
 - 5.2 Neurons and membrane excitation
 - 5.3 Electrochemical potentials

**Only For Session
2020-21**

Session 2021-22

ml
अकादमिक प्रभारी
महाराजा सुखजगल कृष्ण विश्वविद्यालय
भरतपुर (राज.)

- 5.4 Action potentials
- 5.5 Transmission between neurons
- 5.6 Synapses and neurotransmitters
- 5.7 Memory and learning
- 6. Sensory Transduction
 - 6.1 Vision and photoreception
 - 6.2 Thermoreception and infrared detection: Prey detection in snakes.
 - 6.3 Echolocation in bats
- 7. Stress Biology
 - 7.1 Basic concept of environmental stress and strain concept of elastic and plastic strain; stress resistance, stress avoidance and stress tolerance.
 - 7.2 Adaptation, acclimation and acclimatization
 - 7.3 Concept of homeostasis
 - 7.4 Physiological response to oxygen deficient stress.
 - 7.5 Physiological response to body exercise
 - 7.6 Meditation, yoga and their effects.
- 8. Endocrinology
 - 8.1.1 Hormones as messengers.
 - 8.1.2 Classification of hormones
 - 8.2 Phylogeny of endocrine glands (Pituitary, pancreas, adrenal, thyroid, etc.)
 - 8.3 Ontogeny of endocrine glands.
 - 8.4 Neuroendocrine system and neurosecretion
 - 8.5 General principles, structure and hormone action
 - 8.6 Hormones, growth and development
 - 8.7 Hormones and reproduction.

Suggested Reading Material

1. Eckert, R.W.H.; Animal Physiology, Mechanisms and Adaptations, Freeman and Company, New York.
2. Fochachka, P.W. and Somero, G.N.; Biochemical Adaptation, Princeton, New Jersey.
3. Hoar, W.S.; General and Comparative Animal Physiology, Prentice Hall of India.

Only For Session
2020-21

Session 2021-22

अकादमिक प्रभारी
महाराजा सुरजमल कृष्ण विश्वविद्यालय
भरतपुर (राज.)

4. Schiemdt Nelsen: Animal Physiology: Adaptation and Environment, Cambridge University Press.
5. Strand F.L., Physiology: A Regulatory Systems Approach, Macmillan Publishing Co., New York.
6. Prosser, C.L.; Environmental and Metabolic Animal Physiology, Wiley Liss, Inc., New York.
7. Willmer, Stone, P.G. and Johnson, I: Environmental Physiology, Blackwell Sci. Publication, Oxford, U.K.
8. Newell, R.C.(ed.); Adaptation to Environment; Essays on the Physiology of Marine Animals. Butter worths, London, U.K.
9. Townsend, C.R. and Cawlow.P. : Physiological Ecology: An Evolutionary Approach to Resource Use, Blackwell, Sci. Publication, Oxford, U.K.
10. Hill, R.W. Wyse, G.A., Anderson, M.: Animal Physiology, Sinauer Associates, Inc, Publishers, Sunderland, USA.
11. Vander.A.J. Sherman J.H. Luciano D.S., Human Physiology McGraw-Hill Publishing Company, New York.
12. Dejours, P.L. Bolis, L.Taylor, C.R., Weibel, E.R. (eds.), Comparative Physiology: Life in water or Land, Liviana Press, Padova, Italy.
13. Johnson, I.A., Bennett, A.F. (eds.), Animals and Temperature, Thenotypic and Evolutionary Adaptations. Cambridge University Press. Cambridge, U.K.
14. Louw G.N. Physiological Animal Ecology, Harloss, U.K.
15. Barrington, E.J.W., General and Comparative Endocrinology clarendon Press, Oxford.
16. Williams, R.H., Text Book of Endocrinology, W.B. Saunders.
17. Martin, C.R. endocrine Physiology, Oxford University Press.
18. Gorbman, A., dickhoff. W.W., Vigna, S.R., Cvlark, H.B., Ralpls, C.L. Comparative Endocrinology, Wiley- Interscience Publication, New York.

Session 2021-22

Only For Session
2020-21

ndu
अकादमिक प्रभारी
महाराजा सूरजमल वृज विश्वविद्यालय
भरतपुर (राज.)

Duration: 3 Hours

Max. Marks: 100

Periods: 80


Note: In M.Sc. Zoology Previous Examination the theory paper will have the following pattern.

Question paper will have 5 (five) questions in all having equal marks

- (i) Question number 1 will be compulsory and will have 20 very short answer question of 1 mark each.
 - (ii) Question numbers 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
 - (iii) Question numbers 4 and 5 will be long answer type questions with internal choice.
1. Covalent properties of Proteins
 - 1.1 Structure and Chemistry of amino acids
 - 1.2 protein sequencing
 - 1.3 Covalent modifications
 - 1.4 Protein size and composition
 - 1.5 Protein splicing
 2. Protein secondary and tertiary structure
 - 2.1 Protein Tertiary structure and folding patterns
 - 2.2 Role of packing constraints in tertiary structure patterns.
 3. Globular and fibrous proteins.
 - 3.1 Water and the hydrophobic effect.
 - 3.2 Tertiary and quaternary effect.
 - 3.3 Properties of protein interiors and surfaces.
 - 3.4 Fibrous proteins.
 4. Protein folding and thermodynamics
 - 4.1 Protein folding and dynamics.
 - 4.2 Folding overview: The Levinthal Paradox.
 - 4.3 Condensation and molten globules.
 - 4.4 Ramchandaran plots and amino acid propensities.
 - 4.5 Amino acid sequence variation and membrane protein folding.
 - 4.6 Chaperonin-assisted protein folding.
 5. Allostery (Hemoglobin), Myoglobin structure and oxygen binding.
 - 5.1 Hemoglobin subunits cooperativity, the Hill coefficient.
 - 5.2 Quaternary Structure changes and Sickle cell and other molecular diseases.

Session 2021-22
Session 2021-22

Only For Session
2020-21


अकादमिक प्रभारी
महाराजा सूरजमल बूज विश्वविद्यालय
भरतपुर (राज.)

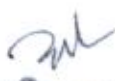
6. Fats
 - 6.1 Fatty acids: Structure, nomenclature, acylglycerols, phospholipids, sphingolipids, glycolipids, lipoproteins,
 - 6.2 Function of lipids.
 - 6.3 Signal transducing molecules.
7. Vitamins
 - 7.1 Classification, occurrence of fat soluble vitamins.
 - 7.2 Classification, occurrence and biological functions of thiamin, riboflavin, folic acid and B₁₂
8. Covalent properties of nucleic acids.
 - 8.1 Modified nucleosides
 - 8.2 Properties of polynucleotides
 - 8.3 Secondary and tertiary structure
9. Nucleic acid structure
 - 9.1 Duplex stability.
 - 9.2 Hybridization.
 - 9.3 RNA structure.
 - 9.4 Hairpin and pseudoknot structures, tRNA.
10. Nucleic acid structure.
 - 10.1 DNA and RNA helical geometrics (A-Z), banding, deformation, triplexes, quadruplexes.
11. Nucleic acid analysis. DNA and RNA sequencing, determination of modified nucleotides. Analysis of nucleic acid secondary structure.
12. RNA Catalysis
 - 12.1 Chemistry and structure of ribozymes.
13. Enzyme mechanisms
 - 13.1 Principles of enzyme catalysis.
 - 13.2 Proteases and polymerases, other example.
 - 13.3 Coenzymes and Cofactors.

Biochemistry

1. Alberts R.H. Frey P.A. and Jencks W.P. Biochemistry Jones, & Bartlett Publisher, Boston/London. 1992.
2. Deb A.C. Fundamentals of Biochemistry, New Book Agency Pvt. Ltd. Calcutta, 2006.
3. Nelson D.L. and Cox M.M. Lehninger Principles of Biochemistry, MacMillan/Worth Publishers, 2001.

Session 2021-22

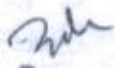
Only For Session
2020-21


 अकादमिक प्रभारी
 महाराजा सुरजमल वृज विश्वविद्यालय
 भरतपुर (राज.)

4. Stryer L. Biochemistry. W.H. Freeman and Co. New York, 2001.
5. Voet D. Voet J.G. and Pratt. C.W. Fundamentals of Biochemistry, Johan Wiley and Sons Inc., New York, 1999.
6. Wilson K. and Walker J. Principles and Techniques of Practical Biochemistry Cambridge University Press, Cambridge, 1994
7. Zubay G.L. Parson W.W. and Vence D.E. Principles of Biochemistry. Wm.C.Brown Publishers, Oxford, England, 1995.
8. Harper's Biochemistry by Murray R.K., Granner D.K., Mays P.A., Radwell V.W. McGraw Hill Publication, 2000.
9. Mathews, C.K., Van Holde, K.E., Ahern, K.G., Biochemistry, Pearson Education Pvt. Ltd. Delhi, India, 2003.
10. Horton, H.R., Morson, L.A. Serimgeour, K.G., Perry, M.D., Rawn, J.D., Principles of Biochemistry, Pearson Education, International, 2006.
11. McKee, T., McKee J.R., Biochemistry (The Molecular Basis of Life) McGraw Hill company, Inc.
12. Elliott, W.H. and Elliott, D.C. Biochemistry and Molecular Biology, Oxford University Press, Oxford, 2003
13. Champe, P.C., Harvey, R.A.; Lippincott's Illustrated Reviews: Biochemistry, Lippincott Williams & Wilkins, Philadelphia.

Session 2021-22

Only For Session
2020-21


अकादमिक प्रभारी
महाराजा सूरजमल बूज विश्वविद्यालय
भरतपुर (राज.)

PAPER-VI: POPULATION GENETICS AND STATISTICAL METHODS**Duration: 3Hours****Max.Marks : 100****Periods: 80**

Note:- In M.Sc. Zoology Previous Examination the theory paper will have the following pattern.

Question paper will have 5 (five) questions in all having equal marks

- (i) Question number 1 will be compulsory and will have 20 very short answer question of 1 mark each.
- (ii) Question numbers 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
- (iii) Question numbers 4 and 5 will be long answer type questions with internal choice.

Unit-1**Statistical Methods**

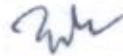
1. Definition and application of Biostatistics.
2. 2.1 Basic statistics-average.
- 2.2 Statistics of dispersion, coefficient of variation.
- 2.3 Standard errors: Confidence limits.
- 2.4 Probability distributions (binomial, Poisson and normal)
- 2.5 Tests of statistical significance- Students t-test
- 2.6 Simple correlation of regression.

Unit-II**Population Genetics**

1. Concepts of evolution and theories of organic evolution with and emphasis on Darwinism Sexual selection and Zahavi's rule.
2. Neo-Darwinism
 - 2.1 Hardy-Weinberg's law of genetic equilibrium and its applications
 - 2.2 Detailed account of destabilizing forces
 - (i) Natural selection
 - (ii) Mutation
 - (iii) Genetic drift
 - (iv) Migration
 - 2.3 Genetic structure of natural populations.
 - 2.4 Phenotypic variation
 - 2.5 Factors affecting human disease frequency.
3. Molecular population genetics
 - 3.1 Patterns of change in nucleotide and amino acid sequences.

**Only For Session
2020-21**

Session 2021-22



अकादमिक प्रभारी
महाराजा सूरजमल मूल विश्वविद्यालय
भरतपुर (राज.)

- 3.2 Ecological significance of molecular variations.
- 3.3 Emergence of Non-Darwinism-Neutral hypothesis.
- 4. Genetics of Quantitative traits in populations.
 - 4.1 Analysis of quantitative traits.
 - 4.2 Quantitative traits and natural selection.
 - 4.3 Inbreeding depression and heterosis.
 - 4.4 Molecular analysis of quantitative traits.
- 5. Genetics of specifications
 - 5.1 Phylogenetic and biological concept of species.
 - 5.2 Patterns and mechanisms of reproductive isolation.
 - 5.3 Models of specification (allopatric, sympatric, parapatric).
- 6. Molecular Evolution
 - 6.1 Gene evolution.
 - 6.2 Micro-and macro-evolution.
- 7. Molecular phylogenetics
 - 7.1 Construction of Phylogenetic trees.
 - 7.2 Phylogenetic inference-distance methods, parsimony methods, maximum likelihood method.
 - 7.3 Amino acid sequence and phylogeny.
 - 7.4 Nucleic acid phylogeny-DNA-DNA hybridizations, restriction enzyme sites, nucleotide sequence comparisons and homologies.

Suggested Reading Material (Biostatistics).

1. Batschelet, E: Introduction to Mathematics for Life Scientists Springer, Verlag, Berlin.
2. Allen Bluman Elementary Statistics: A brief version 5(ed).
3. Banden, D., Modelling in Behavioural Ecology, Chapman and Hall London, U.K.
4. Sokal R.R. and Rolf, F.J.: Biometry: Freeman, San Francisco.
5. Snedecor, H.W. and Cochran, W.G., Statistical Methods. Affiliated East West Press, New Delhi.
6. Green, R.H.: Sampling Design and Statistical Methods for Environmental Biologists, John Wiley & Sons, New York.
7. Murray, J.D., Mathematical Biology, Springer-Verlag, Berlin.
8. Bernard Rosner. Fundamentals of Biostatistics.
9. Wayne W. Daniel. Biostatistic: Basic Concept & methodology for health Science. Wiley student edition.
10. David L. Strener and Geoffery Norman Biostatistics: The Bare essentials.

**Only For Session
2020-21**

Session 2021-22

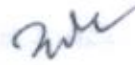
wh
**अकादमिक प्रभारी
महाराजा सुरजमल बूज विश्वविद्यालय
भरतपुर (राज.)**

Suggested Reading Material (Population Genetics)

1. Dobzharpky, T., Alaya, F.J., Stebbins, G.L., Valentine, J.M, Genetics and Origin of Species, Surjeet Publication, Delhi.
2. Futuyamma, D.J. Evolutionary Biology, suinuaer Associates, Inc., Massachusetts, U.S.A.
3. Hart, D.L., A Primer of Population Genetics, Suinuaer, Suinuaer Associates, Inc., Massachusetts, U.S.A.
4. Jha, A.P. Genes and Evolution, John Publication, New Delhi.
5. King M., Species Evolution: The Role of Chromosomal Charrge Cambridge University Press, Cambridge.
6. Merral, D.J., Holt, R. Evolution and Genetics, Rinchart and Winston, Inc.
7. Smita.J.M., Evolutionary Genetics, Oxford University Press, New York.
8. Strikberger, M.W., Evolution, Jones & Barlett Publishers, Boston, London.

**Only For Session
2020-21**

Session 2021-22



**अकादमिक प्रभारी
महाराजा सुरजमल बृज विश्वविद्यालय
भरतपुर (राज.)**

3 Hours Duration

100 Marks

Paper I	Biology of Chordates (each Paper)
Paper II	Environmental Biology and Ethology
Paper III	Genes and Differentiations
Paper IV	Tools and techniques in Biology
Paper V	Special Paper
Paper VI	Special Paper
	Laboratory Exercises
	Demonstration and tutorials
	SEMINAR

PAPER I : BIOLOGY OF CHORDATES

Duration : 3 Hours

Max. Marks - 100

Periods : 70

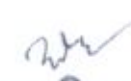
Note :- The theory paper of M.Sc. Final (Zoology) will have the following pattern.

Question paper will have 5 (five) questions in all having equal marks.

- i. Question number 1 will be compulsory and will have 20 very short answer question of 1 marks each.
 - ii. Question numbers 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these question.
 - iii. Question numbers 4 and 5 will be long answer type questions with internal choice.
1. Origin and outline classification of the chordates. 3
 2. Interrelationships of Hemichordata, Urochordate and Cephalchordata and their relations with other deuterostomes. 5
 3. Neoteny 8
 4. Origin, evolution and adaptive radiation of Chordates. 20
 - 4.1 Geological time-scale and fossils.
 - 4.2 Origin, evolution and general characters of Agnatha (Ostracoderm and Cyclostomes).
 - 4.3 The early Gnathostomes (Placoderms).
 - 4.4 A general account the Elasmobranchii, Holocephali, Dipnoi and Crossopterygii.
 - 4.5 Adaptive radiation in bony fishes.

Session 2021-22

Only For Session
2020-21


अकादमिक प्रभारी
महाराजा सुरजमल बुख विश्वविद्यालय
भरतपुर (राज.)


- 4.6 Origin evolution and adaptive radiation of Amphibia.
- 4.7 Origin and evolution of Reptiles. The conquest of land; Seymouria and related forms cotylosauria, basic type and related forms, Cotylosauria, basic types and outline classification of reptiles.
- 4.8 Living Reptiles: a brief account of Rhynchocephalia. Chelonia, Crocodilia and Squamata.
- 4.9 Origin and evolution of Birds
- 4.10 Origin of flight: Flight/adaptation.
- 4.11 Origin of Mammals.
- 4.12 Evolution of man: Relationship of man with other primates. 10
6. Organogenesis
7. Embryonic adaptations 10
- 7.1 Evolution of the cleidoic egg, its structural and physiological adaptations.
- 7.2 Development and physiology of extra-embryonic membranes in amniotes.
- 7.3 Evolution of viviparity.
- 7.4 Development, types and physiology of the mammalian placenta.
8. Metamorphosis in Amphibia
- 8.1 Structural and physiological changes during metamorphosis,
- 8.2 Endocrine control of metamorphosis.
9. Regeneration 5
- 9.1 Type of regeneration (physiological, reparative and compensatory hypertrophy) regenerative ability in chordates.
- 9.2 Morphological and histological process in amphibian limb regeneration.
- 9.3 Origin of cell for regenerations and differentiation.

Suggested Reading Material :

1. Alexander, R.M.: The Chordata, Cambridge University Press, London.
2. Barrington, E.J.W. : The Biology of Hemichordata and Protochordata, Olter and Boyed, Edinbourgh.
3. Bourne, G.H.: The Structure functions of nervous tissues academic press, New York.
4. Carter, G.S.: Structure and Habit in Verterate Evolution sedwick and Jackron, London.

Session 2021-22


**Only For Session
2020-21**


अकादमिक प्रभारी
महाराजा सुरजमल बूज विश्वविद्यालय
भरतपुर (राज.)

5. Eccles, J.C. : The understanding of the Brain. McGraw Hill Company new York.
6. Kingsley, J.S. : Outlines of Comparative Anatomy of Vertebrates Central Book Depot, Allahabad.
7. Kent, C.G. : Comparative Anatomy of Vertebrates.
8. Malcom Jollie: Chordata Morphology, East-West press Pvt. Ltd. New Delhi.
9. Milton H: Analysis of Vertebrate Structure, John Wiley and Sons Ltd. New York.
10. Montelli. A.R.: The Chordates, Cambridge University Press, London.
11. Smith, H.S.: Evolution of Chordata Structure, Hold Rinehart and Winstoin, Inc. New York.
12. Sedgwick, A.A.: Text Book of Zoology. Vol-1
13. Tansley, K. : Vision in Vertebrate, Chapman and Hall Lid., London.
14. Torrey, T.W.: Morphogenesis of Vertebrates, Hohn Wiley & Sons, New York
15. Walters, H.E. and Sayles, L.D. : Biology of Vertebrates, Macmillan and Co., New York.
16. Romer, A.S.: Vertebrate Body, W.B. Saunders Company, Philadelphia.
17. Young J.Z. : Life of Vertebrates, The Oxford University Press, London.
18. Colbert. E.H.: Evolution of the Vertebrates, John Wiley & Sons, Inc., New York.
19. Romer, A.S.: Vertebrate Palentology. University of Chicago Press, Chicago.
20. Clark, W.K., : History of Primates, University of Chocago Press, Chicago.
21. Weichert, C.K. and Presch, W. : Elements of Chordate Anatomy. MacGraw Hill Bokk Cimpany, New York.
22. Messers, H.M.: An Introduction of Vertebrate Anatomy.
23. Montagna, W. : Comparative Anatomy, John Wiley & Sons, Inc., New York.
24. DeVeer, S.G.: Embryos and Ancestors, Claredon Press, Oxford.
25. Andrew, S.M.: Problems in Vertebrate Evolution, Academic Press, New York.
26. Waterman, A.J.: Chordata Structure and Function, MacMillan Co., New York.
27. Joysay, K.A. and Kemp. T.S.: Vertebrate, Evolution, Oliver and Boyd, Edinbough.
28. Lovtrup, S.: The Phylogeny of Vertebrate. John Wiley & Sons, London.
29. Barbiur T. Hongton : Reptiles and Amchibians : Their Habitats and Adaptations. Miffin Co. New York.
30. Andrevos, S.M., Miles, R.S., Walker, A.D.: Problems in Vertebrate Evolution, Academic Press, New York.

Session 2021-22

Only For Session
2020-21


अकादमिक प्रभारी
महाराजा सूरजमल वृज विश्वविद्यालय
भरतपुर (राज.)

Paper-II : Environmental Biology and Ethology

Duration : 3 Hours

Max. Marks - 100

Periods : 70

Note :- The theory paper of M.Sc. Final (Zoology) will have the following pattern.

Question paper will have 5 (five) questions in all having equal marks.

- i. Question number 1 will be compulsory and will have 20 very short answer question of 1 marks each
- ii. Question numbers 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these question.
- iii. Question numbers 4 and 5 will be long answer type questions with internal choice.

Unit-1 : Environmental Biology

1. Interactions between environment and biota
 - a) Concept of habitat and ecological niches.
 - b) Limiting factors.
 - c) Energy flow, food chain, food web and trophic levels, ecological pyramids.
 - d) Biotic community: Concept, Structure, dominance, fluctuation and succession.
2. Ecosystem dynamics and management
 - a) Self sustaining mechanisms
 - b) Functional aspects and productivity concept.
 - c) Niche, ecotone, and overlapping of niches.
3. Environmental impact assessment
 - a) Environmental pollution.
4. Principles of conservation: Conservations strategies
 - a) Various natural resources.
 - b) Management
 - c) Preserving biological diversity with reference to India and Rajasthan and their sustainable management strategies.
5. Organization and dynamics of ecological communities.
 - a) The habitat approach.
 - b) A detailed knowledge of communities of fresh water, marine, terrestrial and estuarine area with respect to
 - i. Extent
 - ii. Zonation
 - iii. Environment

Session 2021-22

**Only For Session
2020-21**

ml
अकादमिक प्रभारी
महाराजा सुरजमल बूज विश्वविद्यालय
भरतपुर (राज.)

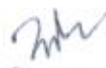
- iv. Biota
- v. Adaptations
- 6. The ecological outlook
 - a) Environmental ethics
 - b) Radiation (electromagnetic and ionizing) and environment
 - c) Global climatic changes (El Nino and La Nina)
 - d) Space ecology

Unit-II: Ethology

1. Introduction to the study of animal behavior
 - a) Aims of behavioural research
 - b) Diversity of animal behavior
 - c) Ethology: Historical perspective
2. Concepts of ethology
 - a) Fixed action patterns
 - b) Action specific energy
 - c) Sign stimulus
 - d) Innate releasing mechanism.
 - e) Learning and imprinting.
3. Proximate mechanisms in behavior/neuroethology
 - a) Introduction to neuroethology: Cellular mechanisms in behavior
 - b) Neural basis of sensory perception
 - c) Central neural processing
 - d) Neural basis of motor responses
 - e) Brain and behavior
 - f) Behavioural endocrinology
4. Spatial patterns, navigation and communication
 - a) Orientation, navigation, migration and channels of communication.
 - b) Physical properties of signals.
 - c) Field studies on primates: A preliminary knowledge.
 - d) Animal communication,
 - e) Pheromones; primer and releaser effects.
5. Social organizational orientation
 - a) Social organizations and its advantages.
 - b) Evolution of social systems.
 - c) Social groups of bees and mondeys

Only For Session:
2020-21

Session 2021-22


अकादमिक प्रभारी
महाराजा सुरजमल वृज विश्वविद्यालय
भरतपुर (राज.)

d) Learning:

- (i) Introduction, definition and types
- (ii) Habit, trial and error and conditioning

Suggested Reading Material (Environmental Biology):

1. Begon, M. Harper, J.I. and Townsend, C.R. : Ecology, Individuals, Populations and Communities. Blackwell Science, Oxford University Press, Oxford.
2. Cherratt, J.M. : Ecological Concepts. Blackwell Scientific Publication, Oxford. U.K.
3. Elseth, B.D. and Baumgartner, K.M.: Population Biology, Van Nostrand Co., New York.
4. Orgenson, S.E. : Fundamentals of Ecological Modeling. Elsevier.
5. Krebs. C.J.: Ecology. Harper and Row. New York.
6. Krebs. C.J. Ecological Methodology. Harper and Row, New York.
7. Ludwig, J.A. and Reynolds, J.F.: Statistical Ecology, John Wiley & Sons, New York.
8. Pianka. E.R.: Evolutionary Ecology, Harper and Row, New York.
9. Recklefs, R.E. and Miller, G Ecology, WII Freeman and company, New York
10. Swartzmen, G.L. and Kaluzny, S.P. Ecological Stimulation Primer, Macmillan, New York.
11. Danial. D. Chiras, Environmental Science (IX edition). Jones and Barlett (Student edition) Burlington
12. Mishra, R, Ecology Workbook. Scientific Publishers, Jodhpur (Raj.)

Ethology:

1. Rof, D.A.: The Evolution of Life Histories, Chapman and Hall, London, U.K.
2. Alcock, J.: Animal Behaviour: An Evolutionary Approach, Sinauer Assoc. Sunderland, Mass, USA.
3. Bradbury, J.W. and Vehren Camp. S.L. Principles of Animal Communications. Sinauer Assoc Sunderland Mass, USA.
4. Clutton- Brock, T.H. : The Evolution of Parental Care Princeton Univ. Press, Princeton, USA.
5. Eobi-Eibesfeldt, Holt 1: Ethology, The Biology of Behaviour, Rinehart and Winston, New York
6. Gould, J.L. : Mechanism of Evolution of Behaviour.
7. Hauser, M.: The Evolution of Communication, MIT Press, Cambridge, Mass. USA.
8. Hinde, R.A. : Animal Behaviour : A Synthesis of Ethology and Comparative psychology, McGraw Hill Company, New York.
9. Krebs, J.R. and Davis, N.V.: Behavioural Ecology, Blackwell Oxford, U.K.
10. Wilson, E.O.: Sociobiology: The New Synthesis. Harward University Press, Cambridge, Mass. USA

Session 2021-22

Only For Session
2020-21

Handwritten Signature
अकादमिक प्रभारी
महाराजा सुरजमल बृज विश्वविद्यालय
भरतपुर (राज.)

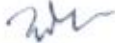
Paper - III: Genes And Differentiation**Duration : 3 Hours****Max. Marks - 100****Periods : 70****Note:- The theory paper of M.Sc. Final (Zoology) will have the following pattern.**

Question paper will have 5 (five) questions in all having equal marks.

- i. Question number 1 will be compulsory and will have 20 very short answer question of 1 mark each.
 - ii. Question number 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
 - iii. Question numbers 4 and 5 will be long answer type questions with internal choice.
1. Introduction to animal development.
 - a) Problems of developmental biology.
 - b) Developmental patterns in metazoans.
 2. Creating multicellularity
 - a) Cleavage types.
 - b) Mesoderm and endoderm.
 3. Early vertebrate development
 - a) Neurulation and ectoderm.
 - b) Mesoderm and endoderm.
 4. Cytoplasmic determinants and autonomous cell specification
 - a) Cell commitment and differentiation
 - b) Germ cell determinants
 - c) Germ cell migration
 - d) Progressive cell-cell interaction and cell specification fate
 5. Body Axes
 - a) Establishment of body axes in mammals and birds
 - b) Proximate tissue interactions
 6. Homeobox concept in different Phylogenetic groups.
 7. Hormones are mediators of development
 - a) Amphibian metamorphosis
 - b) Insect metamorphosis
 9. Environmental evolution and animal development modularity
 - a) Environmental cues and effects.
 - b) Malformations and disruptions,
 - c) Changing evolution through development modularity.

Only For Session
2020-21

Session 2021-22
Session 2021-22


अकादमिक प्रभारी
महाराजा सुरजमल मुज विश्वविद्यालय
भरतपुर (राज.)


10. Biology of sex determination
 - a) Chromosomal sex determination - Mammals and Drosophila
 - b) Secondary sex determination in mammals.
 - c) Environmental sex determination.
11. Cell diversification in early embryo
 - a) Xenopus Blastomeres.
 - c) Totipotency & Pluripotency.
 - d) Embryonic stem cells.
 - e) Renewal by stem cells-epiderms
12. Hemopoietic stem cells
 - a) Stem cell disorders.
 - b) Blood cell formation

Suggested Reading Material

1. Development Biology S.F. Gilbert, Sinauer Associates Inc., Massachusetts.
2. Ethan Bier, the Cold Spring : Cold Spring Harbour Laboratory Press, New York.

Session 2021-22
Session 2021-22

Only For Session
Session 2020-21
Session 2021-22


अकादमिक प्रभारी
महाराजा सुरजमल गुज विश्वविद्यालय
भरतपुर (राज.)

Duration : 3 Hours

Max. Marks - 100

Periods : 70

Question paper will have 5 (five) questions in all having equal marks.

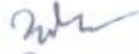
- i. Question number 1 will be compulsory and will have 20 very short answer question of 1 mark each.
- ii. Question number 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
- iii. Question numbers 4 and 5 will be long answer type questions with internal choice.

Section A: Tools

1. Principles and application of
 - a) Light Microscopy and micrometry.
 - b) Phase contrast microscopy
 - c) Interference microscopy
 - d) Polarized microscopy.
 - e) Fluorescence & epifluorescence microscopy.
 - f) Transmission electron microscopy,
 - g) Scanning electron microscopy.
2. Principle and Application of
 - a) Ultracentrifugation. Differential and density gradient.
 - b) Electrophoresis: Various media for electrophoresis and various types such as paper, agarose, PAGE, submerged DNA electrophoresis, pulse chase electrophoresis, isoelectrofocussing points and capillary electrophoresis.
 - c) Chromatography: various types such as paper, TLC, GLC, HPLC, ion-exchange and affinity chromatography,
 - d) Freeze techniques: freeze-drying, freeze substitution, freeze fracture and freeze etch.
 - e) Lambert-Beers Law and colorimetry & spectrophotometry fluorescence, U.V., N.M.R., O.R.D./CD, ESR, IR, Atomic absorption, plasma emission spectrophotometry,
3. Principles and application of radiation techniques in Biology
 - a) Radiation dosimetry.
 - b) Radioisotopes and half life of isotopes.
 - c) Tracer techniques in biology.

Session 2021-22

Only For Session
2020-21


अकादमिक प्रभारी
महाराजा सुंदरजील बृज विश्वविद्यालय
भरतपुर (राज.)

Section B: Techniques

1. Assay 2
 - a) Chemical Assays.
 - b) Biological Assays-in vivo and in vitro assays.
2. Principles of cytological and cytochemical techniques
 - a) Fixation, chemical basis of fixation by formaldehyde, glutaraldehyde, chromium salts, mercury salts, osmium salts, alcohol and acetone.
 - b) Chemical basis of staining of carbohydrates, proteins, lipids and nucleic acids.

**Only For Session
2020-21**

Session 2021-22



**अकादमिक प्रभारी
महाराजा सूरजमल वृज विश्वविद्यालय
भरतपुर (राज.)**

2020-21

1. ENTOMOLOGY**Paper-V : Morphology and Physiology****Duration : 3 Hours****Max. Marks - 100****Periods : 90**

1. Integument: Structure, composition and functions, biochemistry of sclerotization.
2. Functional Morphology of head, thorax and abdomen including head segmentation and appendages.
3. Muscular system.
4. Digestive system: Alimentary canal and physiology of digestion.
5. Circulatory system: Morphology
6. Respiratory system: Structure of respiratory organs and physiology. Adaptations for aquatic respiration.
7. Excretory system: Structure of excretory organs
8. Nervous system: Morphology
9. Neuroendocrine system: Morphology
10. Sense organs: Mechanoreceptors, Chemoreceptors auditory organs, sound and light producing organs, visual organs
11. Reproductive systems: Structure
12. Embryology: Structure of egg, embryonic and postembryonic development, types of larvae, pupae and metamorphosis, role of endocrine in growth and development, diapauses, viviparity and parthenogenesis.

1. ENTOMOLOGY**Paper -VI: Systematics, Ecology And Applied Entomology****Duration : 3 Hours****Max. Marks - 100****Periods : 90****Note:-** The theory paper of M.Sc. Final (Zoology) will have the following pattern.

Question paper will have 5 (five) questions in all having equal marks.

- iv. Question number 1 will be compulsory and will have 20 very short answer question of 1 mark each.
 - v. Question number 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
 - vi. Question numbers 4 and 5 will be long answer type questions with internal choice.
1. Classification of insects up to orders and suborders, basis and short history of classification. Introduction to primitive insects.
 2. Detailed classification of important and selected super families and families of the following orders. Orthoptera, Isoptera, Hemiptera, Coleoptera. Lepidoptera, Diptera and Hymenoptera.

Session 2021-22

Session 2021-22

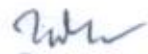
Only For Session
2020-21

अकादमिक प्रभारी
महाराजा सुखजल नृज विश्वविद्यालय
भरतपुर (राज.)

3. Social life in Isoptera and Hymenoptera.
4. Life cycle of Locusts and Aphids.
5. Origin and Evolution of insects with special reference to fossil - insects; causes of success of insects. 6. Ecology of Insects
 - 6.1 Effect of Physical factors.
 - 6.2 Intra-Interspecific relations,
 - 6.3 Population dynamics
 - 6.4 Host-Plant interactions
7. Biochemical adaptations to environmental stress (Metamorphosis, Diapause, Polymorphism etc.)
8. Concept of pest - How and Why an insect become pest?
9. History, damage caused and control of major pests of
 - 9.1 Cash crops: Sugarcane, Tobacco, mustard
 - 9.2 Cereal Crops : Wheat ,Paddy, Maize millet, sorghum, and Lentils.
 - 9.3 Pest of vegetable crops : Fruits and oil seed crops
 - 9.4 Cash fibre crops: cotton and sun hemp etc.
 - 9.5 Pests of Medical and veterinary importance with reference to role of WHO and UNICEF. Insect borne disease (A preliminary idea)
 - 9.6 Storage pest (stored grain and milled products with an elementary idea of different storage).
10. Pest control: Basic idea, EIL, and ETL.
 - 10.1 Various methods of pest control
Prophylactic and cultural methods, quarantine regulations
 - 10.2 Physical control
 - 10.3 chemical control
 - 10.4 Biological control
 - 10.5 Chemistry and mode of action of insecticides
Inorganic insecticides, Organochlorine insecticides, organophosphorus compounds and carbamates.
 - 10.6 Insecticides of plant origin
 - 10.7 Synthetic pyrethroids
 - 10.8 Insect growth regulators.
 - 10.9 Microbial insecticide
 - 10.10 Chemosterilant, repellent and antifeedents
 - 10.11 Fumigants and fumigation
11. Social insects : Social organization, Caste Differentiation,

Session 2021-22

Only For Session
2020-21


अकादमिक प्रभारी
महाराजा सुरजमल बृज विश्वविद्यालय
भरतपुर (राज.)


2. Fish Biology**Paper-V: Morphology and Physiology of Fishes****Duration: 3 Hours****Max. Marks - 100****Periods: 90****Total No. of Lectures: 90****Note:-** The theory paper of M.Sc. Final (Zoology) will have the following pattern.

Question paper will have 5 (five) questions in all having equal marks.

- i. Question number 1 will be compulsory and will have 20 very short answer question of 1 mark each.
 - ii. Question number 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
 - iii. Question numbers 4 and 5 will be long answer type questions with internal choice.
1. Classification of fishes with special reference to evolutionary trends and adaptations.
 2. Integument and exoskeleton
 3. Fins : Types of fins structure, modifications and functions of fins.
 4. Food, feeding habits and feeding adaptations/behavior; structure of the alimentary canal and physiology of digestion and absorption.
 5. Blood vascular system : Structure of the heart; principal blood vessels and circulation of blood (elasmobranch, teleost and Dipnoi).
 6. Gills and aquatic respiration. Organization of gills in fishes: structure of a typical teleostean gill, physiology of gill respiration: gill ventilation, gill surface area, blood flow through gills, water blood barrier, gas exchange at the gill surface and gas exchange between blood and tissues
 7. Air breathing fishes; causative factors and structural adaptations.
 8. Structure and functions of the swimbladder.
 9. Water and electrolyte regulation in marine fresh water and euryhaline fishes.
 10. Structure and functions of the sense organs :
 - i) Eye: visual pigments and vision.
 - ii) Chemoreceptors: Olfactory and gustatory; biological significance of chemoreception.
 - iii) Labyrinth.
 - iv) Mechanoreceptors (lateral line organs.)
 11. Structure and physiology of the endocrine organs and tissues:
 - i) Pituitary
 - ii) Thyroid
 - iii) Gonads.

Only For Session
2021-22


Session 2021-22
Session 2021-22


अकादमिक प्रभारी
महाराजा सुरजमल बूज विश्वविद्यालय
भरतपुर (राज.)

- iv) Adrenal
 - v) Endocrine pancreas
 - vi) Bronchial
 - vii) Caudal neurosecretory cells and urophysis.
 - viii) Pineal.
12. Reproduction: Organs of reproduction; modes of reproduction; oviparity, viviparity hormonal and environmental regulation of reproduction. Aging and growth of fish.
 13. Reproduction behavior: Secondary sexual characters, nest building and parental care.
 14. Development: Types of eggs; fertilization; hatching and metamorphosis.
 15. Adaptations: Coloration, sound production, electric, organs, luminescent organs (location, structure, physiology and biological significance).
 16. Immune protection in fish systems and stress.
 17. Setting-up and maintenance of an aquarium.
 18. Fish products and byproducts; Liver oil, body oil, meal, fish manure, guano, glue, isinglass, roc (caviar), fins and leather.

Session 2021-22

Only For Session
2020-21


अकादमिक प्रभारी
महाराजा सुखजमल बृज विश्वविद्यालय
भरतपुर (राज.)

Session 2021-22

Paper-VI: AQEACULTURE AND FISHERIES

Duration: 3 Hours

Max. Marks - 100

Periods: 90

Total No. of Lectures: 90


Note:- The theory paper of M.Sc. Final (Zoology) will have the following pattern.

Question paper will have 5 (five) questions in all having equal marks.

- i. Question number 1 will be compulsory and will have 20 very short answer question of 1 mark each.
 - ii. Question number 2 and 3 will consist of only short answer type questions with 4 subdivisions of 5 marks each. There will be internal choice in these questions.
 - iii. Question numbers 4 and 5 will be long answer type questions with internal choice.
1. Definitions of (a) inland, (b) marine (c) capture fisheries.
 2. Riverine fisheries: Ecology and fisheries of the major river systems, effects of dams and barrages on riverine fisheries.
 3. Estuarine fisheries: Ecology and fishery resource of major estuaries; potential and management of estuarine fisheries.
 4. Marine fisheries :
 - 4.1 Ecology and general survey of marine capture fishes with special reference to sardine, mackerel, Bombay duck and pomfret.
 5. Estimation of fecundity and population. Population dynamics and fishery catches.
 6. Growth and age; environmental factors and methods.
 7. Crustaceans and Molluscan fisheries (Marinewater, Brackishwater and Freshwater) culture of edible oyster and shrimps.
 8. Methods of Fishing: Crafts (non-mechanised and mechanized) and gears used in India for fishing in inland and marine water; recent advances in fishing method, electrical fishing: light fishing, fish finders (Eco-sounder and sonar) and their use.
 9. Transport and preservation of fish: Methods of transport, post-mortem changes and rigor mortis in fish; spoilage (bacterial and chemical); fish preservation-handling and cleaning of fresh fish, ceiling, freezing, canning and pickling.
 10. Fishery management: fish yield, effect of fishing on yield and optimum catch; concept of a rational fishery.
 11. Environment and fish. Environmental factors (abiotic and biotic), interrelation to the life of fishes; pollution of aquatic ecosystems sources of pollution and nature of pollutants, effects of pollution on fisheries, legislative and other remedial measures to contain aquatic pollution.

Session 2021-22

Only For Session **Session 2021-22**
2020-21


अकादमिक प्रभारी
महाराजा सूरजमल बूज विश्वविद्यालय
भरतपुर (राज.)

12. Freshwater fish culture in India; Fish seed resources (riverine, bundh breeding, hypophysation) hatching of eggs, hatchlings, 'hapas' and different types of hatcheries, management of hatcheries; methods of transporting fish seed, fingerlings and breeders; causes of mortality during transportation and measures for reducing it.
13. Planning and management of freshwater ponds for fish culture (freshwater fish-farming); survey of site, layout, soil and water requirements, preparation of nursery, rearing and stocking ponds, control of predators and weed fishes; liming and manuring; control of aquatic insects and weeds, procurement and segregation of fish seed; stocking rates; stocking ratios of different species for composite culture; artificial feed and supplement feeding, harvesting.
14. Culture of Indian major carps (rohu, catla and mrigal) exotic carps Common carp, grass carp, silver carp and tilapia. Composite culture principle, techniques and significance: Wet and dry bundh technique, induced breeding, hypophysation, selective breeding and hybridization.
15. Nutrition and physiological energetic: Nutritional requirement of fish with reference to proteins, lipids, carbohydrates, vitamins and minerals: essential amino acids and essential fatty acids; energy requirements: food conservation, efficient energy budgets.
16. Fish as food: Biochemical composition of raw fish, factors affecting biochemical composition of fish; nutritive value of raw and preserved fish; poisoning, toxicity and allergies from fish as food; quality control of fish as food.
17. Fisheries education, training and extension in India : Brief information about the objectives and functions of central Institute of Fisheries Education (Bombay) Central inland capture Fisheries Research Institute (Barrackpore) Central institute of Freshwater aquaculture (Chennai), National Bureau of Fisheries Genetics Resources (Allahabad). Central Institute of Fisheries Research Institute (Cochin), Central Institute of Fisheries Nautical and Engineering Training (Cochin), Central Institute of Fisheries Technology (Cochin) and National Institute of Oceanography (Dona Paula).

List of Practicals Exercises:

1. Study of distinguishing features, identification and classification of specimens of important species of fish available in the museum; Collection of local fish fauna and its identification upto the species level using taxonomic keys.
2. Anatomy and Histology:
 - a) Study of anatomy of teleost represented by the catfish wallago attu: External anatomy and gills, uiscera, alimentary canal and urinogivetal organs; musculature of gill ventilation, and feeding; eye muscles and their innervations, endosketion (through dried and alizarin preparation).

Only For Session
2020-21

Session 2021-22

Indu
अकादमिक प्रभारी
महाराजा सुरजमल वृत्त विश्वविद्यालय
भरतपुर (राज.)

Branchial blood vessels, brain and cranial nerves, swim bladder, weberian ossicles, membranous labyrinth connections.

- b) Preparation and study of stained permanent mounts of ampullae of Lorenzini (from *Dasyatis*), otolith, weberian ossicles, membranous labyrinth connections.
 - c) Dissection of air-breathing organs and their blood supply in *Anabas testudineus*, *Clarias batrachus*, *Heteropneustes fossilis* and *channa sp.*
3. Preparation of microscopic slides of stained sections of following organs/tissues/structures from an adult teleost for their histological study of liver, intestine, kidney, testis, Ovary, gill, pituitary, thyroid tissue, head kidney (for interregal and chromaffin cells).
4. Physiology and biochemistry:
- a) Study of the effect of epinephrine, NaCl and KCl on fish chromatophores.
 - b) Study of changes in chromatophores of fish kept against white (light) and black (dark) backgrounds for protracted periods.
 - c) Determination of the rate of oxygen consumption (Winkler method) in a water breathing fish at different temperatures,
 - d) Determination of the rate of ammonia and urea excretion in fish,
 - e) Estimation of protein, fat, ash and water contents in fish muscle.
 - f) Study of free amino-acid pool in fish muscle through paper chromatography.
5. Basic Laboratory Techniques:

Maintenance of fish in freshwater: Setting up to an aquarium, quality of water in the aquarium and its aeration: Introduction of fish in the aquarium; feeding of fish and management of aquarium. Ecology: Physico-chemical analysis of water. Age and growth. Identification of maturity stages of fish; determination of gonosomatic index; estimation of fecundity; measurement of ova diameter. Plankton. Benthos and Primary productivity: Collection of plankton and its qualitative and quantitative analysis; identification of common groups of freshwater plankton; collection and analysis of benthos from a freshwater fish pond, identification of mollusks, weeds, predatory fishes and harmful insects in a fresh water fish pond or lake by dark and light bottle method. Identification of important cultivable species of fish, their eggs and principal stages in their life histories.

preparation of pituitary gland extract; dosage and technique of injecting pituitary gland extract. Water Analysis; determination of water temperature light turbidity. Dissolved oxygen, dissolved carbon dioxide, ammonia, salinity, alkalinity, nitrates, phosphates, pH, particle size, available

Fish anesthetics and anesthetization; simple surgical procedure (gonadectomy), fish saline.

Session 2021-22

Only For Session
2020-21

अकादमिक प्रभारी
जयराज सुरजनल बुज विश्वविद्यालय
भरतपुर (राज.)

Fieldwork and study tour

34.

- a) A visit to a farm/fish seed production centre,
- b) 3 to 4 day tour to study various fisheries activities at selected centres/sites.

Session 2021-22

Only For Session
2020-21

Session 2021-22



अकादमिक प्रभारी
महाराजा सुरजमल नृज विश्वविद्यालय
भरतपुर (राज.)