

GOVT. COLLEGE FOR WOMEN, PARADE GROUND JAMMU (AN AUTONOMOUS COLLEGE)



Syllabus and Course of Study in Zoology – M.Sc. Semester-IV For examinations to be held in 2022-23, 2023-24, 2024-25

Course No.: PSZOTC-401

Credit - 4

Course Title: Reproductive & Developmental Biology

M.M.: 100

Minor-1: 20

Minor-2: 20

Major Test: 60

LEARNING OBJECTIVES

- The course in developmental and reproductive Biology has been framed in such a way to enable the students to understand fundamental concepts in Reproductive Biology and Development.
- The learners will be familiarized with the mechanism and control of various developmental processes.

LEARNING OUTCOMES:-

After completion of the course the students will be able to:

1. Understand the anatomy and histomorphology of vertebrate gonads.
2. Comprehend the mechanism of action and synthesis of sex steroids.
3. Understand the origin of primordial germ cells, concept of spermatogenesis and Oogenesis.
4. Understand mechanism and events in the process of fertilization
5. Comprehend the concept of cleavage, blastulation and development and organogenesis in birds and mammals.

UNIT-I : Gonadal Anatomy and Development

1. Chromosomal sex, Gonadal sex, Phenotypic sex
 - 1.1 Anatomy of vertebrate Gonads and ducts
 - 1.2 Histomorphology of vertebrate gonads
 - 1.2.1 Structure and development of vertebrate gonads
 - 1.3 Genetic regulation of Gonadal development
 - 1.4 Disorders of chromosomal sex and disorders of Gonadal development
 - 1.5 Sex steroids, Bio synthesis, Transport, mechanism of action and functions
 - 1.6 Gonadotropins, types, mechanism of action and functions

Unit-II : Regulative mechanism and process

- 2.1 Origin of Primordial Germ Cells and their migration
- 2.2 Spermatogenesis and its regulation, structure of sperm
- 2.3 Folliculogenesis – process and regulation
 - 2.3.1 Vitellogenesis – process and importance
 - 2.3.2 Role of Lampbrush chromosomes
- 2.4 Oogenesis – Process and Regulation
 - 2.4.1 Oogenic meiosis – its regulation
 - 2.4.2 Follicular atresia, significance
 - 2.4.3 Corpora Lutea

Unit-III : Fertilization, Breeding behavior and contraceptives

- 3.1 Puberty;- precocious and delayed
- 3.2 Types of egg and egg membranes
- 3.3 Fertilization – major events; - molecular mechanisms
 - 3.3.1 capacitation
 - 3.3.2 Acrosomal exocytosis – (Acrosomal Reaction)

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- 3.3.3 Cortical reaction
- 3.3.4 Sperm penetration into egg
- 3.3.5 Amphimixis

- 3.4 Estrous cycle
- 3.5 Menstrual cycle
- 3.6 Hormonal contraceptives, contraception

Unit-IV : Cleavage and Blastulation

- 4.1 Cleavage, characteristics and molecular mechanism
- 4.2 Patterns and types of cleavage
- 4.3 Types of Blastulae – in vertebrates
- 4.5 Gastrulation characteristics and mechanism
 - 4.5.1 Morphogenetic movements – epiboly and emboly – Principal and subsidiary
 - 4.5.2 Gastrulation with reference to Birds and Mammals
- 4.6 Significance of cleavage and Gastrulation, exogastrulae
- 4.7 Presumptive fate map in chordates

Unit-V : Development and organogenesis in birds and mammals

- 5.1 Early development in chicks
- 5.2 Tissue induction, types of induction and mechanism of induction
- 5.3 Molecular mechanism of neural tube formation and segregation
- 5.4 Development of eye and associated developmental Anomalies
- 5.5 Development of Ear
- 5.6 Development of kidney/Excretory organs
- 5.7 Extra embryonic membranes

NOTE FOR PAPER SETTING

Examination Theory	Syllabus to be covered in examination	Time allowed for Exam.	% weightage (Marks)
Minor Test I	Upto 20%	1 Hr.	20
Minor Test II	21% to 40%	1 Hr.	20
Major Test	41% to 100%	2Hrs. & 30 Mins.	60

Major Test will have to sections A & B.

SECTION 'A' shall comprise of 5 multiple choice questions of 1 mark each and 5 short answer type questions of 2 marks each. Total 15 marks.

Section 'B' shall comprise of 6 questions, two questions from each unit from the remaining three units. Each question carries 15 marks. Students will attempt three questions selecting one question from each unit.

Syllabus for Practicals of Animal Physiology

Credit-02

1. Histology and Morphology of significant endocrine glands.
2. Study of male and female reproductive systems (Fish to mammals)
3. Extraction of Chick embryo.
4. Staining and mounting of the chick embryo (Blastoderm)
5. Permanent slide study of T.S of Testis (Fish to mammals), T.S. of Ovary (Fish to mammals)
6. Study of Metamorphosis in amphibians through charts.
7. Chick embryology (slide study)

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- a. Chick embryo – 16 hours (Whole mount)
- b. Chick embryo – 24 hours (Whole mount)
- c. Chick embryo – 33 hours (Whole mount)
- d. Chick embryo – 43 hours (Whole mount)
- e. Chick embryo – 55 hours (Whole mount)
- f. Chick embryo – 72 hours (Whole mount)
- g. Chick embryo – 96 hours (Whole mount)
8. Study of Fertilized egg of frog (slide study), Egg of Hen, Blastula of frog, Gastrula of frog

Books Recommended

1. Pettern B.M. Carlson, B.M. (1977). Foundation of Embryology. T.M.M. edition
2. Blinsky, B.I. (1981): Introduction to Embryology, Saunders College Pub. Philadel
3. Saunders, J.W. (1982): Dev. Biology Patterns, Principles, Problems, Macmillan Pub. Co. Inc. New York.
4. Berrill N.J: Developmental Biology. McGraw Hill, New Delhi
5. McEwen, Vertebrate Embryology
6. Alferd Kuhn: Lectures on Developmental Physiology. 18.J.W. Saunders, Jr. Animal Morphogenesis.
7. C.R. Martin: Endocrinology, Oxford University Press
8. R.H. Williams. Text book of Endocrinology. W.B. Saunders
9. Scott F, Gilbert: Developmental Biology (6th Ed.) NCBI Bookself
10. Bruce, M.Carlson (2013): Human Embryology and Developmental Biology

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Syllabus and Course of Study in Zoology – M.Sc. Semester-IV For examinations to be held in 2022-23, 2023-24, 2024-25

Course No. PSZOTC-402

Credit - 2

Course Title: An introduction to Wildlife Sciences.

M.M.: 50

Minor-1 : 10

Minor-2 : 10

Major Test : 30

LEARNING OBJECTIVES

- The course under reference has been framed to enable the students to have an insight in to the fundamental concepts pertaining to Wildlife in general and that of J&K in particular. Wildlife studies have gained importance over past few decades and conservation strategies are being formulated to conserve the ecologically important species that are facing extinction owing to myriad of reasons. Unfortunately however, this aspect has hitherto been ignored and has remained in oblivion as far as curricula of studies in J&K is concerned. This, therefore, underlines the importance of introducing this course in post graduation so as to sensitise the students about the importance and issues concerning wildlife, thus leading to generation of response and concerted efforts towards wildlife research.

LEARNING OUTCOMES:-

- After having completed the course under reference, a student shall be expected to have gained knowledge about the following:
 - Overview of Faunal Wildlife in general and that of J&K in particular.
 - Concept of Red Data Book, Remote sensing and GIS, anthropogenic pressures on wildlife.
 - Wildlife tourism and its avenues in J&K.
 - Conservation strategies.
 - Diversity and allied aspects of mammals, birds, reptiles and amphibians of J&K.

Syllabus

Unit-I: Wildlife: A primer.

1. Wildlife as a natural resource: Indian context.
2. Wild faunal status of J&K.
3. Wildlife crimes and Wildlife Protection Act.
4. Human-wildlife conflict and management.
5. Wildlife population estimations.
6. Concept of Red Data Book.
7. Concept of Remote sensing and GIS.
8. Wildlife tourism: Perspectives and Prospects in J&K.

Unit-II: Mammalogy

1. Classification of mammals up-to orders represented in Indian sub-continent.
2. Unique characteristics of different orders and taxa represented in each order.
3. Current status and distribution of important Indian mammalian species.
4. Behaviour and social organization in mammals; social and mating systems; territories; communication.
5. Endemism in mammals.
6. Concept of altruism in mammals.
7. Project Hangul: Conserving the Kashmir Stag
8. Monkey menace in Jammu: Aggression, Feeding Behaviour and possible solutions.

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Unit-III: Ornithology and Herpetology:

1. Avian systematics and classification of Indian birds.
2. Avifauna of J&K: Status and distribution.
3. Avian extinctions - past and present.
4. Sexual selection in birds.
5. Bird Plumage: Patterns & Functions.
6. Bird migration with special reference to Bar-headed geese.
7. Bird census techniques.
8. Abundance of amphibian and reptilian fauna in Indian sub-continent.
9. Amphibian and reptilian fauna of J&K.

Practicals:

1. Line transect method for abundance estimation of mammals and bird (direct and indirect evidences).
2. Demonstration of basic equipment needed in wildlife studies: Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses, PH meter, Hygrometer, Soil Moisture Meter, Camping gear.
3. Study of avian community of Gharana Wetland
4. Field visits for inventorisation of common faunal species.
5. Field visit to Zoological park.
6. Audio Visual documentation of locally available faunal species
7. Filed visit reports.

Suggested readings:

1. Raj Punjwani, Wildlife Conservation in India, Natraj: Dehradun; 2000
2. Remote sensing & image interpretation by Lillesand, T and Kiefer, R.W.
3. Principles of remote sensing by Sabins, F.F.
4. Fundamentals of GIS by Michael Dewers
5. Mammal Ecology by M.J. Delany
6. The book of Indian Animals by S.H. Prater
7. The life of Vertebrates by J.Z.Young
8. Mammalogy by Terry A. Vaughan
9. Social behaviour in mammals by T.Poole
10. Threatened animals of India by B.K. Tikader
11. The Deer and the Tiger by George B. Schaller
12. Ornithology by Frank, B. Gill
13. The book of Indian birds by Salim Ali
14. The fall of Sparrow by Salim Ali
15. Avian Ecology by Birkhead and Perrins
16. Bird Sound by Gerhard, A. Thellcke
17. Popular handbook of Indian bird by Hugh Whistler
18. M. A. Smith., The fauna of British India (Reptilia and Amphibia- Vol. -III, Serpentes Vol. IV)
19. George R. Zug. Herpetology- An Introductory Biology of Amphibians and reptiles
20. Ecology, Wildlife Conservation & Management by TAPASHI GUPTA.
21. Wildlife Biology: An Indian Perspective by Goutam Kumar Saha
22. Conservation Biology: A Primer for South Asia by Kamaljit S Bawa
23. The Illegal Wildlife Trade: Inside the World of Poachers, Smugglers and Traders (Studies of Organized Crime) by Daan P. van Uhm.

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Syllabus and Course of Study in Zoology – M.Sc. Semester-IV For examinations to be held in 2022-23, 2023-24, 2024-25

COURSE NO. PSZOTC-403

Course Title: Microbiology

Credits: 2

Maximum Marks: 50

Time Duration: 2Hrs.

a) Minor Test I: 10

b) Minor Test II: 10

c) Major Test: 30

Course Learning Objectives

This course covers the importance of microbiology in different spheres like human health, industries and agriculture. The course includes the overview of disease transmission and the clinical presentations of various common diseases. The content also helps in building fundamental knowledge of microbial fermentation and various products obtained through this process which have high industrial value. The role of various microbes in controlling water pollution is also included in this course which can be a field of research for higher studies.

Course Learning Outcomes

Upon completion of the course, students will be able to

- Assess the role of microbes in Industrial and Agricultural arena
- Understand the disease transmission, pathogenesis and prophylaxis
- Know the fermentation processes and various products of microbial fermentation
- Gain knowledge regarding role of microorganisms in bioremediation processes.

SYLLABUS

UNIT I. Medical Microbiology:

(10h)

1.1 Microbiology- Branches, Scope and its Relevance

1.1.1 Contribution of eminent microbiologist: Robert Koch, Pasteur, Flemming and Jenner

1.2 Microbial virulence

1.3 Causative Agents, Etiology, Pathogenesis and Prophylaxis of Air borne diseases.

1.3.1 Tuberculosis

1.3.2 Pneumonia

1.4. Food/ water/ Soil borne diseases/Viral diseases

1.4.1. Food poisoning – Botulism

1.4.2. Typhoid fever

1.4.3. Cholera

1.4.4. Hepatitis

1.4.5. HIV AIDS

1.4.6. Zika Virus

1.4.7. SARS-CoV-2

1.5. Arthropod transmitted diseases

1.5.1. Leishmaniasis

1.5.2. Malaria

UNIT-II Industrial Microbiology

(10h)

2.1 Microbial Fermentation: Concept of fermentation; Types of fermentation processes: Batch, continuous and fed batch

2.2 Products of microbial fermentation

2.2.1 Food products- vinegar, pickles

2.2.2 Milk products – cheese, yogurt

2.2.3 Beverages – wine and beer

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- 2.3 Other microbial products
 - 2.3.1 Antibiotics
 - 2.3.2 Organic acids
 - 2.3.3 Enzymes

Unit-III Agricultural Microbiology (10h)

- 3.1 Agricultural microbiology Introduction, Concepts and scope of agricultural microbiology, influence of microorganisms in plant growth
- 3.2 Soil microbiology – Microbes in soil – rhizosphere, phyllosphere and mycorrhiza
- 3.3 Biological nitrogen fixation, concept of nif gene, symbiotic and non symbiotic micro organisms
- 3.4 Bioremediation: the pollution solution
 - 3.4.1 Bacteria as excellent players in reducing water pollution
 - 3.4.2 Super bug: a tool to treat oil spills
- 3.5 Biopesticides & Biofertilizers (N,P,K)

PRACTICALS

1. To study the parts and working of a bright field microscope.
2. To study various sterilization techniques used in a microbiology lab.
3. To study the construction and working of Autoclave.
4. To study the parts and working of Biosafety Cabinet (Laminar Air flow Cabinet).
5. To Prepare and sterilize Microbial media; Liquid and Solidified (LB Media).
6. To cultivate microorganisms from a soil sample (Both streak plate and spread plate Method)
7. To cultivate microorganisms from a water sample (Both streak plate and spread plate Method).
8. To Isolate and propagate of a bacterial colony.
9. To perform Gram staining of isolated bacterial cells.

Note for Paper Setting

Examination Theory	Syllabus to be covered in examination	Time allotted for Exam	% weightage (marks)
Minor Test I	upto 20%	1 Hr.	10
Minor Test II	21% to 40%	1 Hr.	10
Major Test	41% to 100%	2Hrs.	30

- i. Major test will have two sections (A & B)

Section A is compulsory comprising of 10 questions. First five multiple choice questions of 1 mark each and 6 to 10 very short answer type questions of 1 mark each.

- ii. of 1 mark each and be spread over entire syllabus
- iii. Section B comprises of 4 questions from remaining 2 units and candidate has to attempt one question from each unit of 10 marks each.

Teaching and Learning Process:

Lectures using blackboard and power-point presentations will be delivered by the teachers and the queries of the students will be addressed after they have revised the topic. Concepts can be clarified by giving assignments. As a part of peer learning, regular group discussions will be held amongst the students to enhance their knowledge. In order to develop scientific temperament and communication skills of the students, power point presentations, paper presentations and debate can be organized on various themes as prescribed in the syllabi, while focusing on the latest development in them.

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Assessment Methods:

Students can be assessed by following methods for proper understanding of the subject.

- Problem solving assignments.
- Power Point presentation evaluation on different topics.
- Holding debates and assessment for understanding of the subject.
- Multiple Choice Questions (Test) for assessing grasping of the topics.

Books Recommended:

1. Wood, J. B. (1985). *Microbiology of fermented foods*. Volumes I and II. Elsevier Applied Science Publishers. London, England
2. Mitchell R. (1992). *Environmental Microbiology*. John Wiley & Sons.
3. Tauro P, Kapoor KK & Yadav KS. (1996). *Introduction to Microbiology*. Wiley Eastern.
4. Pelczar MJ, Chan ECS & Kreig NR. (1997). *Microbiology: Concepts and Application*. Tata McGraw Hill.
5. Joshi, V.K. and Pandey, A. Ed. (1999). *Biotechnology. Food Fermentation*, (2 Vol. set). Education Publ. New Delhi
6. Levine MM, Kaper JB, Rappuoli R, Liu MA & Good MF. (2004). *New Generation Vaccines*. 3rd Ed. Informa Healthcare.
7. Rajeshwari, S. Sethi and Sreekrishna, V. (2004). *Biotechnology-2 New Age International Publ. Delhi*
8. M.P. Arora. (2005). *Microbiology*. Himalaya Publ. House. Mumbai
9. Wulf Cruieger and Anneliese Cruieger. (2005). *Biotechnology: A text book of Industrial Microbiology 2nd Ed*. Panima Publ. Corporation, New Delhi.
10. Male D, Brostoff J, Roth DB & Roitt . (2006). *Immunology*. Elsevier.
11. Jay, J.M. (2008) *Modern Food Microbiology* (Sixth Edition). Aspen Publishers, Inc, Gaithersburg, Maryland.
12. Ananthanaryan & Paniker's. (2009). *Textbook of Microbiology*. Univ. Press Pvt. Ltd. Himayatnagar, Hyderabad.
13. Gerard, J. Tortora, Berdell R. Funke & Christine L. Case. (2011). *Microbiology: An Introduction 9th Ed*, Pearson Education.
14. Pedro Escoll (2017). *Bacterial evasion of the host immune system*. Caister Academic Press

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Syllabus and Course of Study in Zoology – M.Sc. Semester-IV For examinations to be held in 2022-23, 2023-24, 2024-25

Course No. PSZOTE- 405

Course Title: Fish & fisheries

CREDITS: 4

Maximum marks : 100

a. Minor Test I : 20

b. Minor Test II : 20

c. Major Test : 60

Course learning Objectives

The present course on fish and fisheries is, designed to acquaint the students with information on different types of water bodies, their changing physicochemical nature, their influence on inhabiting biota and fish production. This course aims to provide sufficient knowledge regarding life of fishes, their breeding potentials and culturing methods.

Course Learning Outcome:

After completion of the course the students will be able to:

1. Understand the Significance of Fishery Science
2. Comprehend the status of Marine, Riverine and lacustrine fisheries in India.
3. Know about the physiochemical nature of water bodies and their influence on biota
4. Understand the role of Plankton and benthos in fisheries
5. Know about the nutritional requirements of fishes
6. Understand the techniques employed in fish breeding
7. Set up an aquarium
8. Identify diseases in aquarium fishes
9. Know about the efficient fishing techniques

Syllabus

Unit-I

Introduction to Fishery science and fisheries of India (12 hrs)

- 1.1 Central Institute of Fisheries Education: Research, extension and major achievements
- 1.2. Importance of Fishery Science.
- 1.3 Fishery Science as an integrated study.
- 1.4. Status and scope of Lacustrine fisheries, Riverine fisheries in India with special reference to J&K
- 1.5 Cold and warm water fisheries in J&K.
- 1.6 Major Reservoirs and Reservoir fisheries
- 1.7. Marine Fisheries.
- 1.8 Concept and relevance of Integrated Fish Farming in India.

Unit-II Fish Environment

(13hrs)

2.1 Abiotic

- 2.1.1 Temperature: Effect on vital biological processes
Thermal stratification
- 2.1.2 Light: Sources; factors influencing light penetration; influence of light penetration on aquatic organisms.
- 2.1.3 pH - distribution and significance.
- 2.1.4 Sources and significance of CO₂, DO, Nitrates, Nitrites and Ammonia

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2.2. Biotic

- 2.2.1. Plankton: Definition, classification and its role in fishery.
- 2.2.2. Benthos: Definition, classification and its role
- 2.2.3. Common benthic organisms

Unit III Nutritional requirements, Biochemical Composition and of fish processing (12hrs)

3.1 Nutritional requirements of fish:

- 3.1.1 Protein
- 3.1.2 Lipids
- 3.1.3 Vitamins and Minerals

3.2 Feed formulation, Types and Forms of feed

3.3 Biochemical Composition of fish

3.4 Nutritional Value of fish

3.5 Fish spoilage and its prevention; Preservation of fish

Unit IV Fish Breeding and Biotechnological Advances

(13hrs)

4.1 Natural Breeding of Indian Major carps

- 4.1.1 Location of breeding grounds and seed collection
- 4.1.2 Factors responsible for Natural breeding

4.2 Wet and Dry bund breeding techniques for breeding Indian major carps

4.3 Induced breeding of fish through various techniques with special reference to synthetic hormones and its advantages

4.4 Advances in Fish Genetics and Biotechnology

- 4.4.1 Selective breeding and hybridization
- 4.4.2 Genetic Engineering- Gynogenesis, Androgenesis, induced polyploidy, Gene manipulation, Sex Manipulation

4.5 Cryopreservation techniques and importance

Unit-V Aquarium management/Diseases

(12 hrs)

5.1. Aquaria

- 5.1.1. Types, Setting and Maintenance
- 5.1.2. Aquarium Accessories
- 5.1.3. Biological notes on Common aquarium fishes.

5.2 Fish Diseases: Symptoms, Etiology, Prophylaxis and treatment of

- 5.2.1 Bacterial: Dropsy, Gill Rot, Pop eye, Furunculosis, swim bladder disease
- 5.2.2 Viral : hemorrhagic septicemia
- 5.2.3 Protozoan: Ich, Trichidinia sp
- 5.2.4 Helminth diseases: Ascariasis, Trichuriasis, skin and gill flukes
- 5.2.5 Fungal diseases: Ichthyoponus, Branchiomysis

5.3 Fishing methods

- 5.3.1 Traditional Fishing methods used in inland and marine waters
- 5.3.2 Recent advances in fishing methods
 - 5.3.2.1. Light fishing
 - 5.3.2.2. Electric Fishing
 - 5.3.2.3. Sonar/Echosounders
- 5.3.3 Fish study through Navigation

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Note for Paper Setting

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Minor Test II	21% to 40%	1 Hr.	20
Major Test	41% to 100%	2Hrs & 30 mins.	60

- Major test will have two sections (A & B)
- Section A shall comprise of five (5) multiple choice question of 1 mark each covering the entire syllabus and 5 short answer questions of 2 mark each from the entire syllabus. (A Sec = 15 marks)
- Section B comprises of 6 questions (2 from each unit) from the remaining 3 units and candidate has to attempt one question from each unit (15 marks each).

Books Recommended

- John E. Bardach, Ryther and Mc Larney (1972). Aquaculture. The Farming and Husbandry of Fresh water and marine organisms.
- C.B.L. Srivastava. (1985). A Textbook of Fisheries Science and Indian Fisheries.
- Jhingran, V. G. (1997). Fish and Fisheries of India. Hindustan Publishing Corporation, India.
- Sarkar, S.K. (2002). Freshwater Fish Culture. Daya Publ. House, New Delhi.
- Amita Sexana. (2003). Aquarium Management. Daya Publ. House, New Delhi.
- Selvamani, B.R and R.K. Mahadevan.(2008). Fish Harvesting and Processing. Campus Books International
- Jagtap, H.S, S.N. Mukherjee and V.K. Garad. (2009). A Textbook of Pisciculture and Aquarium. Daya Publ. House, New Delhi.
- .J.S. Lucas and P.C. Southgate . (2012). Aquaculture: Farming, Aquatic Animals and Plants. 2 Ed. Wiley Blackwell, U.K.
- S.S. Khanna and H.R.Singh (2014). A Textbook of Fish Biology and Fisheries of India. Hindustan Publishing House.
- Rahul P. Parihar. (2014). Fish Biology and Indian Fisheries.
- Heimo Mikkola (2017). Fisheries and aquaculture in the modern world.
- Francis Day. The Fishes of India. Volume I and II. London. William Dawson and Sons Ltd.
- Gunther Sterna. Fresh Water Fishes of The World. Volume I and II A Falcon Book from Cosmo Publications.

Practicals for Fish & fisheries:

- Identification of some major carps of food value in your area.
- Identification of some local minor carps of food value.
- Methods for determination of : CO₂, DO, pH, Turbidity, light penetration in water

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4. Biochemical analysis of fish tissue.
5. To study common bacterial diseases of fishes through specimens or pictures.
6. To study common fungal diseases of fishes through specimens or pictures.
7. To study a few helminth parasites of fishes through slides/ specimens/ charts.
8. Methods to preserve fish and avoid spoilage.
9. To set up and maintain an aquarium.
10. To identify some local fishes of ornamental value.
11. To study a few fish food organisms.
12. Visit to a fish farm.
13. Visit to Trout hatchery.

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Syllabus and Course of Study in Zoology – M.Sc. Semester-IV For examinations to be held in 2022-23, 2023-24, 2024-25

Course No. PSZOTE-406

Title: Molecular Genetics & Cytogenetics

CREDITS: 4

MAXIMUM MARKS:100

- a) **Minor Test I : 20**
- b) **Minor Test II : 20**
- c) **Major Test : 60**

OBJECTIVES:

Molecular Genetics & Cytogenetics are amongst the most exciting branches of biological sciences wherein continuous advancement is being made at an unprecedented pace. A post graduate level student of Zoology is expected to know about the latest techniques and concepts evolving in both these branches. The syllabus under consideration here has been prepared accordingly and shall prove helpful to students who intend to take up research after completing post-graduation. The contents are also in sync with the syllabi prescribed for the NET examination.

LEARNING OUTCOMES:

After completion of the course, a student is expected to have gained knowledge about

- Chromosome preparations and Karyotyping.
- Advanced cytogenetic techniques like FISH, CGH, Spectral Karyotyping
- Organization of human genome and evolution of human nuclear genome.
- Stem cells and use in human welfare.
- Common genetic disorders and their genetic basis.
- Various diagnostic tools for genetic disorders.
- Important aspects of genetic counseling.

The outcomes of this course shall have a bearing on the research prospects of the students.

SYLLABUS

Unit I Analysing Human Chromosomes

(13hrs)

- 1.1 Human Chromosomes: An overview.
- 1.2 Techniques in the study of chromosomes and their applications: chromosome preparations.
 - 1.1.1 Short term (lymphocyte) culture
 - 1.1.2 Long term (fibroblast) culture
 - 1.1.3 G-Banding
 - 1.1.4 C-Banding
 - 1.1.5 High resolution Banding
 - 1.1.6 Q-Banding
 - 1.1.7 Karyotyping
- 1.2 Advanced Cytogenetic Techniques
 - 1.2.1 Fluorescent in Situ Hybridization (FISH)
 - 1.2.2 Comparative Genomic Hybridization (CGH)
 - 1.2.3 Spectral Karyotyping

(12hrs)

Unit II Human Genome and its evolution

- 2.1 Organization of human genome
 - 2.1.1 Nuclear genome
 - 2.1.2 Mitochondrial Genome

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- 2.2 Evolution of human nuclear genome
- 2.3 Human Gene families: Multigene families and Superfamilies
- 2.4 Homolog, paralogs and orthologs
- 2.5 Repetitive DNA and its types
- 2.6 Transposable elements: LINE, SINE, Retrotransposons

Unit III Stem Cell Biology, Gene therapy and Genetic Disorders (13hrs)

- 3.1 Stem cell research and therapeutic cloning
 - 3.1.1 Stem Cell Basics: types, potency
 - 3.1.2 Source and Isolation of stem cells
 - 3.1.3 Use of stem cells in human welfare
- 3.2 Therapeutic Cloning
- 3.3 Ethical Issues in therapeutic cloning
- 3.4 Gene therapy
- 3.5 Genetic basis of following:
 - 3.5.1 Huntington's disease
 - 3.5.2 Cystic fibrosis
 - 3.5.3 Thalassemia
 - 3.5.4 Haemophilia
 - 3.5.5 DMD
 - 3.5.6 Fragile-X Syndrome**

Unit IV Diagnosis and treatment of genetic diseases (12hrs)

- 4.1 DNA based diagnosis
- 4.2 Pre-implantation diagnosis
- 4.3 Prenatal diagnosis
 - 4.4.1 Invasive techniques: CVS, Amniocentesis, Fetoscopy
 - 4.4.2 Non invasive techniques: Ultrasonography, Fetal Cells in maternal blood, maternal fetalserum
- 4.4 Population Screening
- 4.5 Treatment of genetic diseases

Unit V Human Genome project and genetic counseling (13hrs)

- 5.1 Human Genome Project
 - 5.1.1 History, Organization and Goals of Human Genome Project
 - 5.1.2 Findings and Implications.
- 5.2 Genetic counselling
 - 5.2.1 Purpose of Counselling
 - 5.2.2 Components of genetic counseling
 - 5.2.3 Eugenics
 - 5.2.4 Euphenics
- 5.3 Human Genetic Variations
- 5.4 Gene Environment Interactions

Note for Paper Setting

Examination Theory	Syllabus to be covered in examination	Time allotted for Exam	% weightage (marks)
Minor Test I	upto 20%	1 Hr.	20
Minor Test II	21% to 40%	1 Hr.	20
Major Test	41% to 100%	2Hrs.& 30 mins.	60



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- i. Major test will have two sections (A & B)
- ii. Section A is compulsory comprising of 10 questions of 1.5 marks each and be spread over entire syllabus
- iii. Section B comprises of 6 questions (2 from each unit) from the remaining 3 units and candidate has to attempt one question from each unit (15 marks each).

Practical exercises for Molecular Genetics & Cytogenetics

1. Extraction of genomic DNA using Phenol-Chloroform method (organic)
2. Extraction of genomic DNA using extraction kits.
3. Enzymatic digestion of genomic DNA.
4. Enzymatic digestion of prokaryotic DNA.
5. To demonstrate chromosome banding.
6. DNA amplification using Polymerase Chain Reaction.
7. Karyotyping from metaphase photographs.
8. To study pedigree symbols and to carry out pedigree analysis.
9. To prepare a pedigree of own family.

BOOKS RECOMMENDED

1. T.A. Brown, (2002). Genome, Second Edition, Bios Scientific Publishers Ltd
2. David P. Clark, (2005). Molecular Biology. Elsevier Academic Press.
3. T. A. Brown, (2006): Genome : Third Edition, Garland Science
4. Benjawan Lewin, (2008). Gene IX. Jones and Barlett Publishers.
5. Ricki Lewis. (2009) Human Genetics-Concepts and Application. Second Edition. WCB-McGraw Hill.
6. Judith Goodship, Patrick Chinnery, and Tom Strachan (2010). Genetics and Genomics in Medicine.
7. F Vogel A.G. Motulusky. (2010). Human Genetics: Problems and Approaches. Third Completely Revised Edition, Springer-Verlag.
8. D. Peter Snustad and Michael J.Simmons. (2012). Principles of Human Genetics. Fifth edition. John Wiley & Sons, Inc.
9. Molecular Genetics - D Friefelder
10. Molecular Cell Biology - Lodish
11. Cell and Molecular Biology - G.Karp
12. The Cell, a molecular approach - G.M. Cooper & R.E. Hausman
13. Essentials of Cell Biology - Alberts et al, Garland Press Science
14. Molecular Genetics - Klug & Cummings

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Syllabus and Course of Study in Zoology – M.Sc. Semester-IV For examinations to be held in 2022-23, 2023-24, 2024-25

Course No. PSZOTE-407

Course Title: Entomology

CREDITS: 4

MAXIMUM MARKS : 100

- a. Minor Test I : 20
- b. Minor Test II : 20
- c. Major Test : 60

Course learning Objective:

This course has been designed to introduce the students to various useful and harmful species of insects found in this area. Topics concerning insect behaviour, insect plant interactions, insect ecology and biology alongwith control measures studies such as chemical, biological etc. have been included in order to make the students aware of the importance of these studies in insect pest management (IPM) which is an area of considerable relevance in an agriculture based, economy like ours.

Course Learning Outcome:

After completion of the course the students will be able to:

1. Identify Important insect pests with special reference to J&K state
2. Comprehend various control measures feasible against the insect pests
3. Understand the hazards of using chemical insecticides
4. Know about modern techniques of insect control
5. Identify various diseases spread by insect vectors and measures to control the same.
6. Know about beneficial insects and their products.
7. Realise the ecological importance of insects dwelling in different niches.
8. Know about social insects and their life.
9. Comprehend various types of communication among insects
10. Understand the defence mechanisms in insects

SYLLABUS

Unit-I Important species of insect pests with special reference to J&K state: (12hrs)

- 1.1 Concept of Pests: Economic injury level and economic threshold level
- 1.2 Overview and biology of common pests
 - 1.2.1 Fruit & vegetable pests
 - 1.2.2 Stored grain & household pests
 - 1.2.3 Pests of cereal crops: Wheat, Paddy, Sorghum, Maize
- 1.3 Insect Pest control & Management:
 - 1.3.1 Cultural, Chemical, Hormonal Control of Insect pests
 - 1.3.2 Relevance and importance of Biological control methods with reference to utilisation of various bio-control agents:
 - a. Bacillus thuringiensis
 - b. Entomopathogenic nematode species
 - 1.3.3 Insect pest management, strategies and tools in integrated pest management
 - 1.3.4 Insecticide synergists and antagonists
 - 1.3.5 Development of Insecticide resistance to Insecticides
 - 1.3.6 Genetic methods of insect pest control.

Unit-II Insects of medical Importance (13 hrs)

- 2.1 Mode of transmission and epidemiology of major vector borne diseases such as Malaria, yellow fever, kalazar, typhus, plague, filariasis
- 2.2 Insects of commercial Importance & their products
 - 2.2.1 Honey bees

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- 2.2.2 Silk and Tassar Worms
- 2.2.3 Lac insects
- 2.2.4 Strategies for commercialisation of insect products

Unit-III Ecological Role of Insects (12hrs)

- 3.1 Insect as pollinators
- 3.2 Aquatic insects
- 3.3 Insects as parasites and predators
- 3.4 Forensic entomology with special reference to man and wild life
- 3.5 Ground dwelling insects
- 3.6 Insect biotic potential and environmental resistance
- 3.7 Entomophagy
- 3.8 Insect Plant Relationship:
 - 3.8.1 Host selection and plant characteristics in host plant selection
 - 3.8.2 Behavioural and physiological components in insect plant relationship

Unit-IV Social Insects and Insect communication (13hrs)

- 4.1 Social Insects
 - 4.1.1 Social organisation
 - 4.1.2 Caste differentiation and evolution of social instinct
 - 4.1.3 Honey bees
 - 4.1.4 Termites and ants as social units
- 4.2 Insect communication
 - 4.2.1 Chemical communication
 - 4.2.2 Audio & tactile communication
 - 4.2.3 Visual communication
 - 4.2.4 Luminescent insects

Unit-V Defense Mechanism in Insects (12hrs)

- 5.1 Behavioural & Structural defence
- 5.2 Chemical defence
- 5.3 Coloration defence
- 5.4 Mimicry

Note for Paper Setting

Examination Theory	Syllabus to be covered in examination	Time allotted for Exam	% weightage (marks)
Minor Test I	upto 20%	1 Hr.	20
Minor Test II	21% to 40%	1 Hr.	20
Major Test	41% to 100%	2Hrs & 30 mins.	60

- i. Major test will have two sections (A & B)
- ii. Section A shall comprise five (5) multiple choice question of 1 mark each covering the entire syllabus and 5 short answer questions of 2 mark each from the entire syllabus. (A Sec = 15 marks)
- iii. Section B comprises 6 questions (2 from each unit) from the remaining 3 units and candidate has to attempt one question from each unit (15 marks each).

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Practicals for the said course:

1. Identification of insects using identification key.
2. Preparation of a killing bottle and a spreading board.
3. Collection, killing and spreading of insects.
4. Pinning of Insects and preparation on an insectarium.
5. Identify, Classify and comment on some Apterygotes.
6. Identify, Classify and comment on some Pterygotes.
7. To study the life cycle of an insect in controlled conditions.
8. To identify the various species of butterflies in the college campus.
9. To identify the various species of beetles in the college campus.
10. To record the affinity of an insect species to different plants.
11. To recapitulate the different types of mouthparts, legs and antennae in insects.

Books Recommended

1. Wigglesworth, V.B. (1976). Insect and the life of Man. London Chapman & Hall.
2. Hermann, H.R. (1982). Social Insects (Vol-III). Academic Press, London.
3. Fryer, J.C.F. (2008). Insect Pests of Fruit Crops. Biotech Books, Delhi.
4. Pedigo, L.P. and Rics, M.E. (2009). Entomology and Pest Management (VI Edi.) PHI Learning Private Limited.
5. Bhargava, M.C. and Kumawat, K.C. (2010). Pests of Stored Grains and their Management. New India Publishing Agency.
6. Cotton, R.T. (2011). Insect Pests of Stored Grains and Grains Products: Identification, Habits and Methods of Control Biotech Books, Delhi.
7. Haldhar and Deshwal (2017). Fundamentals of Agriculture Entomology. New Vishal Publication.
8. Marc J. Klowden. (2007). Physiological Systems in Insects. Elsevier Inc.
9. Snodgrass. Insects: their ways and means of living.
10. Thembhare, D. B. Modern Entomology. Himalaya Publishing House.