

शासकीय कमला राजा कन्या स्नातकोत्तर स्वशासी महाविद्यालय,  
ग्वालियर (मध्य प्रदेश)



प्राणीशास्त्र विषय के अध्ययनमंडल  
द्वारा अनुमोदित प्राणिशास्त्र विषय के  
स्नातक पाठ्यक्रम

अनुमोदन अकादमिक सत्र  
2018-2019

प्रस्तुतकर्ता

स्नातकोत्तर अध्ययन केन्द्र

प्राणीशास्त्र विभाग

प्राप्तकर्ता

अकादमिक प्रकोष्ठ



वेबसाइट : [www.krgc.gwl.org](http://www.krgc.gwl.org) ईमेल : [krgc@rediffmail.com](mailto:krgc@rediffmail.com)  
दूरभाष : 0751 - 2625495, 0751 - 2438173, फैक्स : 0751 - 2625495

GOVT. KAMALA RAJA GIRLS P.G. (AUTO.) COLLEGE  
GWALIOR (M.P.)



**BACHELOR OF SCIENCE**  
**(THREE YEAR DEGREE COURSE)**

**IN**

**ZOOLOGY**

**SYLLABUS**

**(2018-2021)**





B.Sc. - I Year - Zoology

Books of MP Hindi Granth Academy

- Parker & Haswall : Text book of Invertebrate Zoology
- Kotpal, R.L. : Invertebrate
- Rastogi, V.B. : Developmental Biology
- Arora, M.P. : Embryology
- Verma, P.S and Agrawal, V.K. : Chordate Embryology
- Karp : Cell and molecular Biology
- Shee ar & Bianchi : Cell and Molecular Biology
- Rastogi V.B. : Introduction to cytology
- De Robertis : Cell and Molecular Biology
- Power, C.B. : Cell Biology
- Verma, P.S and Agrawal, V.K. : Cell Biology, Genetics, Molecular Biology, Evolution

*Rathore*  
28.4.17  
(Prof. H.S. Rathore)

*H. S. Rathore*  
28/4/17  
(Dr. H.S. Rathore)

*Rajendra Singh*  
28.4.17  
(Dr. Rajendra Singh)

*Vinod Kumar*  
28.4.17  
(Dr. Vinod Kumar)

*Ravi Sankar*  
(Dr. Ravi Sankar)

*D. Jey*  
*Kishu*  
*Anita*  
*W*

*S. S. Shrivastava*  
28/4/17  
Dr. C.S. Shrivastava

*Rajiv Shevaram*  
28/4/17  
(Dr. Rajiv Shevaram)

*Shobha*  
28.4.17  
(Dr. Shobha Shobha)

*C. C. Babu*  
Dr. C. C. Babu

*Dr. Shrikrish Pratap Singh*  
Prof. & Head, Dept. of Zoology  
Govt. Autonomous P.G. College, Satna (M.P.)  
Chairman, Board of Studies, U.P.S. University, Bera

*Dr. Anil Kumar*  
Dr. Anil Kumar

*Dr. Anita Salunka*  
Dr. Anita Salunka

*विभागाध्यक्ष*  
*प्राणिशास्त्र विभाग*  
*शा. कमला राजे कन्या स्ना. स्व. महाविद्यालय*  
*ग्वालियर (म.प्र.)*



Department of higher Education, Govt. of M.P.  
Under Graduate Syllabus for B.Sc. (Bio) 3 Years  
As recommended by Central Board of Studies in Zoology

उच्च शिक्षा विभाग, म.प्र. शासन  
स्नातक कक्षाओं के लिए त्रिवर्षीय पाठ्यक्रम  
केन्द्रीय अध्ययन मण्डल प्राणीशास्त्र द्वारा अनुशंसित

Class / कक्षा : B.Sc. II year (Session-2018-19)  
Paper : 1  
Subject / विषय : Zoology  
Title of Paper : Vertebrates and Evolution  
Max Mark/ अधिकतम अंक : ~~42~~ 40

UNIT I

1. Origin of Chordates, Classification of Phylum Chordate upto orders according to Parker and Haswell (Latest edition).
2. Urochordata- Type study of Herdmania
3. Cephalochordata- Type study of Amphioxus, Affinities of Amphioxus
4. Comparison between Petromyzon and Myxine.

UNIT II

1. Comparative account of integuments
2. Comparative account of limb bones and girdles of vertebrates (Amphibia, Reptiles, Birds and Mammals).
3. Comparative account of digestive system (Amphibia, Reptiles, Birds and Mammals).
4. Comparative account of respiratory system (Amphibia, Reptiles, Birds and Mammals).

UNIT III

1. Comparative account of aortic arches and heart.
2. Comparative account of brain.
3. Comparative account of Urinogenital system.
4. Placentation in mammals.

UNIT IV

1. Origin of life- modern concepts only.
2. Lamarckism, Darwinism.
3. Modern synthetic theories: Variations, Mutation, Isolation & Speciation
4. Adaptation and Mimicry
5. Micro, macro evolution and mega evolution.

UNIT V

1. Fossils, methods of fossilization, determination of age of fossils.
2. Study of extinct forms: Dinosaurs and Archaeopteryx.
3. Zoogeographical distribution.
4. Evolution of man
5. Geological time scale and Insular fauna.

Prof. & Head, Dept. of Zoology  
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Chairman, Board of Studies, A.P.S. Univ.

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Class / कक्षा : B.Sc. II year (Session-2018-19)  
Paper : II  
Subject/ विषय : Zoology  
Title of Paper : Animal Physiology and Bio-Chemistry  
Max Mark/ अधिकतम अंक : 42<sup>1/2</sup> 40

**Unit I: Nutrition and Metabolism**

1. Physiology of digestion in mammals
2. Protein Metabolism: Deamination, Decarboxylation, Transamination of amino acids and Ornithine cycle.
3. Carbohydrate metabolism- Glycogenesis, Glycogenolysis, Glycolysis, The Citric acid cycle, Gluconeogenesis.
4. Lipid Metabolism- Beta oxidation of fatty acids.

**Unit II: Respiration, Excretion and Immune System**

1. Mechanism and Physiology of respiration in mammals (transport of gases, chloride shift).
2. Physiology of Excretion- urea and urine formation in mammals
3. Innate and acquired immunity, immune cells and lymphoid system, immune response: cellular and humoral immunity

**Unit III: Regulatory Mechanisms of Enzymes and role of Vitamins**

1. Thermoregulation.
2. Definition and nomenclature of enzymes, classification of enzymes.
3. Mechanism of enzyme action.
4. Co-enzymes
5. Vitamins

**Unit IV: Neuromuscular Co-ordination**

1. Types of neurons and glial cells
2. Physiology of nerve impulse conduction.
3. Types and structure of Muscles
4. Theory of muscle contraction and its biochemistry.

**Unit V: Endocrine system**

1. Structure and functions of Pituitary gland.
2. Structure and functions of Thyroid gland.
3. Structure and functions of Adrenal gland.
4. Structure and functions of Parathyroid, Thymus and Islets of Langerhan's.
5. Physiology of Male and female Sex hormones

Dr. Shivash Singh  
Prof. & Head, Dept. of Zoology  
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Chairman, Board of Studies, A.P.S. University, Rewa

28.11/17

(Dr. Vinod Kumar) 07.12  
Dr. Anil Kumar

Dr. Anil Kumar

Dr. Anil Kumar

Dr. Shivash Singh

Dr. Anil Kumar

Dr. Anil Kumar

Dr. Anil Kumar

Dr. Anil Kumar

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ग्वालियर (म.प्र.)



B.Sc. - II Year - Zoology

Books of MP Hindi Granth Academy

Parker & Haswal : Text book of Vertebrate Zoology  
 Kotpal, RL : Vertebrate  
 Jordan, EL and Verma, PS : Chordate Zoology  
 Rastogi, VB : Organic Evolution  
 Singh and Chaturvedi : Organic Evolution  
 Ernst W. Mayr : Evolution and the Diversity of life  
 Colbert : Evolution  
 Verma, PS and Agrawal, VK : Cell Biology, Genetics, Molecular Biology, Evolution  
 Verma PS : Animal Physiology  
 Nigam, HL : Animal Physiology  
 Wood, DW : Principle of Animal Physiology  
 Berg, AK : Animal Physiology and Biochemistry  
 Prosser, CL : Comparative Animal Physiology  
 Goyal and Shastri : Animal Physiology  
 Shrivastava, HS : Biochemistry  
 Lehninger : Biochemistry

*Rathore*  
 28.1.17  
 (Prof. H. S. Rathore)

*Shrivastava*  
 28/1/17  
 (Dr. C. S. Shrivastava)

*Shrivastava*  
 28/1/17  
 (Dr. Shivank Pratap Singh)  
 Prof. & Head, Dept. of Zoology  
 Govt. Autonomous P.G. College, Satna (M.P.)  
 Chairman, Board of Studies, A.P.S. University, Rewa

*Buyal*  
 28.1.17  
 (Dr. Romesh Singh)

*Shrivastava*  
 28/1/17  
 (Dr. Rajni Shrivastava)

*Shrivastava*  
 28/1/17  
 (Dr. Ujjwal Singh)

*Shrivastava*  
 28.1.17  
 (Dr. Vinodini Nigam)

*Shrivastava*  
 28.1.17  
 (Dr. Shobha Shrivastava)

*Shrivastava*  
 28/04/17  
 (Dr. Anita Solanki)

*Sahni*  
 (Dr. N. Sahni)

*Shrivastava*  
 (Dr. C. S. Shrivastava)

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 ग्वालियर (म.प्र.)

*Dubey*  
*Kishor*  
*Shrivastava*  
*Shrivastava*

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Class / कक्षा : B.Sc. II year (Session-2018-19)  
Subject/ विषय : Zoology Practical  
Max. Mark/ अधिकतम अंक : 50

1. Dissections of commercially available species of locally available fishes (Efforts may be done to use computer simulation technique).
2. Study of museum specimens (Vertebrates)
3. Study of specimens of evolutionary importance viz living fossils, connecting links, extinct animals, fossils: Limulus, Latimeria, Dinosaurs, Asiatic chital, Archeopteryx, Peripatus, etc.
4. Osteology : Limb bones and girdle bones of Frog, Varanus, Pigeon and Rabbit.
5. Detection of Protein, Carbohydrate and Lipid / Study of Human salivary enzyme activity in relation to pH.
6. Hematological Experiment- RBC and WBC counting / Blood grouping in blood samples / Estimation of Hemoglobin and sugar in blood samples
7. Histological study of various endocrine glands --T. S. of Thyroid, T. S. of Pituitary gland, T. S. of Adrenal gland, T. S. of Testis, T. S. of Ovary.
8. Histological study of Digestive and Visceral organs - T.S of Stomach, T.S of Intestine, T.S of Pancreas T. S. of Liver, T.S of Lungs and L.S. of Kidney

Distribution of Marks

1. Dissection	08
2. Spot related to evolution	05
3. Spotting (4 spot, 2 Bones, 2 Slides)	16
4. Biochemical test / Enzyme activity	05
5. Hematological Experiment	06
4. Viva -voce	05
7. Record	05

Total 50

*Dr. Shivesh Pralap Singh*  
Prof. & Head, Dept. of Zoology  
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Chairman, Board of Studies, A.P.S. University, Rewa

*Dr. Shobha Shouche*  
(Dr. Shobha Shouche)  
(Dr. Shobha Shouche)

*Dr. N. S. Rathore*  
Dr. N. S. Rathore

*Dr. S. S. Shrivastava*  
Dr. S. S. Shrivastava

*Dr. Kamla Raj*  
विभागाध्यक्ष प्राणिशास्त्र विभाग  
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*Dr. Kiran*  
Dr. Kiran

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Class / कक्षा	:	B.Sc. III year (Session-2019-20)
Paper	:	I
Subject/ विषय	:	Zoology
Title of Paper	:	Genetics
Max Mark/ अधिकतम अंक	:	<del>42</del> 40

**UNIT I : Heredity and Genetic material**

1. Mendel's laws of heredity.
2. Variations- sources and types
3. Structure, molecular organization and function of DNA and RNA and types of RNA
4. DNA replication in Prokaryotes.
5. Nucleosome (Solenoid model)

**UNIT II Gene Expression**

1. Genetic Code
2. Transcription in Prokaryotes
3. Translation in Prokaryotes
4. Gene expression: Regulation of protein synthesis and Lac operon model.
5. Split gene, overlapping gene, pseudo gene

**UNIT III : Linkage and Chromosomal aberration**

1. Linkage and crossing over- Types and significance
2. Sex determination- Chromosomal and genetic balance theory.
3. Sex linked inheritance (Haemophilia, colour blindness)
4. Structural and numerical changes in chromosomes
5. Mutation-Types and Mutagens

**UNIT IV : Human Genetics**

1. Human Karyotype
2. Human Genome Project
3. Multiple allele and inheritance of blood group
3. Autosomal and Sex Chromosome Syndromes in human
4. Genetic diseases in human- Sickle cell anaemia, Albinism and Thalassaemia

**UNIT V : Genetic Engineering**

1. Recombinant DNA technology and Gene Cloning
2. Polymerase chain reaction.
3. Blotting- Southern and Northern
4. DNA finger printing
5. Gene therapy

*(Dr. N. S. Jaiswal)*  
*Dr. N. S. Jaiswal*

*Dr. Debey Singh*

*Dr. Shivraj Pratap Singh*  
Prof. & Head, Dept. of Zoology  
Govt. Autonomous P.G. College, Satna (M.P.)  
... & P.S. University, Rewa

*Dr. ...*

*Dr. ...*  
28/4/17  
...  
विभागाध्यक्ष  
प्राणिशास्त्र विभाग  
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Department of higher Education, Govt. of M.P.  
Under Graduate Syllabus for B.sc (Bio) 3 Years  
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उच्च शिक्षा विभाग, म.प्र. शासन  
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Class / कक्षा	:	B.sc III year (Session-2019-20)
Paper	:	II
Subject/ विषय	:	Zoology
Title of Paper	:	Ecology and Applied Zoology
Max. Mark/ अधिकतम अंक	:	<del>42</del> 40

**Unit-I Concept of Ecology**

1. Abiotic and biotic factors, Component of ecosystem.
2. Energy flow in ecosystem : Food chain, Food web and Pyramids.
3. Biogeochemical cycle : Carbon, Oxygen, Nitrogen, Phosphorus
4. Population Concept – Characteristics of population. Factors affecting Population growth.

**Unit-II Habitat Ecology**

1. Fresh water , marine and terrestrial habitat
2. Ecological division of India.
3. Biodiversity : Natural resources and their conservation with special reference to forests.

**Unit-III Wild Life and Environment**

1. Wild life Protection Act ,National Parks and Sanctuaries of Madhya Pradesh
2. Endangered species of India.
3. Types of pollution : Air, water, soil, thermal and noise pollution.
4. Urbanisation and effect of human population on environment.

**Unit-IV Aquaculture**

1. Prawn culture: Culture of fresh water prawn , methods of prawn fishing , preservation and processing of prawns
2. Pearl culture and pearl industry.
3. Frog culture.
4. Major carp culture : Management of ponds , preservation and processing of fishes.
5. Maintenance of Aquarium.

**Unit-V Economic Entomology**

1. Sericulture: Species of silkworm, life history of *Bombyx mori*, Sericulture Industry in India.
2. Apiculture – Life cycle of the honey bee, methods of bee keeping, products of bees, enemies of bees.
3. Lac culture: Lifecycle of lac insect and host plant of lac insects.
4. Common pests: Stored grains: *Sitophilus oryzae* and *Tribolium castaneum*, Vegetable pest: *Pieris brassicae* and *Dacus cucurbitae*.
5. Biological control of insect pests.

Dr. Shivash Singh  
Prof. & Head, Dept. of Zoology  
Autonomous P.G. College, Satna, M.P.  
Member, Board of Studies, A.P.S. University, Bhopal

Dr. K. L. Singh  
28/11/17  
28/11/17  
विभाग अध्यक्ष  
प्राणिशास्त्र विभाग  
मा. कमला राजे कन्या स्ना. स्व. महाविद्यालय  
ग्वालियर (म.प्र.)

Books of MP Hind Granth Academy

- Lewin : Genetics (Latest Edition Strickberger : Genetics)
- Gardner, MJ : Principles of Genetics
- Singh, BD : Genetics
- Singh, BD : Biotechnology
- Gupta, PK : Genetics
- Gupta, PK : Molecular Biology and Genetic Engineering
- Verna, PS and Agrawal, VK : Genetics
- Purchi : Biotechnology
- Kehli and Ansar : Economic Zoology
- Kehli : Ecology
- Oduy, EP : Fundamental of Ecology
- Sharma PD : Environmental Biology and Toxicology
- Natrajan, SS : A Manual of Fresh Water Aquaculture
- Upadhyaya : Economic Zoology
- Pal, Ajay : Cellular & Molecular Biology

~~Pragya Khanna~~

~~Cell & Molecular Biology~~

~~Pragya Khanna~~  
28.4.17

~~28/4/17~~

~~Dr. Shrinivas~~

~~Dr. Shrinivas~~

Dr. Shivashankar Singh

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Chairman, Board of Studies, A.P.S. University, Rewa

~~28/4/17~~

~~(Dr. Celina Yadav)~~

~~28/4/17~~

~~(Dr. Shobha Srivastava)~~

~~(Dr. Shobha Srivastava)~~

Prof. H.S. Rathore

28.4.17

(Dr. R. G. S. Singh)

(Dr. Rajiv Shrivastava)

(Dr. Vinodini Nigam)

(Dr. N. S. Sahai)

~~28/4/17~~

(Dr. Anita Solanki)

~~(Dr. Anita Solanki)~~

~~(Dr. Anita Solanki)~~

विभागाध्यक्ष  
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Class / कक्षा : B.Sc. III year (Session-2019-20)  
Subject / विषय : Zoology Practical  
Max. Mark / अधिकतम अंक : 50

The practical's work will be as per theory syllabus and the candidates will be required to show the knowledge of the following :-

1. Study of fresh water, marine and terrestrial fauna. Major carps, Common stored grain pest and vegetable pest
2. Water analysis - Dissolve Oxygen, pH, Hardness, Turbidity.
3. Study of Ecosystems and maintenance of Aquarium
4. Study of instrument related to Genetics- Centrifuge, PCR, gel electrophoresis, DNA finger printing.
5. Wild life - Endangered species.
6. Life cycle of silkworm, Honey Bee, Lac insect

Distribution of Marks

1. Spotting	12
2. Analysis of water	04
3. Exercise based on wildlife	05
4. Ecosystem	04
5. Study of Instruments	05
6. Problem on Genetics	05
7. Life Cycle	05
8. Viva-voce	05
9. Practical Record and collection	05

Total 50

Dr. Shivakrishna Singh  
Prof. B. Sc. Dept. of Zoology  
Govt. Autonomous P.G. College, Satal (B.P.)  
Baraman, Board of Studies, A.P.S. University, Bhopal

Dr. Shobha Shrivastava  
Dr. Usha Yadav  
28/11/17

Dr. S. S. Singh  
Dr. Rajiv Shrivastava  
Dr. Vinod Kumar  
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Department of Higher Education, Govt. of H.P.  
Under Graduate Syllabus for B.Sc (Bio) 3 Year 5  
AS recommended by Central Board of Studies in Zoology

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स्नातक कक्षाओं के लिए त्रिवर्षीय पाठ्यक्रम  
केन्द्रीय अध्ययन मण्डल प्राणीशास्त्र द्वारा अनुशंसित

Class / कक्षा : B.Sc I year (Session-2017-18)  
Paper : I  
Subject/ विषय : प्राणीशास्त्र  
Title of Paper : अकशेरुकी  
Max. Mark/ अधिकतम अंक : ~~42~~ 40

इकाई I

1. द्विदिशीय नामकरण एवं अंतर्राष्ट्रीय कोड का सामान्य अध्ययन
2. निम्नतर अकशेरुकी प्रणियों का वर्गीकरण (पारकर एवं हेजवेल का 7वाँ संस्करण अनुसार)  
(i) पाटोजोआ (ii) पोरिफेरा (iii) सीलेट्रेटा (iv) इलिन्थेरा
3. उच्चतर अकशेरुकी प्रणियों का वर्गीकरण (पारकर एवं हेजवेल का 7वाँ संस्करण अनुसार)  
(i) ऐनेलिडा (ii) आर्थ्रोपोडा (iii) मोलस्का (iv) इकाइनोडर्मेटा (v) हनीवग्डेटा

इकाई II

1. प्रोटोजोआ - एसाजमोडियम का प्रारूप अध्ययन
2. प्रोटोजोआ एवं रिंग
3. पोरिफेरा - साइकोन का प्रारूप अध्ययन
4. सीलेट्रेटा - ओवलिथा का प्रारूप अध्ययन
5. प्रवास एवं प्रवास-श्रित्ती का निर्माण

इकाई III

1. इलिन्थेरा - फेरिसोला का प्रारूप अध्ययन
2. ऐनेलिडा एवं रिंग
3. ऐनेलिडा - केंचुए का प्रारूप अध्ययन (फेरोटिमा)
4. ऐनेलिडा में मेटामेसिजा
5. ट्रोकाफोर लार्वा की संरचना एवं महत्व

इकाई IV

1. आर्थ्रोपोडा - त्रिमे का प्रारूप अध्ययन (पेलीमॉन)
2. इन्सेक्टा के लार्वा
3. मानव रागो के वाहक कीट
4. मोलस्का - साइला का प्रारूप अध्ययन (एपल घोंघा)
5. मोलस्का के लार्वा

इकाई V

1. इकाइनोडर्मेटा - तारा मछली की बाह्य संरचना एवं जल सवहन तंत्र
2. इकाइनोडर्मेटा के लार्वा
3. माइजर फाइला - एक्टोप्रोबटा एवं रोटीफेरा
4. हेमिफोर्डेटा - वेलोनोमलार्सेस का प्रारूप अध्ययन
5. वेलोनोमलार्सेस की वृत्त

Dr. S. S. Chandra (28/11/17)  
Dr. M. S. Chandra (28/11/17)  
Dr. Rajiv Chandra (28/11/17)  
Dr. Ram, Shri Singh (28/11/17)  
Dr. Vinod Kumar (28/11/17)  
Dr. Shobha Singh (28/11/17)  
विभागाध्यक्ष  
प्राणिशास्त्र विभाग  
राजे कन्या स्ना. स्व. महाविद्यालय

Class / कक्षा : B.Sc I year (Session-2017-18)  
 Paper : II  
 Subject/ विषय : प्राणीशास्त्र  
 Title of Paper : कोशिका विज्ञान एवं भ्रूणिकी विकास  
 Max. Mark/ अधिकतम अंक : ~~42~~ 40

इकाई I

1. कोशिका विज्ञान का इतिहास, कोशिका सिद्धांत
2. प्रोकेरियोटिक एवं यूकेरियोटिक कोशिका
3. गोल्जी बॉडी, एन्डोप्लाज्मिक रेटिकुलम, लाइसोसोम की संरचना एवं कार्य
4. माइटोकॉन्ड्रिया, राइबोसोम संद्रिओल, नाइक्रोसोम की संरचना एवं कार्य

इकाई II

1. केन्द्रक एवं केन्द्रिका की संरचना एवं कार्य
2. प्रारम्भिक गुणसूत्र की संरचना एवं कार्य
3. विभिन्न प्रकार के गुणसूत्र -- लेमिंग्ट्रुश एवं पॉलीटीन
4. पंचदक-कोशिकाद्वयीय पारस्परिक क्रिया
5. कोशिका चक्र, समसूत्री एवं अर्ध सूत्री कोशिका विभाजन

इकाई III

1. शुक्राणुजनन
2. अंडाणुजनन
3. निषेचन
4. आनिषेकजनन
5. पुनसंभवन

इकाई IV : मेढक का विकास

1. विदलन
2. क्लस्कुलेशन
3. फेटमेप का निर्माण
4. नोस्ट्रुलेशन एवं तीन जनन स्तरों का निर्माण
5. टेम्पोल लावा की संरचना

इकाई V : चूजे का विकास

1. विदलन
2. क्लस्कुलेशन
3. फेटमेप का निर्माण
4. नोस्ट्रुलेशन
5. प्रिमिटिव स्ट्रीक बनने तक चूजे के भ्रूण का विकास
6. चूजे में वाहक भ्रूण शिल्लियाँ

Prof. A.S. Rathore (28.4.17)  
 Dr. S. Shiroben  
 Dr. Shivesh Pratap Singh (Prof. & Head, Dept. of Zoology, P.G. College, Satna (M.P.))  
 Dr. Rajiv Shevastava  
 Dr. Vinodini Mishra (विभागाध्यक्ष प्राणिशास्त्र विभाग)  
 Dr. S. S. Choudhary  
 Dr. P. K. Singh  
 Dr. Shobha Singh





Department of higher Education, Govt. of M.P.  
Under Graduate Syllabus for B.Sc (Bio) 3 Year  
AS recommended by Central Board of Studies in Zoology

उच्च शिक्षा विभाग, म.प्र. शासन

स्नातक कक्षाओं के लिए त्रिवर्षीय पाठ्यक्रम  
केन्द्रीय अध्ययन मण्डल प्राणीशास्त्र द्वारा अनुश्रुत

Class / कक्षा : B.Sc II year (Session-2018-19)  
Paper : II  
Subject/ विषय : प्राणीशास्त्र  
Title of Paper : जन्तु कार्यिकी एवं जैव-रसायनिकी  
Max. Mark/ अधिकतम अंक : ~~42~~ 40

इकाई I : पाचन एवं कार्यिकी

1. स्तनधारियों में पाचन की कार्यिकी
2. प्रोटीन उपापचय - निऑनोनीकरण, विकार्बोक्सीलेशन अमीनो अम्ल का अमाइनी अनुवर्तण एवं खनिजित चक्र
3. कार्बोहाइड्रेट उपापचय -- ग्लाइकोजेनेसिस, ग्लाइकोजिनोलाइसिस ग्लाइकोलाइसिस साइट्रिक अम्ल चक्र, ग्लाइकोनियोजेनेसिस
4. वसा उपापचय - वसोय अम्ल का बीटा ऑक्सीकरण

इकाई II : श्वसन, उत्सर्जन एवं प्रतिरक्षा तंत्र

1. स्तनधारियों में श्वसन तंत्र की कार्यिकी एवं क्रियाविधि (वायवीय परिवहन एवं कनोराइड रिफ्ट)
2. उत्सर्जन की कार्यिकी -- स्तनधारियों में यूरिया तथा यूरिन की निर्माण विधि
3. सहज एवं अर्जित प्रतिरक्षा प्रणाली, प्रतिरक्षा कोशाएं तथा लिम्फोइड तंत्र, प्रतिरक्षा प्रतिक्रिया, कोशिकीय तथा ह्यूमोरल प्रतिरक्षा

इकाई III : एन्जाइम्स की नियमन क्रियाविधि तथा एवं विटामिन्स के कार्य

1. तापनियमन
2. एन्जाइम की परिभाषा, नामकरण एवं वर्गीकरण
3. एन्जाइम की क्रियाविधि
4. सह-एन्जाइम
5. विटामिन्स

इकाई IV : तंत्रिका- पेशीय सन्न्वय

1. न्यूरोन्स के प्रकार तथा ग्लिअल कोशिकाएं
2. तंत्रिक आवेग संचरण की कार्यिकी
3. पेशीय संरचना एवं पेशियों के प्रकार
4. पेशीय संकुचन का सिद्धांत तथा उसकी जैवरसायनिकी

इकाई V : अन्तस्त्रावी तंत्र

1. पिट्यूट ग्रंथी की रचना एवं कार्य
2. थायरॉइड ग्रंथी की रचना एवं कार्य
3. अतिवृक्क ग्रंथी की रचना एवं कार्य
4. पेरिथायराइड थायमस, आइलेटस ऑफ लैंगरहेन्स की रचना एवं कार्य
5. नर एवं मादा के जनन हार्मोन्स की कार्यिकी

Dr. S. S. Shrivastava (28/11/17)  
Dr. Rajiv Shrivastava (28/11/17)  
Dr. Anil Solanki (28/11/17)  
Dr. Shobha Shrivastava (28/11/17)  
Dr. Shobha Shrivastava (28/11/17)  
Dr. Shivendra Prasad Singh (28/11/17)  
Prof. & Head, Dept. of Zoology  
Govt. Autonomous P.G. College, Satna (M.P.)  
Chairman, Board of Studies, A.P.S. University, Now.





Department of Higher Education, Govt. of M.P.  
Under Graduate Semester wise Syllabus  
as recommended by Central Board of Studies in Zoology

उच्च शिक्षा विभाग, म.प्र. शासन  
स्नातक कक्षाओं के लिये समेस्टर अनुसार पाठ्यक्रम  
केन्द्रीय अध्ययन मण्डल प्राणीशास्त्र द्वारा अनुशंसित

Class / कक्षा	:	B.Sc.
Semester / समेस्टर	:	V
Subject / विषय	:	Zoology (प्राणीशास्त्र)
Title of Paper	:	Animal Physiology and Biochemistry
Max. Marks	:	85

**Unit I: Nutrition, Metabolism**

1. Physiology of digestion in mammals
2. Protein Metabolism: Deamination, Decarboxylation. Transamination of amino acids, and Ornithine cycle.
3. Carbohydrate metabolism- Glycogenesis, Glycogenolysis, glycolysis, The Citric acid cycle, Gluconeogenesis.
4. Lipid Metabolism-Beta oxidation of fatty acids.

**Unit II: Respiration Excretion and Immune System**

1. Mechanism and of respiration in mammals (transport of gases, chloride shift)..
2. Physiology of Excretion- urea and urine formation in mammals
3. Innate and acquired immunity, immune cells and lymphoid system, immune response: cellular and humoral

**Unit III: Regulatory Mechanisms and Enzymes**

1. Thermoregulation.
2. Definition and nomenclature of enzymes, classification of enzymes.
3. Mechanism of enzyme action.
4. Vitamins and Co-enzymes

**Unit IV: Neuromuscular Co- ordination**

1. Introduction to functional anatomy of human brain
2. Types of neurons and glial cells
3. Theory of muscle contraction and its biochemistry.
4. Physiology of nerve impulse conduction.

**Unit V: Endocrine system and Reproductive system**

1. Structure and functions of Pituitary Gland.
2. Structure and functions of Thyroid Gland.
3. Structure and functions of Adrenal Gland.
4. Structure and functions of Parathyroid, Thymus and Islets of langerhan's.
5. Physiology of Male reproductive organ and female reproductive organ.

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Under Graduate Semester wise Syllabus  
as recommended by Central Board of Studies in Zoology

उच्च शिक्षा विभाग; म.प्र. शासन  
स्नातक कक्षाओं के लिये समेस्टर अनुसार पाठ्यक्रम  
केन्द्रीय अध्ययन मण्डल प्राणीशास्त्र द्वारा अनुशंसित.

Class / कक्षा : B.Sc.  
Semester / समेस्टर V : Practical  
Subject / विषय : Zoology (प्राणीशास्त्र)

1. Detection of protein, carbohydrate and lipid.
2. Study of Human salivary enzyme activity in relation to pH.
3. Detection of nitrogenous waste products - Ammonia & Urea
4. Blood pressure measurements
5. Exercise on Haematology - Counting of RBC /WBC and Blood grouping in blood samples.
6. Estimation of Haemoglobin and sugar in blood samples.
7. Histological study of various endocrine glands -T. S. of Thyroid, T. S. of Pituitary gland ,  
T. S. of Adrenal gland , T. S. of Testis; T. S. of Ovary.
8. Histological study of Alimentary canal & various digestive organs - T.S of Stomach; T.S of  
Intestine ,T.S of Pancreas, and T. S. of liver.
9. Histological study of Visceral organs - T.S of Lungs, L.S. of Kidney
10. Histological study of Muscles - Striated, Unstriated & Cardiac muscle.

Distribution of Marks

Time 3 hours

Maximum Marks: 50

1. Spotting (10 Spots).
2. Biochemical tests
3. Physiological Experiment (RBC/WBC Count/ Blood Group / Hb)
4. Exercise on enzyme activity
4. Viva-Voce.
5. Practical Record and Collection.

Marks Allotted

20Marks  
05 Marks  
10 Marks  
05 Marks  
05 Marks  
05Marks

Total

50Marks

विभागाध्यक्ष  
प्राणीशास्त्र विभाग  
कमला सने कन्या स्ना. स्व. महाविद्यालय  
ग्वालियर (म.प्र.)

18/8/18

18/8/18

18/8/18

18/8/18

18/8/18

18/8/18

18/8/18

18/8/18

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18/8/18

Department of Higher Education, Govt. of M.P.  
Under Graduate Semester wise Syllabus  
as recommended by Central Board of Studies in Zoology

उच्च शिक्षा विभाग, म.प्र. शासन  
स्नातक कक्षाओं के लिये समेस्टर अनुसार पाठ्यक्रम  
केन्द्रीय अध्ययन मण्डल प्राणीशास्त्र द्वारा अनुशंसित

Class / कक्षा : B.Sc.  
Semester / समेस्टर : VI  
Subject / विषय : Zoology (प्राणीशास्त्र)  
Title of Paper : Ecology and Applied Zoology  
Max. Marks: 85

**Unit-I Concept of Ecology :**

1. Abiotic and biotic factors
2. Energy flow in ecosystem : Food chain and Food web
3. Biogeochemical cycle :  $CO_2$  N and P
4. Population Concept – Characteristics of population. Factors affecting Population growth, Pollution indicators.

**Unit-II Habitat Ecology.**

1. Fresh water . marine and terrestrial habitat
2. Ecological division of India.
3. Biodiversity : Natural resources and their conservation with special reference to forests.

**Unit-III Man and Environment**

1. Wild life conservation(Laws , National Parks and Sanctuaries of MP)
2. Endangered species of India.
3. Types of pollution : Air, water, soil, thermal and noise pollution.
4. Urbanisation and effect of human population on environment.

**Unit-IV Aquaculture**

1. Prawn culture: Culture of fresh water prawn , methods of prawn fishing , preservation and processing of prawns
2. Pearl culture and pear industry.
3. Frog culture: Breeding and selection.
4. Major carp culture : Management of ponds , preservation and processing of fishes.
5. Maintenance of Aquarium.

**Unit-V Economic Entomology**

1. Sericulture: Species of silkworm, life history of *Bombyx mori*; Sericulture Industry in India.
2. Apiculture – Life cycle of the species methods of bee keeping, products of bees, enemies of bees.
3. Lac culture: Lifecycle, and association with the host plant.
4. Common pests: Stored grains: *Sitophilus oryzae* and *Tribolium Castaneum*, Vegetable pest: *Piers brassicae* and *Dacus cucurbitae*.
5. Biological control of insect pests.

18/8/18  
विभागाध्यक्ष  
प्राणिसंस्त्र विभाग  
कमला राजे कल्या स्नातक स्व. महाविद्यालय  
म.प्र.

Department of Higher Education, Govt. of M.P.  
Under Graduate Semester wise Syllabus  
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उच्च शिक्षा विभाग, म.प्र. शासन  
स्नातक कक्षाओं के लिये समेस्टर अनुसार पाठ्यक्रम  
केन्द्रीय अध्ययन मण्डल प्राणीशास्त्र द्वारा अनुशंसित

Class / कक्षा : B.Sc.  
Semester / समेस्टर VI : Practical  
Subject / विषय : Zoology (प्राणीशास्त्र)

1. Study of fresh water, marine and terrestrial fauna
2. Water analysis- Dissolved Oxygen, Chloride, pH, hardness, turbidity, temperature
3. Pond ecosystem
4. Wild life: Endangered and threatened species
5. Study of specimen related to micro and mega evolution: Commensalism, symbiosis, mimicry, parasitism, colouration, etc.
6. Study of various fossils: Limulus, Latimera, Dinosaurs, Archaeopteryx
7. Models of ecosystem
8. Study of life cycles of animals of economic importance
9. Study of planktons
10. Study of pests

Distribution of Marks

Time 3 hours

Maximum Marks: 50

Marks Allotted

1. Physicochemical analysis of water bodies	10
2. Exercise based on applied zoology (life cycles)	05
3. Exercise based on museum keeping techniques	05
4. Spotting	16
5. Models of ecosystem	04
6. Viva	05
7. Recrd	05
Total	50

विभागाध्यक्ष  
प्राणिशास्त्र विभाग  
मा. क.स.ला. सं. स्व. महाविद्यालय  
ग्वालियर (संक्षि.)  
7/8/18  
8-8  
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## M.Sc In Zoology

### Course Codes And Titles

<u>First Semester</u>	<u>Second Semester</u>
ZOOL. 101: Structure & Function of Invertebrates	ZOOL.201: General & Comparative Animal Physiology
ZOOL. 102: Biostatistics, Bioinformatics & Research Methodology	ZOOL. 202: Biomolecules: Structure and function
ZOOL.103: Cellular and Molecular Biology	ZOOL.203: Population Ecology & Environmental Biology
ZOOL.104: Tools & Techniques for Biology	ZOOL.204: Biosystematics, Taxonomy & Evolution
ZOOL.105: Invertebrates, Quantitative Biology & bioinformatics ( Practical )	ZOOL.205: Physiology & Biochemistry ( Practical )
ZOOL.106: Molecular Cell Biology, Genetics & Tools & Techniques ( Practical )	ZOOL.206: Ecology, Environmental Biology, Systematics, Taxonomy & Evolution ( Practical )
<u>Third Semester</u>	<u>Fourth Semester</u>
ZOOL.301: Comparative Anatomy of Vertebrates	ZOOL. 401: Animal Behaviour
ZOOL.302: Developmental Biology	ZOOL. 402: Biology of Parasitism & Vertebrate Immune System
ZOOL.303 (A): Aquatic Ecology & Resources	ZOOL. 403(A): Fisheries & Pisciculture
ZOOL.304 (A): Fish Biology & Physiology	ZOOL. 404(A): Aquaculture
ZOOL.305: Vertebrates & genes & Differentiation ( Practical )	ZOOL.405: Animal Behaviour, Biology of Parasitism & Vertebrate Immune System ( Practical)
ZOOL.306 (A): Aquatic Ecology & Fish Biology ( Practical )	ZOOL. 406(A): Fisheries, Pisciculture & Aquaculture ( Practical )

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विभागाध्यक्ष  
प्राणिशास्त्र विभाग  
कमला राजे कन्या स्ना. स्व. महाविद्यालय  
ग्वालियर (म.प्र.)

## DETAILED SYLLABUS

### FIRST SEMESTER

#### ZOOL. 101: STRUCTURE AND FUNCTION OF INVERTEBRATES

##### UNIT - 1

1. Organization of coelom: Acoelomates, pseudocoelomates and coelomates
2. Protostomia and deuterostomia
3. Locomotion: Flagellar and ciliary movement in protozoa
4. Hydrostatic movement in Coelenterata, Annelida and Echinodermata

##### UNIT - 2

5. Patterns of feeding and Digestion in lower Metazoa
6. Filter feeding in polychaeta, Mollusca and Echinodermata
7. Organs of respiration : Gills Lungs and trachea
8. Respiratory pigments and their functions
9. Mechanism of respiration and transport of gases

##### UNIT - 3

10. Organs of excretion: Coelom, coelomoducts and Malpighian tubules
11. Mechanism of excretion in invertebrates
12. Primitive Nervous system of Coelenterates and Echinoderms
13. Advanced Nervous system of Annelida, Arthropoda (Crustacea and Insecta) and Mollusca (Cephalopoda)

##### UNIT - 4

14. Trends in neural evolution
15. Larval forms of crustacean, mollusca and Echinodermata
16. Larval forms of invertebrate parasites
17. Strategies and evolutionary significance of larval forms

##### UNIT - 5

18. Organization and general character of Rotifera
19. Organization and general characters of Acanthocephala
20. Organization and general characters of Ectoprocta
21. Organization and general characters of Endoprocta
22. Organization and general characters of Phoronida

##### Suggested Readings:

- Hyman, L.H. the Invertebrates, Vol - 1 Protozoa through Ctenophora. Mc Graw Hill Co. New York.  
Hyman, L.H. The Invertebrates, Vol - 2<sup>nd</sup> McGraw Hill Co. New York and London.  
Barnes, R.D. Invertebrate Zoology, 3<sup>rd</sup> edition W.B. Saunders Co. Philadelphia.  
Barrington B.J.W. Invertebrate structure and function, Thomas Neison and Sons Ltd. London.  
Sedgwick A.A. student Text Book of Zoology Vol. 1<sup>st</sup> 2<sup>nd</sup> and 3<sup>rd</sup> Central Book Depot, Allahabad.  
Parker T.J., Haswell, W.A. Text Book of Zoology, Macmillan Co. London.

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प्राणिशास्त्र विभाग  
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## ZOOL, 102: BIOSTATISTICS, BIOINFORMATICS AND RESEARCH METHODOLOGY

### UNIT - 1

1. DISTRIBUTION: Normal, Binomial and Poisson
2. Hypothesis testing
3. Student's t test
4. Chi Square test
5. The mean, mode, median, standard deviation and Standard error of classified Data

### UNIT - 2

6. Analysis of variance (one way and two way ANOVA)
7. Correlation
8. Regression
9. Graphic representation of data

### UNIT - 3

10. Computers and their application in biology
11. Operation system: DOS WINDOWS
12. Application software: MS Word, MS Access
13. MS Excel, MS Power Point
14. Internet and its uses

### UNIT - 4

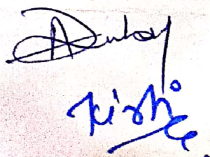
15. Bioinformatics: Definition, history and scope
16. Analysis of DNA and protein sequences: molecular and genomic database (e.g., GENE BANK, SWISS - PROT and other databases)
17. Introductory ideas on use of database for sequence retrieval, similarity search and sequence alignment; post transcriptional modification prediction
18. Bioinformatics in drug discovery

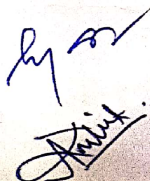
### UNIT - 5

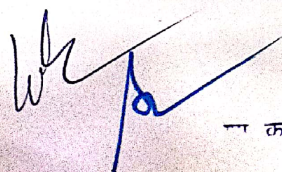
19. Research: definition and meaning of research problem.
20. Research design
21. Research methodology
22. Interpretation of research outcome and writing report.


#### Suggested Readings:

- Batschelet, E, Introduction to Mathematics for Life Scientists. Springer - Verlag, Berlin.
- Jorgenson, S.E. Fundamentals of Ecological Modelling. Elsevier, New York.
- Swartzman, G. Land S.P.O. Kaluzny: Ecological Simulation Primer, Macmillan, New York.
- Lendren D. Modelling in Behavioral Ecology. Chapman and Hall, London, UK.
- Sokal, R.R. and F.J. Rohlf. Biometry. Freeman, San Francisco.
- Snedecor, G.W. and W.G. Cochran. Statistical Methods Assisted East - West Press, New Delhi (Indian Ed.)
- Green R.H. Sampling, Design and Statistical Methods for Environmental Biologists.
- John Wiley & Sons, New York.
- Murray, J.D. Mathematical Biology Springer Verlag Berlin.
- Pielou, E.C. The Interpretation of Ecological Data: A Primer on Classification and Ordination.
- Kothari C.R, Research Methodology: Methods & Techniques, New Age Publ. New Delhi 2012
- De Saplo, Calculus for Biologists.
- Rubinov, S.I. Introduction to Mathematical Biology.
- Saxena, V.P. 'Jalv Ganit EK Parichaya' (M.P. Hindi Granth Academy).
- Brown, S.M. Bioinformatics - A Biologists Guide to Biocomputing and Internet, Eaton Publishing, New York, 2000.
- Lesk, A.M. Introduction to Bioinformatics. Oxford, 2002.
- Bioinformatics Methods and Protocols, In: Methods in Molecular Biology. Vol. 132. Human press, 2001.

  
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- Higging & Taylor. Bioinformatics – Sequence, Structure and Databanks Oxford, 2000.  
Baxevanis and Ouellette Bioinformatics John Wiley & Sons, 1998.  
Swindell Internat for the Molecular Biologists 3. Horizon Scientific, 1996.  
Peruski & Peruski. The internet & new Biology, ASM, 1997.  
Gibson, G. & S.V. Muse. A Primer of Genome Science. Sinauer. Associates Inc. Publishers, 2002.  
Krane and Raymer Fundamental Concept of Bioinformatics. Person Education, 2003.  
Awsthead, Parish and Twyman. Instant Notes: Bioinformatics, Viva Book Pvt. Ltd., 2003.  
Attwood and Parry – Smith. Introduction to Bioinformatics, Pearson Education, 2003.  
Rastogi S.C.et.al., Bioinformatics, Methods & applications. PHI Learning Pvt.Ltd., New Delhi

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## ZOOL, 103 CELLULAR AND MOLECULAR BIOLOGY

### UNIT - 1

1. Biomembrances: Structure of Membrane (Fluid mosaic model) , Molecular composition of the membrane, functional significance
2. Transport across cell membranes: Simple diffusion and osmosis, facilitated diffusion (Transporters, uniports and antiports carries, symports, Ion channels), Active transport, Membrane pumps, bulk transport (Endocytosis and Exocytosis)
3. Cytoskeleton: Microfilaments: structure dynamics and functions, Microtubules: structure dynamics and functions.
4. Intracellular transport: Axonal transport, Transport of pigment in melanophores: role of kinesin and dynein.

### UNIT - 2

5. Cell - cell adhesion and cell junctions : collagen and Non - collagen components of extracellular matrix of animal cells, Fibronectins and Integrins, cell adhesion proteins, their types.
6. Cell junctions (occluding, Anchoring & Gap Junctions)
7. Signal transduction mechanisms: Basic concept- (Intracellular and cell surface receptors, signal amplification, secondary messengers, signaling through G Protein coupled receptors (PKA, PKC), Enzyme linked receptor signaling (Growth factor receptor signaling, jax state pathway, Network and Crosstalk between different signaling mechanism, role of NO and CO in cell signalling.)
8. Apoptosis : Basic concept-

### UNIT - 3

9. Neurons: General organization of neurons classification of neurons
10. Glia: Structure & Types of Glia, Function of glia
11. Synapses: Ultra structure of a synapse , Types of Synapses, Synaptic transmission: Electrical & chemical, Functions of nerve fibers
12. Muscle contraction: Excitation - contraction coupling and Sarcoplasmic reticulum.

### UNIT - 4

13. Genome organization: Molecular organization of Gene Chromosomal organization of Gene
14. Organelle genome:: Structure and function of mitochondrial genome.
15. Gene mutation: induced mutations spontaneous mutations
16. DNA damage and repair: Types of DNA damage , Basic pathway of DNA repair ,

### UNIT - 5

17. Gene regulation in prokaryotes: DNA binding motifs, Lac operon, Tryptophan operon
18. Sex determination in Drosophila: Chromosomal basis, Molecular basis
19. Sex determination in mammals: Hormonal basis, Molecular basis
20. Basic Concepts of Dosage compensation in Drosophila, & mammals

#### Suggested Readings:

- Albert et. Al. Essential Cell Biology, Garland Publishing Inc., New York, 1998.  
Albert, D. Bray J. Lewis, M. Raff, K. Roberts and J.D. Watson. Molecular Biology of the cell, B. Garland Publishing Inc. New York, 2001.  
Boney. Cell Biology Level 2<sup>nd</sup>. Macdonald & Evans, 1982.  
Darnell, J.H. Lodish and D. Baltimore. Molecular cell biology. Scientific American Book, Inc., USA  
De Robertis & De Robertis. Cell and Molecular Biology. Lea & Febiger  
Gilbert Development Biology. Sinauer, 2000,  
Karp. Cell and Molecular Biology John Wiley & Sons, New York, 1996.  
Lodish et al. Molecular Cell Biology. Freeman & Co., 2000.  
Tobin and Morcel Asking about Cells Saunders, 1997.

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**ZOOL. 104: TOOLS AND TECHNIQUES FOR BIOLOGY****Unit - 1**

1. Microscopy, principle & application of : Light microscope, phase contrast microscope and fluorescence microscope
2. General principal and application of Electron microscope (TEM & SEM)
3. Principle and Application of Confocal microscopy
4. Cryotechniques : Cryopreservation of cells, tissues, organs and organism Freeze fracture & freeze drying

**UNIT - 2**

5. Principles and applications of photometry: Beer & Lambert's law, Absorption spectrum & absorption maxima
6. Colorimeter & spectrophotometer- working principles and applications
7. Flame photometer - working principles and applications
8. Atomic absorption spectrophotometer- working principles and applications

**UNIT - 3**

9. Separation techniques: Chromatography, principle, types and applications
10. Electrophoresis, principle, types & applications, PAGE and agarose gel electrophoresis
11. Radioisotopes in biology: units of radioactivity, Radioactive counters
12. Autoradiography

**UNIT - 4**

13. Techniques in immunodetection I : Immunocytochemistry & Immunohistochemistry ,,
14. Techniques in immunodetection II : Immunoblotting, and immunofluorescence
15. Histological techniques : principles and methods of perfusion, tissue fixation, Microtomy, cryotomy, and Histochemical staining: stereotaxy
16. Immunological techniques : Immunodiffusion and Immunoelectrophoresis

**UNIT - 5**

17. Cell culture techniques: Design and functioning of tissue culture laboratory, Culture media, essential components and preparation, Cell viability testing
18. Cytological techniques: Mitotic & Meiotic chromosome preparations from insects and vertebrates Chromosome banding techniques (G- C-, O-, R- banding etc.)
19. Molecular cytological techniques: In situ hybridization ( Radiolabelled & non - radiolabelled methods). FISH and Restriction banding
20. Molecular biology techniques: Southern hybridization and Northern hybridization DNA sequencing Polymerase chain reaction (PCR)

**Suggested Readings:**

- Bisen: Laboratory protocols in applied lifescience. CRC Press, 2014  
 Clark & Switzer. Experimental Biochemistry. Freeman, 2000.  
 Locquin and Langeron. Handbook of Microscopy, Butterwaths, 1983.  
 Boyer, Modern Experimental Biochemistry, Benjamin, 1993.  
 Frelfelder, physical Biochemistry, Freeman, 1982.  
 Wilson and Walker, Practical Biochemistry, Cambridge, 2000.  
 Cooper, The Cell A Molecular Approach ASM, 1997.  
 John R.W. Masters. Animal Cell culture A practical approach, IRL Press.  
 Rubert Braun, Introduction to instrumental analysis McGraw Hill Int. Ed. K. Willson & K. H. Goulding. A Biologist's Guide to principles & Techniques of practical Biochemistry. ELBS Ed.

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## LIST OF PRACTICAL EXERCISES FOR LABORATORY COURSE

### ZOOL. 105: INVERTEBRATES, QUANTITATIVE BIOLOGY & BIOINFORMATICS

- study of protozoa in living state and permanent mounting
- collection, preservation, staining, mounting and identification of different larvae, protozoans, sponges, coelenterates helminths, particularly the following:  
balantidium, opalina, nyctotherus, monocystis, euglena, paramaecium, plasmodium, vorticella, hydra, sponges rotifers, ascarsis, liverfluke etc.
- mounting and identification of whole mounts of invertebrates their structural parts like gills, radula, statocyst, tentorium, tympanum spiracles malpighian tubules salivary, glands of insects, sting apparatus of honey bee, nephridia and ovary of earthworm, etc .
- study of museum specimens of invertebrate animals
- dissection of the following animals for demonstration of various internal structures : starfish, echinus, pheretima, crab, squilla, grasshopper, cockroach, scorpion, mytilus, octopus, loligo, sepia, aplysia.
- study of permanent slides of invertebrate animal materials
- biostatistical problems: preparation of charts, diagrams (bar, histograms, pie , graphs, etc.), computation of mean, mode, median, standard deviation, standard error of classified data, chi square , t-test and ANOVA
- statistical analysis of field data
- computer applications in statistical problems
- constructing mathematical models for simple zoological activities
- solution and analysis of models
- case studies of biological populations

### SCHEME OF PRACTICAL EXAMINATION

1. Major dissection of organ system of invertebrate with display and diagram.	15
2. Biostatistical problem.	12
3. Exercise of computer application and bioinformatics.	12
4. Preparation of stained permanent mount of nonchordate material with diagram and identification.	06
5. Spotting (museum specimens -03, slide -03, mathematical models ( 02 ) computer applications -02).	25
6. Collection and preservation of specimen.	10
7. Viva voce.	10
8. Practical record.	10
<b>TOTAL MARKS</b>	<b>100</b>
<b>DURATION (HOURS)</b>	<b>06</b>

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**LIST OF PRACTICAL EXERCISES FOR LABORATORY COURSE**

**ZOOL, 106: MOLECULAR CELL BIOLOGY GENETICS AND TOOLS & TECHNIQUES**

1. Microtomy of invertebrate or vertebrate materials
2. Preparation of buffer solutions of defined ionic concentration and determination of pH
3. Absorption spectrum of coloured and colourless solutions using spectrophotometer and colorimeter
4. Separation and detection of dyes/amino acids/sugars using paper chromatography TLC
5. Study of permanent slides of cytology
6. Study of mitosis from onion root tips by making stained temporary squash preparation
7. Study of Meiosis from testicular tissue of grasshopper
8. Salivary gland squash preparation for the study of polytene chromosomes of *Drosophila*
9. Mammalian blood smear preparation for the study of drum stick sesa chromosome rat/ human
10. Study of Mendelian ratios from the seed coat color pattern of seeds (monohybrid ratio)
11. Collection of *Drosophila* for the study of morphological characters of Males and Females
12. Study of cellular ultrastructure by means of electron micrographs
13. Working and applications of tools: B- Counter, ELISA reader and association/spectrophotometer and image analyzer

**SCHEME OF PRACTICAL EXAMINATION**

S.No.	EXERCISE	MARKS
1.	Cytological/ molecular biological/ cytogenetic exercises.	12
2.	Microbiological/ genetics exercise.	12
3.	Determination of pH, preparation of buffer, colorimetric or spectrophotometric Exercises.	12
4.	Chromatographic separation (paper/thin layer) of biomolecules/ Working and applications of tools	12
5.	Spotting (cytological slides-3, immunological tools-2, microbiological preparations-1, electron micrographs-2).	24
6.	Microtomy : (a) Sectioning & stretching (b) staining & mounting.	08
7.	Viva voce.	10
8.	Practical record.	10
<b>TOTAL MARKS</b>		<b>100</b>
<b>DURATION (HOURS)</b>		<b>06</b>

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## SECOND SEMESTER:

### ZOOL.201: GENERAL AND COMPARATIVE ANIMAL PHYSIOLOGY

#### UNIT -I

1. Blood and circulation: Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, hemoglobin, immunity haemostasis.
2. Respiratory system: Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination.
3. Respiratory pigments through different phylogenetic groups.
4. Neutral and chemical regulation of respiration.

#### UNIT-II

5. Excretory system: Comparative physiology of excretion, kidney, urine, formation, urine concentration, waste elimination & micturition.
6. Regulation of water, balance, blood volume, blood pressure, electrolyte balance, acid-base balance.
7. Digestive system: Digestion, absorption, energy balance, BMR.
8. Thermoregulation: Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.

#### UNIT-III

9. Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissues.
10. ECG- its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.
11. Nervous system: Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.
12. Physiology of impulse transmission through nerves and synapse.

#### UNIT-IV

13. Comparative study of mechanoreception
14. Comparative study of photoreception
15. Comparative study of phonoreception
16. Comparative study of chemoreception

#### UNIT-V

17. Sense organs: Vision, hearing and tactile response.
18. Stress and adaptation.
19. Endocrinology and reproduction: Endocrine glands, basic mechanism of hormone action, hormones and diseases: reproductive processes.
20. Neuroendocrine regulation of Hormones, their classification and chemical nature.

#### Suggested Readings:

- Prosser, C.L. *Comparative animal physiology*. W.B. Saunders and Co.  
Eckert, R. *Animal physiology- Mechanisms and adaptation*. W.H. Freeman and Co.  
Hoar, W.S. *General and Comparative Animal physiology*.  
Schemdt-Neilsen. *Animal Physiology: Adaptation and Environment*. Cambridge Prosser, C.L. *Environmental and Metabolic Physiology*. Wiley-Liss, New York

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## ZOOL. 202: BIOMOLECULES, STRUCTURE & FUNCTIONS

1. Primary, secondary, tertiary and quaternary structures of proteins
2. Protein folding and denaturation
3. DNA: Double helical structure of DNA: Replication & Recombination
4. RNA: Types and Structure of RNA; Cellular functions of different RNAs

### UNIT-II

5. Basic concept of metabolism: Coupled and interconnecting reactions of metabolism, cellular energy resources and ATP synthesis
6. Glycolysis and glyconeogenesis
7. Citric acid cycle: Oxide phosphorylation
8. Pentose Phosphate Pathway and Glyconeogenesis.

### UNIT-III

9. Functional importance of lipid storage & membrane lipids; lipid storage diseases
10. Fatty acid metabolism: Synthesis and degradation of fatty acids
11. Protein Synthesis
12. Bile Composition and functions: bile dysfunction associated diseases

### UNIT-IV

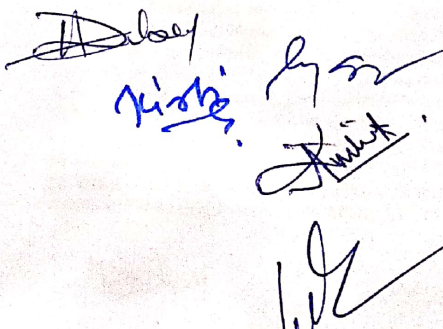
13. RNA synthesis and splicing
14. Biosynthesis of amino acids
15. Biosynthesis of nucleotides
16. Biosynthesis of membrane lipids and steroids.

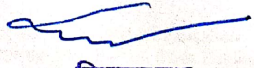
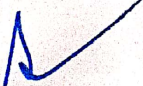
### UNIT-V

17. Enzymes: Basic concepts and kinetics
18. Mechanism and Regulation of enzyme catalysis
19. Concept of free energy and thermodynamic principles in biology
20. Energy rich bonds, compounds and biological energy transducers

### Suggested Readings:

- Voet, D. and J.G. Voet. Biochemistry. John Wiley & sons  
Freifelder, D. Physical Biochemistry. W.H. Freeman & Co.  
Segal, I.H. Biochemical Calculations. John Wiley and Sons  
Creighton, T.E. Protein Structure and Molecular Properties. W.H. Freeman & Co.  
Freifelder, D. Essentials of Molecular Biology.  
Cooper, T.G. Tools of Biochemistry.  
Hawk. Practical Physiological Chemistry.  
Garret, R.H. and C.M. Grisham: Biochemistry. Saunders College Publishers.



  
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## ZOOL. 204: BIOSYSTEMATICS, TAXANOMY AND EVOLUTION

### UNIT-I

1. Definition and basic concepts of biosystematics and taxonomy
2. Trends in biosystematics: Chemotaxonomy, cytotaxonomy and molecular taxonomy
3. Dimensions of speciation and taxonomic characters
4. Species concept: Different species concepts

### UNIT-II

5. Species category, sub-species and other infra-specific categories
6. Theories of biological classification
7. Taxonomic categories & Hierarchy of categories
8. Taxonomic characters: Different kinds, origin of reproductive isolation, biological mechanism of genetic incompatibility

### UNIT-III

9. Taxonomic procedures: Taxonomic collections, preservation, curation, process of identification
10. Taxonomic keys: Different kinds of keys, their merits and demerits
11. International code of Zoological nomenclature (ICZN): Operative principles interpretation & application of important rules formation of scientific names of taxa
12. Concepts of evolution and theories of organic evolution

### UNIT-IV

13. Neo-Darwinism and population genetics: Hardy-Weinberg Law of genetic equilibrium: Gene frequency and the destabilizing forces (natural selection, mutation, genetic drift, migration & meiotic drive)
14. Molecular population genetics, Pattern of changes in nucleotide and amino acid sequences Ecological significance of molecular variations (genetic polymorphism)
15. Speciation: Patterns and mechanisms of reproductive isolation: Modes of speciation: Allopatry & Sympatry
16. Zoo-geological time scale

### UNIT-V

17. Trends in evolution
18. Molecular evolution: Gene evolution of gene families
19. Molecular phylogenetics: Construction of phylogenetic tree, Amino acid sequences and phylogeny
20. Nucleic acid phylogeny: DNA-DNA hybridization, restriction enzyme sites, nucleotide sequence comparison and homologies

#### Suggested Readings:

- Kato, M. The Biology of Biodiversity, Springer  
Avice, J.C. Molecular Markers, Natural History and Evolution. Chapman & Hall, New York  
Wilson, E.O. Biodiversity, Academic Press, Washington  
Simpson, G.G. Principle of Animal Taxonomy, Oxford IBH Publishing Company  
Mayr, E. Elements of Taxonomy  
Wilson, E.O. The Diversity of Life (College Edition) W.W. Northerm & Co.  
Tikadar, B.K. Threatened Animals of India, ZSI Publication, Calcutta  
Dobzhansky, Th. Genetics and Origin of Species. Columbia University, Press  
Dobzhansky, Th. F.J. Ayala G.L. Stebbins and J.M. Valentine Evolution. Surjeet Publication Delhi  
Futuryama, D.J. Evolutionary Biology. Suinuaer Associates. INC Publishers. Dunderland  
Jha, A.P. Genes and Evolution, John Publication, New Delhi  
Merrel, D.J. Evolution and Genetics. Holt, Rinchart and Winston, Inc  
Strikberger, M.W. Jones and Bartett Publisher, Boston London

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**LIST OF PRACTICAL EXERCISES FOR LABORATORY COURSE****ZOOL- 205: PHYSIOLOGY AND BIOCHEMISTRY**

- Detection of carbohydrates, proteins and lipids in the given sample
- Demonstration of salivary digestion
- Demonstration of gastric pancreatic digestion
- Demonstration of pancreatic digestion
- Detection of urea, uric acid, ammonia in the given sample
- Counting of red blood corpuscles in the blood of rat or man
- Counting of white blood corpuscles in the blood of rat or man
- Determination of haemoglobin percentage in the blood of rat or man
- Detection of blood groups and Rh factor in rat or man
- Determination of rate of respiration in an insect, mammal or fish
- Determination of blood clotting time
- Preparation of haemin crystals
- Determination of Erythrocyte sedimentation rate (ESR)
- Separation of Serum and tissue protein with the help of electrophoresis
- Demonstration of reflex action
- Quantitative determination of biological parameters (protein, cholesterol and blood sugar, RNA and DNA etc.) with the help of colorimeter

**SCHEME OF PRACTICAL EXAMINATION**

1. Experiment on hematological parameter (Three)	30
2. Experiment on biochemical parameter (Two)	20
3. Qualitative enzymatic assay	10
4. Quantitative assay of a biochemical parameter (Two)	20
5. Viva voce	10
6. Practical record	10
<b>TOTAL MARKS</b>	<b>100</b>
<b>DURATION (HOURS)</b>	<b>06</b>

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## THIRD SEMESTER:

### ZOOL/ 301: COMPARATIVE ANATOMY OF VERTEBRATES

#### UNIT-I

1. Origin of chordata: Concept of Protochordata
2. Origin and classification of vertebrates
3. Vertebrate morphology: Definition, scope and importance
4. Development, structure and functions of vertebrate integument and its derivatives (glands, scales, features and hairs)

#### UNIT-II

5. Respiratory system: Characters of respiratory tissue, external and internal respiration, comparative account of respiratory organs
6. Evolution of heart
7. Evolution of aortic arches and portal systems
8. Blood circulation in various vertebrate groups

#### UNIT-III

9. Form, function, body size and skeletal elements of the body
10. Comparative account of law suspensorium and vertebral column
11. Comparative account of limbs and girdles
12. Evolution of urinogenital system in vertebrates

#### UNIT-IV

13. Comparative account of organs of olfaction and taste
14. Comparative anatomy of brain and spinal cord (CNS)
15. Comparative account of peripheral and autonomic nervous system
16. Comparative account of lateral line system

#### UNIT-V

17. Comparative account of electroreception
18. Comparative account of simple receptors
19. Flight adaptation in vertebrates
20. Aquatic adaptations in birds and mammals

#### Suggested Readings:

- Young, J.Z. life of vertebrates, oxford University Press, London  
Young, J.Z. Life of mammals. Oxford University Press, London  
Colbert, E.H. Evolution of the vertebrates. John Wiley and Sons Inc. New York.  
Kent, C.J. Comparative Anatomy of Vertebrates.  
Wostenholmg, E.W. and knight, J. (ED.) Taste and Smell in Vertebrates. J& A Churehill, London  
Walters, H.A. and Sayles. L.D. Biology of Vertebrates, Macmillon & Co, New York.  
Montagna, W. Comparative Anatomy, Clarendon Press, Oxford.  
Welchert, C.K. and Presch, W. Elements of Chordate Anatomy. 4th edn. McGraw Hill Book Co., New York.

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ग्वालियर (म.प्र.)

**LIST OF PRACTICAL EXERCISES FOR LABORATORY COURSES**

**ZOOL- 206: ECOLOGY, ENVIRONMENTAL PHYSIOLOGY, SYSTEMATICS, TAXONOMY AND EVOLUTIONS**

- Water analysis for dissolved oxygen, free carbon-dioxide, chloride, pH, hardness and alkalinity
- Determination and classification of soil, gravel, coarse and fine sands, clay, sand, clayloam, loam, chalky and peaty
- Ecological niche: A habitat study
- Animal association and communities
- Population dispersion
- Identification and classification of important invertebrate groups
- Techniques of collection and preservation, mounting & display, indexing
- Structural adaptation of ecological significance
- Study of evolutionary trends through models etc.
- Problem related to evolution, population genetics etc. (natural selection, adaptation, trends of evolution, genetic polymorphism etc.)
- Preparation of phylogenetic tree using molecular data
- Toxicity tests: LC50/LD50

**SCHEME OF PRACTICAL EXAMINATION**

1. Experiments of environmental biology/habitat study / community study ( 2 )	20
2. Animal associations / Ecological adaptation (2)	10
3. Problems related to evolution (2)	20
4. Methods of collection, Preservation and identification of invertebrate / vertebrate animals with comments ( 5 animals)	20
5. Mounting and display of two animals ( invertebrates and vertebrates )	10
6. Viva voce	10
7. Practical record	10
<b>TOTAL MARKS</b>	<b>100</b>

**TOTAL MARKS**

**DURATION (HOURS)**

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## ZOOL/ 302: DEVELOPMENTAL BIOLOGY

### UNIT-I

1. Basis concepts of Development: Cell division and the cell cycle, Chromosomal puffs and gene activation, cell commitment and differentiation (Specification, determination, induction competence, differentiation),
2. Morphogen gradients, cell fate, cell potency and morphogenesis
3. Gametogenesis: Origin and migration of primordial germ cells, 2.2 Production of male gametes (Spermatogenesis), 2.3 Gene expression during spermatogenesis and sperm maturation,
4. Production of female gametes (oogenesis) (Pretellogenesis, vitellogenesis and maturation phase in development of amphibian egg), Gene expression during amphibian oogenesis, Ovulation and ovum transport in mammals

### UNIT-II

5. Fertilization and early development: Pre fertilization events (sperm penetration of egg and acrosomal reaction, binding of sperm to the egg, Blocks to polyspermy), Biochemistry of fertilization (metabolic activation of egg, penetration of spermatozoa into the egg, union of gametes), Post- fertilization events
6. Establishment of polarity in amphibians and birds
7. Gastrulation and formation of germ layers in animals
8. Multiple ovulation and embryo transfer technology: In vitro oocyte maturation and super ovulation

### UNIT-III

9. Hormonal regulation of ovulation, pregnancy and parturition
10. Hormonal regulation of development of mammary glands and lactation
11. Endocrinology and physiology of placenta
12. Collection and cryo preservation of gametes and embryos

### UNIT-IV

13. Teratological effects of xenobiotics on gametes
14. Wolfian lens regeneration
15. Melanogenesis
16. Differentiation and development of gonads

### UNIT-V

17. Cell diversification in early embryos, xenopus blastomeres, totipotency & pleuipotency
18. Embryonic stem cells, chord-blood cells & their significance
19. Hemopoetic stem cells, formation of blood cells, Stem cells technology
20. Connective tissue cell family

### Suggested Readings:

- Gilbert, S.F. Developmental Biology, Sinauer Associated Inc, Massachusetts.  
Ethan Bier. The Cold Spring. The cold Spring Harbor Laboratory Press, New York  
Balinsky, B.J. Introduction to Embryology. Saunders, Philadelphia.  
Berril, N.J. and karp, G. Development Biology. McGraw Hill, New York  
Davidson, E.H. Gene Activity During Early Development. Academic press, New York.

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**COURSES FOR SPECIAL (ELECTIVE) GROUPS:**

**A. AQUATIC BIOLOGY AND AQUACULTURE**

**ZOOL. 303 (A) AQUATIC ECOLOGY & RESOURCES**

**UNIT-I**

1. Aquatic ecology: Science and its development
2. Origin and classification of wetlands including lakes
3. Morphology of lakes, reservoirs and ponds
4. Physical chemical and biological characteristics of marine environment

**UNIT-II**

5. Estuaries and other brackish water environments in India and their faunal importance
6. Physical and chemical characteristics of lakes, ponds and rivers
7. Freshwater biota: Plankton, benthos and macrophytes
8. Food chain, food web, trophic levels and energy flow

**UNIT-III**

9. Primary productivity in Inland water and method of its determination
10. Degradation of wetland in India and control measures
11. Aquatic resources: Invertebrates and vertebrates
12. Importance and management of aquatic resources in India

**UNIT-IV**

13. Migration pattern of aquatic animals including aquatic birds
14. Threatened wetlands and endangered aquatic species
15. Aquatic wild life: Habitat and its importance, composition and conservation strategies
16. Aquatic pollution, its causes and control measures

**UNIT-V**

17. Major sources of pollution in rivers and remedies
18. Biological indicators of water pollution
19. Eutrophication, its impact on water bodies and control measures
20. Aquatic toxicology: Aquatic toxicity, long-term toxicity and chronic toxicity

**Suggested Readings:**

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## ZOOL. 304 (A): FISH BIOLOGY & PHYSIOLOGY

### UNIT-I

1. Structure and functions of skin and scales, significance of scales in taxonomy
2. Chromatophores: Classification, ultrastructure and functional significance
3. Origin of paired fins and modification of caudal fin
4. Respiratory organs including accessory respiratory organs and respiration in fish

### UNIT-II

5. Swim bladder and its functional significance
6. Food, feeding habits and nutrition in fish
7. Digestive system and physiology of digestion in fish
8. Osmoregulatory organs and osmoregulatory mechanisms in fish

### UNIT-III

9. Brain of fishes and its functional organization in relation to ecological conditions
10. Lateral line system: Structure, modifications and functional significance
11. Electric organs and their significance
12. Bioluminescence in fish and its significance
13. Chemical communication in fish

### UNIT-IV

14. Neuro-endocrine integration and hypothalamo-hypophysial system in fish
15. Anatomy and physiology of pituitary gland
16. Anatomy and physiology of thyroid gland
17. Pineal organ, internal gland and caudal neurosecretory system

### UNIT-V

18. Seasonal cycles of gonads in Indian fish
19. Hormonal and endocrine control of reproduction in fish
20. Development of teleost fish
21. Parental care in fish

### Suggested Readings:

Brown, M.E. The Physiology of Fishes, Vol. I & II. Academic Press, New York  
Lager, K.F. Bardach, J.E. Miller, R.R. and Passino, D.R.m. Ichthyology, John Wiley & Sons, New York  
Hoar and Randall. Fish Physiology Vo.1- 16. Academic Press, New York  
Nikolsky, G.V. The Ecology of Fishes. Academic Press, New York.

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## LIST OF PRACTICAL EXERCISES FOR LABORATORY COURSE

### ZOOL. 305: VERTEBRATES AND GENES, DEVELOPMENT & DIFFERENTIATION

(USE OF ANIMALS FOR DISSECTIONS TO BE RESTRICTED TO APPROVABLE SPECIES ONLY, ETHICAL COMMITTEES TO BE ESTABLISHED AND MADE FUNCTIONAL AS PER UGC NOTIFICATION PLEASE)

- Classification of lower chordates and study of representatives of various groups
- Dissection of different organ systems of the following animals: Hardmania, Amphioxus, Bony fish and frog or toad
- Minor dissection and stained preparations from lower chordate animals
- Study of disarticulated skeleton of dog fish, bony fish and amphibians
- Study of permanent slides of Urochordata, Cephalochordata elasmobranchs and amphibians
- Classification of Chordata and study of representatives of various groups
- Dissection of different organ system of the following animals: snake, Hemidactylus, Calotes, rat etc.
- Minor dissection and stained preparation from above mentioned animals
- Study of disarticulated skeleton of various vertebrates
- Study of permanent slides of chordate materials
- Study of important characters of poisonous & non-poisonous snakes and their biting apparatus
- Study of migratory and resident birds
- Study of animals of zoo including mammals
- Study of development of eggs of fish, frog, hen and invertebrates
- Study of distribution of RNA in developing eggs
- Study of effects of chemicals and temperature on developing eggs, polyploidy, aneuploidy
- Determination of respiratory rates of eggs
- Study of electron micrographs of spermatogenesis and oogenesis
- Study of permanent slides of chick and frog gonads and embryology

### SCHEME OF PRACTICAL EXAMINATION

1. Dissection of organ-systems and display with diagram of cartilagenous fish, bony fish, house lizard, garden lizard, pigeon or rat
2. Mounting of chordate material/ Minor dissection with diagram (Hardmania, Amphioxus and other chordate material)
3. Preparation and mounting of developmental stages of frog, chick or any other suitable animal
4. Spotting (bones-2, slides-2, museum specimens-2, embryological slides-2, electron micrographs-2)
5. Exercise based on poisonous & non-poisonous snakes/Migratory and resident birds/zoo animals
6. Viva voce
7. Practical record

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**TOTAL MARKS**

**DURATION (HOURS)**

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**LIST OF PRACTICAL EXERCISES FOR LABORATORY COURSE****ZOOL. 306 (A) AQUATIC ECOLOGY & FISH BIOLOGY**

- Analysis of water samples for physic-chemical and biological characteristics, including water depth, transparency turbidity, temperature, nutrients (Phosphates, silicates), BOD, and COD and plankton
- Estimation of primary productivity by light and dark bottle experiment
- Macrobenthic fauna and its estimation
- Preparation of permanent mounts of planktonic organisms
- Physico-chemical analysis of soil of fish pond
- Field studies or river, stream and reservoir ecosystem, wetland sanctuaries and proofs
- Microtomy of fish and shell fish material: block making, sectioning and training
- Histology and histopathology of fish tissues
- Anatomy of fish, sexual dimorphism in carp and other fish
- Dissection of cranial nerves of catfishes and carps
- Gills and accessory respiratory organs of fishes
- Alimentary canals of carps, catfishes and murrels
- Biochemical estimation of fish constituents
- Acute toxicity determination for freshwater fish
- Experiments on fish behavior
- Age determination with the help of scales and other materials

**SCHEME OF PRACTICAL EXAMINATION**

1. Dissection of cranial nerves of Wallago/ mystus / Labeo/Torpedo	24
2. Minor dissection of fish anatomy/ alimentary canal/ accessory respiratory organs/ age determination/ maturity stages/pigeatary behavior	12
3. Estimation of physic-chemical characteristics of water/ soil nutrient	10
4. Analysis/ Primary productivity/ identification of benthic/ planttonic organisms/ toxicity Test	10
5. Spotting (histological/ histopathological slides-3, specimen-3, bones-2	24
6. Viva voce	10
7. Practical record / submission of charts / models / collection etc.	10
<b>TOTAL MARKS</b>	<b>100</b>
<b>DURATION (HOURS)</b>	<b>06</b>

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## FOURTH SEMESTER

### ZOOL, 401: ANIMAL BEHAVIOUR

#### UNIT-I

1. Introduction: Ethology as a branch of biology and animal psychology.
2. Classification of behavioral patterns, analysis of behavior (ethogram)
3. Reflexes and complex behavior
4. Perception of the environment: mechanical, electrical, chemical, olfactory, auditory and visual

#### UNIT-II

5. Evolution and ultimate causation: Inheritance behavior and relationships
6. Motivation: Drive, timing and Interaction of drivers, physiological basis of motivation, hormones and motivation, aggregation
7. Communication: Chemical, visual, light and audio, evolution of language
8. Ecological aspects of behavior: Habitat selection, food selection, optimal foraging theory, anti-predator defenses, aggression

#### UNIT-III

9. Homing, Behaviour, dispersal, host-parasite relations
10. Biological rhythms: Circadian rhythms
11. Orientation and navigation, migration of fishes, turtles and birds.
12. Learning and memory: Conditioning, habituation, insight learning, association learning, reasoning

#### UNIT-IV

13. Reproductive behavior, Evolution of sex and reproductive strategies, mating systems, courtship, sexual selection, parental care
14. Social behavior, aggregation, schooling in fishes, flocking in birds, herding in mammals, group selection, kin selection, altruism, reciprocal altruism, inclusive fitness
15. Social organization in insects
16. Social Organization in primates.

#### UNIT-V

17. Neural and Hormonal control of behavior
18. Genetic and environmental components in the development of behaviour
19. Bioluminescence
20. Electric organs and behavior

#### Suggested Readings:

- Esbt.Libesteldt, L. Ethology The biology of Behaviour Holt, Rinehart & Winston, New York  
Gould, J.L. The mechanism and Evolving of Behaviour  
Kerbs, J.R. and N.B. davis : Behaviourable Ecology Blackwell, Oxford, U.K.  
Hinde, R.A. Animal Behaviour: A synthesis of Ethology and Comparative Psychology  
McGraw Hill, New York  
Alcock, J. I. Animal Behaviour An Evolutionary approach, Sinauer Assoc. Sunderland, Massachsets U.S.A  
Bradbury, J.W. and S.I. Vehneatp, Principles of Animal Communication, Sinauer Assoc. Sunderland, Massachsots, U.S.A  
Kandel. ER, Schwantz, J.H. and Jessell, T.M.: Principles of Neural Science McGraw Hill, New York  
Brown A.G. Nerve cells and Nervous systems Narosa Publishing house, Delhi.  
Mishra: Clinical Neuro- physiology, Clurebell I. livingstone

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## ZOOL, 402: BIOLOGY OF PARASITISM AND VERTEBRATE IMMUNE SYSTEM

### UNIT-I

1. Parasitism: Concept, origin, evolution, advantages and disadvantages in the parasitic life
2. Modes of parasitic invasion: Passive, mechanical, active, contact, transovarial pathways of entry and sites of habitation
3. Host specificity: Definition, origin, types, structural, physiological & pathological response, tissue, ecological and phylogenetic response
4. Host-parasite system: Effects of parasites on hosts (mechanical, nutritional, destructive, toxic etc.)

### UNIT-II

5. Host reactions to parasites: Resistance, compatibility and immunity
6. Innate and acquired immunity
7. Cells of immune system and their differentiation
8. Nature of immune response: Antigenicity and immunogenicity, factors influencing immunogenicity, epitopes and haptens

### UNIT-III

9. Structure and functions of antibodies: Classes and subclasses, gross and fine structure, antibody mediated effector functions
10. Antigen-antibody Interactions: Antibody affinity and avidity, gross reactivity, agglutination
11. Major histocompatibility complex in mouse and HLA system in human: MHC haplotypes, class-I and class-II molecules, cellular distribution, peptide binding, expression and diversity, disease susceptibility and MHC/HLA
12. T-cell receptors: Isolation, molecular components and structure, T-cell maturation and thymus, T-cell activation mechanism, T-cell differentiation, cell death and T-cell population

### UNIT-IV

13. B-cell generation, activation and differentiation: B-cell receptors, selection of immature and self reactive B-cells, B-cell activation and proliferation, T-B-cell interactions, humoral immune response and kinetics
14. Cytokines: Structures and functions, cytokine receptor, cytokines and immune response
15. Complement system: Component activation & biological consequences
16. Cell-mediated effector functions: Cell adhesion molecules, effector cells and molecules, CTL and NK cells- mechanisms of action, delayed type hypersensitivity

### UNIT-V

17. Immune response to infectious diseases: Immune response to viral, bacterial, protozoan and other parasitic worms
18. Vaccines: Types of vaccines, active and passive immunization
19. Immunodeficiency disorders: Primary immunodeficiencies, secondary or acquired immunodeficiencies (AIDS)
20. Transplantation: Immunological basis of graft rejection, general and specific immunosuppressive therapy

### Suggested Readings:

- Chandler, A.C. and C.P. Ruad Introduction to Parasitology. Wiley Eastern, New Delhi  
Croll, N.A. Ecology of Parasites. Heinmann, London]  
Dogiel, V.A. General Parasitology, Oliver and Hoyd, Edinburgh, London  
Jones, A.W. Introduction to Parasitology. Addison-Wesley Reading, Mass  
Kuley, Immunology. W.H. Freeman, U.S.A  
Paul, W, Fundamentals of Immunology  
Rott, L.M. Essential Immunology. ELHS edition

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→ कन्या स्ना. स्व. महाविद्यालय

**COURSES FOR SPECIAL. (ELECTIVE) GROUPS:**  
**A. AQUATIC BIOLOGY AND AQUACULTURE**

**ZOOL, 403 (A) FISHERIES AND PISCICULTURE**

**UNIT-I**

1. Classification of commercially important fish fishes and shell fishes and their significance
2. Fishes and shell fishes of Madhya Pradesh
3. Reservoir and lake fisheries (with emphasis on Tighra reservoir)
4. Reverine fisheries
5. Estuarine and brackets water fisheries

**UNIT-II**

6. Marine fisheries of India
7. Environmental factors ( a biotic and biotic) in relation to life of fishes
8. Exotic fishes larvicidal fishes and their signigicance
9. Common parasites of fishes, fish diseases, their control and treatment
10. Economical importance of fishes and their by-products

**UNIT-III**

11. Cultivable species of inland fishes and principle of their selection
12. Predatory fishes and their importance in fish culture
13. Plankton and their importance in fish culture
14. Fish ponds and their hydrobiological requirements
15. Principles of genetics, hybridization and sex determination in fish

**UNIT-IV**

16. Transgenic, fish, formation and importance
17. Traditional verses modern fish culture practices
18. Paddy corn fish culture and its significance
19. Sewage fish culture and its importance
20. Fish net, gears and method of fishing

**UNIT-V**

21. Fish preservation technology and packing
22. Marketing of fishes and role of co-operative societies
23. Fisheries and rural development
24. Fisheries leglstation
25. Fisheries development in Madhya Pradesh

Suggested Readings:

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## ZOOL, 404 (A): AQUACULTURE

### UNIT-I

1. Identification of stages of life histories of important cultivable fishes and prawn
2. Natural breeding, bundh breeding and Induced breeding of carps though hypophysation and drugs
3. Planning and designing of freshwater fish farms
4. Management of rearing, nursery and stocking ponds

### UNIT-II

5. Transport of live fish and fish seed
6. Planning and management of brackish-water fish farms
7. Nutritional requirements of fish and artificial diet
8. Freshwater aquaculture, Prospectus and management
9. Methods of aquaculture: Pen culture ,Cage culture,bottom and off bottom culture

### UNIT-III

10. Integrated fish farming in India: Agriculture corn fishery, trapa-cum-fishery, poultry.cum-fishery, puffery cum fishery, poultry-piggery-fishes
11. Economical aspect of fish culture management
12. Freshwater prawn culture practice in India
13. Brackish water prawn culture development in India

### UNIT-IV

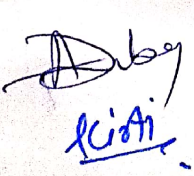
14. Prospects and development of mariculture: Pearl culture mussel culture and oyster culture
15. Frog culture: Species Breeding, Culture, and polyculture with fish
16. Culture of freshwater macrophytes (Azolla) and algae (Spirulina)
17. Prospectus and development of turtle fishery

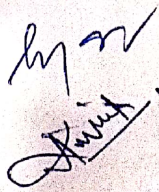
### UNIT-V

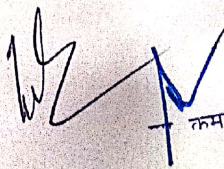
18. Breeding and rearing of crocodiles, crocodile industry: Indian and International,Perspective
19. Production of Jayanti culture of fresh water oyster for pearls, and sea weed culture
20. Whaling industry: Sustainable utilization
21. Major aquatic resources: Export and economic status in India

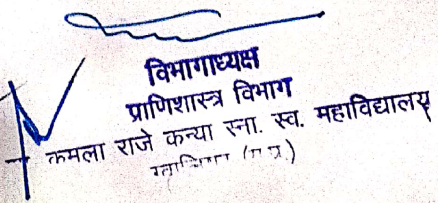
### Suggested Readings:

- Brown, m.e. the physiology of fishes Vol. I & II. Academic Press.  
Lagier, K.F. J.F. Radach, R.R, Miller and D.R.M. Pasino. Ichthyology, John Wiley & Sons. New York  
hoar and Radndall Fish Physiology Vol-16. Academic Press  
Nikosky, G.V. The Ecology of fishes, Academic Press  
Day , I. The Fishes of India . Vol. I & II , William Dawson & Sons Ltd. London  
Khanna,S.S. and singh H.R. Fish biology and fisheries Narendra Pub. House Delhi  
Udwas S.P. Fundamental of technology, Narendra Pub. House, Delhi  
Srivastva, C.B.I Fishery science and fisheries kitah Mahai.  
Clary, M.R. and Sara, R.P. Fundamental of Aquatic Texcology. Hemisphere Pub. Corp.  
Shanna, B.K. and kaur, H. Water Pollution cluel Pub. House  
Sasnthanam, R. Ramanathan, N. and legatheman G.Coastal Aquaculture in India CBS Pub.  
Hynes , H.B.N. The Ecology of hunning water Liverpool Uni Press  
Chokrahorty, C. and Sadhu, A.K. Biology Hatchery and Culture Technology of Tiger prawn and gial freshwater Prawn Daya Pub. House,Delhi  
Saxena, A. Text book of Crustacca Discovery Pub. House.  
Wetzel, R.G. Limnology Lake and Resevoire ecosystem Academe Press

  
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**LIST OF PRACTICAL EXERCISES FOR LABORATORY COURSE****ZOOL, 405: ANIMAL BEHAVIOUR, BIOLOGY OF PARASITISM & VERTEBRATE IMMUNE SYSTEM**

- Experiments on animals behavior:
  - Exploratory behavior in rats/ mice
  - Parental care in rats / mice
  - Burrowing behavior of blowfly larvae
  - Phototactic behavior of blowfly larvae
  - Burrowing & geoncgative behavior of earthworms
  - Borrowing behavior of turtles
  - Cireadian rhythmicity in foraging behavior of honeybees
  - T. .Mare, Y. Mare
- Blood film preparation and identification of cells
- Study of Protozoan and helminth parasites, parasitic adaptation in animals, Parasitic invasions, host-parastic interactions
- Lymphoid organs & their microscope organization
- Study of antigen-antibody interaction
- Immunodiffusion
- Immunoehctrophoresis
- ELISA
- Immunocytochemistry
- Immunodiagnosis (demonstration using commercial kits)

**SCHEME OF PRACTICAL EXAMINATION**

1. Immunological experiments (immunodiffusion / immunoelectrophoresis)	10
2. Immuneytochemistry/ ELISA	10
3. Experiments on animal behavior (02)	20
4. Identification & comments upon & spots ( parasitic adaptation in protozoans, Heliminthes & other animals, parasites invasion, host-parasite interaction & animal behavior)	30
5. Blood film preparation and identification of cells	10
6. Viva voce	10
7. Practical record	10
<b>TOTAL MARKS</b>	<b>100</b>
<b>DURATION ( HOURS )</b>	<b>06</b>

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## LIST OF PRACTICAL EXERCISES FOR LABORATORY COURSE

### ZOOL, 406 (A) :- FISHERIES AND PISCICULTURE & AQUNCULTURE

- Identification of freshwater fishes, amphibions, reptiles and mammals
- Identification of Common weeds, predator fishes and harmful insects
- Maintenance of fish and other aquatic animals in the laboratory
- Biometric observation of prawns, fishes, frogs, turtles and crocodile
- Estimation of length-weight relationship and condition factor of fish
- Determination of fecundity, ova diameter and maturity stages of fishes, prawns, frogs
- Methods of included breeding of fish through hypohysation, collection, preparation and preservation of pituitary extract, close determination and techniques of administration
- Crafts and gears used in inland capture fisheries
- Experimental culture of phyto – and zooplanktons
- Sampling equipments of water planktd and bethic oraganisms
- Statistical procdure in fishery sclene
- Survey of local fish farm, visit to fish seed production and fish culture UNIT in Gwalior, Datia, Dabra, morena and shivpuri
- Visit to fish landing centre, fish markets and study of fishing operations, preservation, packing and transport
- Visit to national institutes /centers for fishery/ survey/ education/ extension trips to Goa, Bhmbneshwar, Bombay Cochin, Barnaekpore, Luknow, Hidwani etc.
- Visit to brackish water aquaculture / prawn culture farms/ centers in A.P.,Kerala, CMFRI, Pawardhera etc.
- Practical consideration to peal culture/ oyster culture
- Preparation and submission of visit/ survey/project report and charts, models and specimens

### SCHEME OF PRACTICAL EXAMINATION

1. Identification of freshwater prawns, fishes, frogs, turtles & crocodiles up to species with biometric data	20
2. Experiments cut carp breeding through hypophysation /cultures of plankton/identification fish frys, fingerlings, post-larve of prawns	10
3. Identification & comment upon common weeds predator fishes, insects, other aquatic organisms harmful to fishes, nets, gears, crafts, sampling tools and apparatuses	30
4. Statistical procedures in fishery science / length-weight relationship/ condition factor / estimation of fecundity	10
5. Viva voce	10
6. Practical record , visit / survey report/ materials, charts, models, specimens	10
7. Seminar	10
<b>TOTAL MARKS</b>	<b>100</b>
<b>DURATION ( HOURS )</b>	<b>06</b>

*Deviyan*  
*Kirti*  
*Shiv*

*W*  
*N*

विभागाध्यक्ष  
प्राणिशास्त्र विभाग  
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