।। सा विद्या या विमुक्तये ।।
स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड
"ज्ञानतीर्थ" परिसर, विष्णुपूरी, नांदेड - ४३१६०६ (महाराष्ट्र)
SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED
"Dnyanteerth", Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)
Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade
ACADEMIC (1-BOARD OF STUDIES) SECTION
Phone: (02462) 229542
Fax : (02462) 229574
Website: www.srtmun.ac.in
E-mail: bos.srtmun@gmail.com

संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे **CBCS Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक २० जून २०२० रोजी संपन्न झालेल्या ४७व्या मा. विद्या परिषद बैठकीतील विषय क्र.११/४७–२०२०**च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील द्वितीय वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०२०–२१ पासून लागू करण्यात येत आहेत.

1. M.Sc.-II Year-Botany
2. M.Sc.-II Year-Herbal Medicine
3. M.Sc.-II Year-Analytical Chemistry
4. M.Sc.-II Year-Biochemistry
5. M.Sc.-II Year-Organic Chemistry
6. M.Sc.-II Year-Physical Chemistry
7. M.Sc.-II Year-Computer Management
8. M.Sc.-II Year-Computer Science
9. M.Sc.-II Year-Information Technology
10. M.C.A. (Master of Computer Applications)-II Year
11. M.Sc.-II Year-Software Engineering
12. M.Sc.-II Year-System Administration & Networking
13. M.Sc.-II Year-Dairy Science
14. M.Sc.-II Year-Environmental Science
15. M.Sc.-II Year-Applied Mathematics
16. M.Sc.-II Year-Mathematics
17. M.Sc.-II Year-Microbiology
18. M.Sc.-II Year-Physics
19. M.Sc.-II Year-Zoology
20. M.Sc.-II Year-Biotechnology
21. M.Sc.-II Year-Bioinformatics

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.: शैक्षणिक–१/परिपत्रक/पदव्युत्तर–सीबीसीएस अभ्यासक्रम/२०२०–२१/**३३५**

दिनांक : १६.०७.२०२०.

स्वाक्षरित/–
उपकुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :
१) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

Swami Ramanand Teerth Marathwada University
Nanded

FACULTY OF SCIENCE & TECHNOLOGY

M.Sc. Zoology Second Year
(Semesters- III & IV)

Curriculum

w.e.f. 2020-21

INTRODUCTION

With the nation facing an unprecedented emergency in the face of a pandemic, almost all aspects of social, economic, educational, and cultural life are undergoing profound change. People across India have gracefully adapted to the changed way of living. Measures initiated by the government to control the situation compelled many changes in the our approach to the teaching-learning process. There are many reforms in different sectors that are being initiated by the government. Educational sector would certainly be one of them. In the backdrop of this drastically altered world, we have undertaken the task of revising the syllabus of post-graduate course in zoology.

The present round of revision of syllabi has become especially important in curriculum designing. Biological sciences, especially genomics and bioinformatics has contributed immensely in the fight against COVID-19. It will not be wrong to expect recurrence of disease spreads in the future. To be able to deal with situations arising out of such diseases, students of life science in general need to be educated and equipped with necessary skills to conduct their lives in both economic and social areas. They also need to become able to use the IT resources provided by the teachers and those available on the internet for learning the subject.

Mankind has made immense advances in the fields of medicine, genetics, biotechnology, genomics and bioinformatics. In today's scientific world dominated by such fields as OMICs, even a cursory coverage in the syllabi, of these new developments significantly improves the academic, social and competitive edge of the students.

In view of the UGC recommendations on model curriculum and the Maharashtra State Universities Act (2016), the Board of Studies (BoS) has proposed the following syllabus for M.Sc. Zoology under this University.

The M.Sc. degree in Zoology being offered by this University provides its students with a course of study that integrates a range of learning and teaching experiences necessary for their educational development and career advancement. This masters programme covers the latest developments in Zoology and its specializations viz. Applied Parasitology, Animal Physiology, Fishery Science and Entomology. It provides theoretical knowledge as well as training in the practical and intellectual skills to enable students to better understand and solve some of the problems in this subject. Graduates in this programme will be induced into critical thinking, and would be able to navigate complex situations in Zoology. The students would also be inculcated with personal and problem-solving skills that will enhance their employability and entrepreneurship prospects.

Enhancing the competence of students has been the key concern in designing and developing this syllabus. Careful thought has gone into selection of topics and setting their scope. Major areas of zoology like Vertebrates, Molecular Biology, Genetics & Genetic Engineering, Endocrinology, Applied Parasitology, Fishery Science, Entomology and Animal Physiology have been included in the syllabus only after multiple rounds of thorough discussions and intensive study. Special attention has been paid to subjects like bioinformatics, molecular biology and genetics to incorporate the latest developments in these fields. Special provision has been made for student exposure to advanced fields of the chosen specialization at the second year of the course. There is the requirement of submission of project report by all students in the subject of their respective specialization. This provision has been included in the syllabus with the view of enhancing

research aptitude and exposure among the students. Alongwith regular classroom teaching, teachers would be expected to provide learning material in digital form, e.g. lecture notes, audio/video lectures, web-links, quiz, etc.

CHOICE BASED CREDIT SYSTEM (CBCS):

The Choice Based Credit System (CBCS) provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions to begin with. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on students' performance in examinations, the UGC has formulated the guidelines to be followed.

Students of this course would be expected to-

1. Be able to play leading role in industry, research and the public services;
2. Understand and appreciate major public concerns and issues associated with zoology;
3. Have an understanding and grasp of international research environment where the frontiers of knowledge in zoology are under research;
4. Be able to adapt and respond positively and flexibly to changing circumstances;
5. Develop the professional skills and personal attributes to deal with complex issues, both systematically and creatively;
6. Have the capacity for individual work and teamwork;
7. Be lifelong learners with intellectual and practical skills.

Objectives

1. To expose students to updated curricula and to recent advances in the subject and enable the students to face NET, SET and other competitive examinations successfully.
2. To create awareness among students about the latest streams of life sciences including biotechnology, tissue culture, genetic engineering, epidemiology and bioinformatics.
3. To improve the quality of laboratory and field work for which zoological study tours and excursions have been made compulsory so that the students can become familiar with field status of ecosystem and surroundings.
4. To prepare students to attract and develop interest in Applied Parasitology, physiology, genetics, cell biology, fisheries science, entomology so that the students can select zoology as their career.

The Members of BoS in Zoology and the Curriculum Restructuring Committee has put in their honest efforts in framing this syllabus. I, on behalf of the BoS in Zoology, sincerely hope that the teacher, student and the entire academic community will welcome and receive it in good academic spirit and extend all their support.

Thanks and regards.

Prof. Dr. Sanjay Shamrao Nanware
Chairman, Board of Studies in Zoology,
Faculty of Science & Technology,
Swami Ramanand Teerth Marathwada University, Nanded
Mobile-9423401227
Email- snanware@rediffmail.com

Swami Ramanand Teerth Marathwada University, Nanded
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN
Effective from June, 2020
Faculty of Science and Technology
M.Sc. Zoology-II Year Third Semester

Paper No. / Title of the Paper	Credit (Marks)			Periods
	External : ESE	Internal: CA	Total Credits (Marks)	
Theory Paper – XI: Vertebrates: Structure and Function	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Theory Paper - XII: Molecular Cell Biology	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Students should opt any one of following specializations, which should be common for Semester III & IV				
Theory Paper XIII-A : Applied Parasitology – I Microbes and Arthropods of Medical Importance ***Or*** **Theory Paper XIII-B** Fishery Science – I Fish morphology, Anatomy and Physiology – I ***Or*** **Theory Paper XIII- C** Entomology-I Insect : Structure & Function ***Or*** **Theory Paper XIII-D** Animal Physiology- I General Physiology-I	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Theory Paper XIV- A** Applied Parasitology – II Protozoans of Medical Importance ***Or ***Theory Paper XIV-B** Fishery Science – II Fish morphology, Anatomy and Physiology– II ***Or*** ***Theory Paper XIV-C** Entomology-II Insect taxonomy, Insect development and Ecology ***Or*** ***Theory Paper XIV-D** Animal Physiology- II General Physiology-II	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Theory Paper - XV: Seminar ***Or*** ****One SWAYAM – MOOCSs Online Course of 02 Credits, different than any such course done in I Year (instead of two Seminars each of Semester III and Semester IV)	---	Credit: 01 (Marks: 25)	Credit: 01 (Marks: 25)	---
TOTAL	**Credit: 12 (Marks: 300)**	**Credit: 05 (Marks: 125)**	**Credit: 17 (Marks: 425)**	**240**

(**ESE:** End of Semester Examination; **CA:** Continuous Assessment; ***:** Elective Paper; ****** ***SWAYAM – MOOCSs Online Course*** **- SWAYAM** or Study Webs of Active- Learning for Young Aspiring Minds Programme of Ministry of Human Resource Development, Government of India. **MOOCSs** -Massive Open Online Course).

Swami Ramanand Teerth Marathwada University, Nanded

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

EFFECTIVE FROM JUNE, 2020

Faculty of Science and Technology

M.Sc. Zoology-II Year Fourth Semester

Paper No. / Title of the Paper	Credit (Marks)			Periods
	External : ESE	Internal: CA	Total Credits (Marks)	
Theory Paper - XVI Genetics and Genetic Engineering	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Theory Paper - XVII Mammalian Endocrinology	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Students should opt for same specialization, as chosen in Semester III				
Theory Paper XVIII-A Applied Parasitology – I Trematodes and Cestodes ***Or*** **Theory Paper XVIII-B** Fishery Science – I Fisheries and Fish Culture – I ***Or*** **Theory Paper XVIII-C** Entomology-I Economic Entomology ***Or*** **Theory Paper XVIII-D** Animal Physiology- I Mammalian Physiology- I	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Theory Paper XIX-A** Applied Parasitology – II Animal Nematodes and Plant Nematodes ***Or ***Theory Paper XIX-B** Fishery Science – II Fisheries and Fish Culture – II ***Or*** ***Theory Paper XIX-C** Entamology-II Agriculture Entomology and Pest Management ***Or*** ***Theory Paper XIX-D** Animal Physiology- II Mammalian Physiology – II	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Theory Paper - XX: Seminar ***Or*** **One SWAYAM – MOOCSs Online Course of 2 Credits, different than any such course done in I Year (instead of two Seminars each of Semester III and Semester IV)	---	Credit: 01 (Marks: 25)	Credit: 01 (Marks: 25)	---
TOTAL	**Credit: 12 (Marks: 300)**	**Credit: 05 (Marks: 125)**	**Credit: 17 (Marks: 425)**	**240**

(**ESE:** End of Semester Examination; **CA:** Continuous Assessment; ***:** Elective Paper ***; ** SWAYAM – MOOCSs Online Course*** - **SWAYAM** or Study Webs of Active- Learning for Young Aspiring Minds Programme of Ministry of Human Resource Development, Government of India. **MOOCSs** -Massive Open Online Course).

** If one SWAYAM – MOOCSs Online Course of 2 Credits is opted, then it will be covering both papers XV of Semester III and Paper XX of Semester IV.

M.Sc. Zoology-II Year (Third and Fourth Semester) Laboratory Course Work

(Annual Pattern)

Paper No. / Title of the Paper	Credit (Marks)		
	External: ESE	**Internal: CA**	**Total Credits (Marks)**
Laboratory Course Work- V: Based on Theory Paper- XI & XII (XI- Vertebrate: Structure and Function; XII- Molecular Cell Biology)	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) Test on Practical=25 Marks	Credit: 04 (Marks: 100)
Laboratory Course Work- VI: Based on Theory Paper- XVI & XVII (LC XVI – Genetics and Genetic Engineering; LC XVII – Mammalian Endocrinology)	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) Test on Practical=25 Marks	Credit: 04 (Marks: 100)
***Laboratory Course Work- VII:** Based on Theory Paper- XIII, XIV, XVIII & XIX (A/B/C/D)	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) Test on Practical=25 Marks	Credit: 04 (Marks: 100)
***Laboratory Course Work- VIII: Project Work**	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) Test on Project=25 Marks	Credit: 04 (Marks: 100)
TOTAL	**Credit: 12 (Marks: 300)**	**Credit: 04 (Marks: 100)**	**Credit: 16 (Marks: 400)**
Total Credit & Marks of M.Sc. Second Year (Theory & Practical)	**Credit: 36 (Marks: 900)**	**Credit: 14 (Marks: 350)**	**Credit: 50 (Marks: 1250)**

(**ESE:** End of Semester Examination; **CA:** Continuous Assessment; ***:** Elective Paper)

M.Sc. In Zoology

Detailed Syllabus

Third Semester

Course Code: XI

Theory Paper- XI

Title of the Paper: VERTEBRATES- STRUCTURE AND FUNCTION

Periods: 60 Credits: 04

Objectives

1. To study the broad taxonomy of vertebrates.
2. To study comparative anatomy of different vertebrate groups.
3. To learn about integumentary and skeletal systems of vertebrates.
4. To understand functional mechanisms of different systems of vertebrates.
5. To study about the structural and functional aspects of different systems of vertebrates.

Unit- I **15**

1. **General introduction to Chordates-** General Characters, origin and ancestry.
2. **Protochordates-** General characters and affinities of Protochordates

3. Vertebrates

3.1. General characters and origin of Vertebrata, Theories of origin of vertebrates.
3.2. Classification of vertebrates upto Class level.

Unit- II **15**

4. Vertebrate integument and its derivatives

4.1. Development, general structure and function of integument and its derivatives
4.2. Glands, scales, horns, claws, nails, hooves, feathers and hairs

5. General plan of circulation in various Groups

5.1. Blood- Composition and function
5.2. Evolution of heart
5.3. Comparative anatomy of heart.
5.4. Evolution of aortic arches
5.5. Blood circulation in various vertebrate groups: Single circulation and Double
5.6. Circulation.

Unit- III **15**

6. Respiratory system

6.1. Types of respiratory organs
6.2. Internal and external respiration
6.3. Comparative account of respiratory organs.

7. Skeletal system

7.1. Comparative account of jaw suspensorium, vertebral column and skull.
7.2. Comparative account of limbs and girdles.

Unit- IV **15**

8. Urinogential system

8.1. Evolution of kidney and gonads in vertebrates.
8.2. Comparative anatomy of Vertebrate kidney and their ducts
8.3. Comparative anatomy of Vertebrate gonads and their ducts

9. Nervous system

9.1. Comparative anatomy of the Brain and spinal cord, Central nervous system.

9.2. Peripheral and autonomic nervous system.

10. Structure and function of sense organs

10.1. Chemoreceptors- Olfactory organs.

10.2. Photoreceptors- Eyes.

10.3. Phonoreceptors- Ears.

Outcomes

1. Able to explain the broad classification of vertebrates based on features.
2. Describe relation between organ systems in different vertebrate groups.
3. Explain the significance of integument and skeletal systems of vertebrates.
4. Compare the structural and functional morphology of vertebrates.

Suggested Reading for -Vertebrate: Structure and Function

1. **Online resources like academic, research databases etc are recommended.**
2. R. L. Kotpal, Modern text Book of Zoology vertebrates, Rastogi publications Meerut 10th revised edition.
3. Boume, G.H., The Structure and functions of nervious tissue academic Press, New York.
4. Carter, G.S., Structure and habit in vertebrate evolution, Sedgwick and Jackson, London.
5. Eecles, J.C., The understanding of the brain, McGraw Hill CO., New York and London.
6. Kent, C.G., Comparative anatom of vertebrates.
7. Malcom Jollie, Chordata morphology, East-West press Ltd., New Delhi.
8. Milton Hilderbrand, Analysis of vertebratestructure-IV, Ed. Johan Wily and Sons Ine., New York.
9. Smith, H.S., Evolution of chordara structure, Hold Rinehart and Winstoin Inc, New York.
10. Sedgwick, A.A., students Text Book of Zoology, Vol.II
11. Torrey, T.W., Morphogenesis of erthates, John Wiley & Sons Inc., New York.
12. Walters, H.E. and Sayles, L.D., Ecology of vertebrates, Machillan and Co., New York.
13. Eolstenhoint, E.W. and Knight J. (Ed), Taste and smell in vertebrates, J & A, Churchill, London.
14. Romer, A.S., Vertebrate Body, IInd Edition, W.B. Saunders Co., Philadelphia.
15. Young, J.Z., Life of mammals, Oxford University press, London.
16. Colbert, E.H., Evolution of the vertebrates, Johan Wiley and Sons Inc., New York.

Laboratory Course- XI- VERTEBRATES: STRUCTURE AND FUNCTION

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. Learn about various vertebrate species, their affinities and their adaptive features.
2. Acquire skills of dissection/demonstration of organ systems in vertebrates.
3. Understand structure of bony parts of different groups of vertebrates.

Practicals

1. Demonstration / Dissection of heart, afferent and efferent arteries of Scoliodon.
2. Demonstration / Dissection of cranial nerves of Scoliodon
3. Demonstration / Dissection of brain and membranous labyrinth of Scoliodon.
4. Demonstration / Dissection of arterial system of Rat.
5. Demonstration / Dissection of venous system of Rat.
6. Demonstration / Dissection of neck nerves of Rat.
7. Demonstration / Dissection of urinogenital system of Rat.
8. Museum study of Protochordates- Balanoglossus, salpa, Doliolum, Herdmania, Amphioxus.
9. Museum study of Pisces- Zygaena, pristis, ophiocephalus, Mastacembalus, Catla-catla, Exocoetus, Hippocampus, Syngnathus, Diodon, Notopterus.
10. Museum study of Amphibia: Icthyophis, Rhacophorus, Rana, Necturus, Ambystoma.
11. Museum study of Reptilia- Chameleon, Phrynosoma, Varanus, Crocodilus, Cobra.
12. Museum study of Aves- Bubo, Duck, Vulture, Psittacula, Pigeon.
13. Museum study of Mammalia- Loris, Bat, Pangolin, Funambulus, Shrew.
14. Osteology of skull of fowl and dog/rabbit.
15. Osteology of vertebral column: Atlas vertebra, Axis vertebra, Trunk, Lumbar, Caudal.
16. Osteology of Pectoral girdle and Pelvic girdle.

Visit to Zoological Survey of India, zoological park, zoological museum, and submission of excursion report.

Outcomes

1. Describe in detail the structure, affinities and adaptive features of vertebrates.
2. Able to dissect/demonstrate important organ systems in vertebrates.
3. Explain about structure of bony parts of different vertebrates.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

M.Sc. In Zoology
Detailed Syllabus
Third Semester
Course Code- XII
Theory Paper- XII
Title of the Paper: MOLECULAR CELL BIOLOGY

Periods: 60 Credits: 04

Objectives

1. To acquire contemporary knowledge and understanding of molecular biology.
2. To study distinctions between structure and functions of prokaryotes and eukaryotes.
3. To understand role of cell communication in their function and carcinogenesis.
4. To learn about latest in gene and genome structure, functions and organization.

UNIT- I: Introduction to Molecular Biology **15**

1. Structure of Prokaryotic and Eukaryotic cells, Plasma membrane (Prokaryote and Eukaryote)- Structure and composition, Fluid Mosaic Model, Functions of cell membrane- Active and Passive Transport.
2. Intracellular compartments, protein sorting- secretary and endocytic pathways.
3. Cytoskeleton
   - 3.1. Microtubule- structure and composition, Microtubule-associated proteins (MAPs),
   - 3.2. Microtubule Organizing Centers (MTOCs), Functions of microtubules.
   - 3.3. Intermediate Filaments- Types and Functions, Microfilaments- Myosin, Actin.
4. Nucleus, structure and functions, structure and organization of chromatin.
5. Cell cycle- Phases, control of cell cycle.

Unit –II: Structure of gene and nature of genome **15**

6. Fine structure of gene- eukaryotic genome organization (coding and non-coding sequences, satellite DNA),
7. DNA damage and repair, DNA amplification.
8. Replication of DNA.
9. Regulation of gene expression in eukaryotes, Attenuation and anti-termination.

Unit – III: Organization of transcriptional units **15**

10. Mechanism of transcription in prokaryotes and eukaryotic
11. RNA processing- capping, polyadenylation, splicing, introns and exons.
12. Ribonucleoproteins, structure of mRNA in prokaryotes and eukaryotic
13. Genetic code & Protein synthesis
14. Operon concept
15. DNA modification- DNA methylation, Heterochromatization
16. Transposition- Mobile genetic elements.

Unit – IV: Biochemistry and molecular biology of cancer **15**

17. Definition, Types, Characteristics of cancer; Mechanism of carcinogenesis.
18. Oncogenes, chemical carcinogenesis, genetic disorders.
19. Hormonal imbalances; Drug metabolism and detoxification.
20. Signal Transduction- Extra cellular messengers, coupled receptors.
21. Second messengers and their role in signal transduction

21.1. Cyclic Adenosine Monophosphate (cAMP)
21.2. Cyclic Adenosine Diphosphate (cGMP)
21.3. Di-Acyl Glycerol (DAG)
21.4. Inositol Triphosphate (IP_3)
21.5. Calcium (Ca^{2+})
21.6. Signaling by insulin receptor.
22. Role of (Nitric Oxide) NO and Carbon Monoxide (CO) as cellular messengers.
23. Apoptosis (Programmed cell death).

Outcomes

1. Elaborate about contemporary developments in the field of molecular biology.
2. Explain the differences between prokaryotes and eukaryotes.
3. Describe the processes of cell communication and carcinogenesis.
4. Learn about latest in gene and genome structure, functions and organization.

Suggested Readings for Molecular Cell Biology

1. **Online resources like academic, research databases etc are recommended.**
2. Molecular Biology of the Cell - Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts and James D. Watson, Garland Publishing Inc.,New York, London, 4th Ed. 2002.
3. Molecular Biology of the Gene – James D. Watson, Lania A. Raker, Stephen P. Bell, Alexander Gann, Michael evine and Richard Logic, Pearson Education, 5th Ed. 2004.
4. Molecular Cell Biology – Harvey Lodish, Arnold Berk, Paul Mastudaria, Chris A. Kaiser, Monty Krieger, Mathew P. Scott, S. Lawrence Zipursky and James Darnell, W.H. Freeman & Company, New York, 5th Ed 2004.
5. Genes IX – Benjamin Lewin, Oxford University Press, 2008.
6. Cell Molecular Biology – Gerald Karp, 5th Ed., John Wiley and Sons Inc., 2008.
7. Cell and Molecular Biology – DeRobertes
8. Cell Biology – David E. Sadava, Jones and Bartlett Publishers, London, 1993.
9. Text Book-Cell Biology.-Dr.S.S.Nanware, Dr.D.B.Bhure & M.U.Barshe 2015 Aruna Prakashan Latur, M.S. ISBN: 978-93-5240-012-6,Publication12th June, 2015

LABORATORY COURSE- XII based on THEORY PAPER- XII

Laboratory Course: XII- MOLECULAR CELL BIOLOGY

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. Learn the techniques of extraction of nucleic acids.
2. Learn the methods of micro-preparation of cell division stages and chromosomes.
3. Study methods of detection of biomolecules.
4. Learn the techniques of separation of biomolecules.

Practicals

1) Extraction of DNA from suitable tissue.
2) Extraction of RNA from suitable tissue.
3) Estimation of DNA from sample.
4) Estimation of RNA from sample.
5) Study of different stages of mitosis.
6) Study of different stages of meiosis.
7) Preparation of slide for different mitotic stages in onion root tips.
8) Preparation of meiotic stages and study of meiosis using suitable material.
9) Detection of Proteins, Carbohydrates and lipids in animal tissues sections using histo-chemical staining techniques.
10) Micropreparation and observation of giant chromosomes from chironomous larvae.
11) Study of sex chromatin from mammalian buccal epithelial cells or hair root cells or lymphocytes.
12) Study of cancer cell histology (observation of slides of different cancer types).
13) Separation of DNA fragments by agarose gel electrophoresis.
14) Separation of cell proteins by electrophoresis.
15) Study of effect of pH on protein solubility in water.
16) Northern blotting, Western blotting (Demonstration only)

Visit to a biotechnology/molecular biology laboratory and submission of report.

Outcomes

1. Perform extraction of DNA and RNA.
2. Perform micro-preparation of cell division stages and chromosomes.
3. Detect different types of biomolecules in sample.
4. Perform separation of biomolecules using different techniques.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

M.Sc. In Zoology

Detailed Syllabus

Third Semester

Paper XIII-A: Applied Parasitology- I

TITLE OF THE PAPER: MICROBES AND ARTHROPODS OF MEDICAL IMPORTANCE

Periods: 60 Credits: 04

Objectives:

1. To introduce students to the basic concepts of Applied Parasitology.
2. To provide a broad-based knowledge and understanding of Parasitology with special emphasis on Microbes and Arthropods of medical importance.
3. To describe the basics of microbes and arthropods of public health importance.
4. To identify vector-host-pathogen relationships in microbe and arthropod-borne diseases.
5. To understand the morphology, life cycle, pathogenicity and control measures of important microbes and arthropods.
6. To understand and apply the principles of controlling diseases caused by microbes and arthropods.

Unit I **15**

1. Brief Introduction to medically important parasites (microbes & arthropods).
2. Study of pathogen microbes with reference to the following diseases: (Emphasis be given to causative organism, pathogenesis, symptoms, transmission, prevention and control)- Syphilis (Treponema pallidum), Typhoid fever (Salmonella typhi), Dengue fever (Dengue virus), Plague, Encephalitis, AIDS (HIV), Hepatitis (Hepatitis A & B viruses), Leprosy (Mycobacterium leprea), Cholera (Vibrio cholerae) and Candidiasis (Candida albicans).

Unit II **15**

3. Viral respiratory diseases (brief overview)- COVID-19; influenza, SARS, MERS
4. Basic Principles of immunity in relation to stem cells, T and B cells.
5. Human defense mechanism, Antigen and Antibody reactions and its role in clinical parasitology, common methods like GDP, CIEP, ELISA, Immunoblot.
6. General account of drug therapy and Drug resistance.
7. Antibiotic formulations.
8. Microbial culture techniques and media enrichment techniques.

Unit III **15**

9. General Account of Arthropods of medical importance.
10. Classification of Arthropods of medical importance.
11. Systematic Position, Geographical Distribution, Morphology, Life Cycle, diseases and Control Measures of-
    11.1. Acarina- Ticks & Mites
    11.2. Parasitic Hemiptera - Bed Bug *(Cimex lacturalis)*
12. Parasitic flies-Outline Classification, Morphology, role as vectors of Human diseases and Control Measures of House Fly (*Musca domestica*), Tse-Tse Fly-*Glossina*

Unit IV **15**

13. Morphology, pathogenecity and Control Measures of-
    13.1. Siphonaptera
    13.2. Anopleura
    13.3. Mallophaga
14. Biology of Parasitic Hymenoptera & role in biological control.
15. Generalized account of Mosquitoes (Anopheline, Culex, Ades); Mosquito borne diseases- Their pathogenesis, diagnosis, treatment and control; Control of mosquitoes.
16. Chemical and Biological Control of Insects.
17. Insecticides- Classification, methods of applications.

Expected Outcomes:

1. Students are able to identify Microbes and Arthropods of medical importance.
2. Students can describe basics of microbes and arthropods of public health importance.
3. Students will be able to understand and apply the principles of controlling diseases caused by microbes and arthropods.
4. Students will be able to elucidate the Vector-Host-Pathogen relationship.
5. Students will be able to understand the basic components of the immune system and its role to protect the host against pathogens.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. R.K. Nayr, T.N. Ananthakrishnan; B.V. David General & Applied Entomology Tata Mc-Graw Hill, Publishers.
3. K.P. Srivastava A Text Book of Applied Entomology Vol.1, Kalyani Publishers New Delhi.
4. Askew R.R. Parsitic insects Londan, Heinemam Education Book.
5. Pedigo Larry P. Entomology & Pest Management; America, Prentice Hall upper Saddle river, 1996.

Laboratory Course: XIII-A based on THEORY PAPER- XIII-A

Applied Parasitology- I

Lab Course XIII-A: MICROBES AND ARTHROPODS OF MEDICAL IMPORTANCE

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives:

1. To provide a practical knowledge of Microbes and Arthropods of medical importance.
2. To identify vector-host-pathogen relationships in arthropod-borne diseases.
3. To understand the morphology, life cycle, pathogenicity and control measures of important arthropods.
4. To understand and apply the principles of controlling diseases caused by microbes and arthropods.

Practicals

1. Demostration of Enzyme-Linked Immunosorbent Assay (ELISA).
2. Microbiological examination of water and foods.
3. Preparation of culture media: Bacteria.
4. Methods of microbial cultivation techniques and media enrichment techniques.
5. Isolation and characterization of microbes.
6. Staining techniques for microbes.
7. Determination of microbial growth curve.
8. Antibiotic sensitivity test.
9. Demostration of VDRL test, WIDAL test.
10. Mounting technique, potassium hydroxide method for clearing arthropods.
11. Study of following arthropods through permanent slides/ photographs: *Aedes, Culex, Anopheles*, *Pediculus humanus, Xenopsylla cheopis, Cimex lectularius, Phlebotomus argentipes, Musca domestica, Glossina palpalis.*
12. Collection, preservation, Preparation of permanent slides and description of mouth-parts of – i. House fly ii. Mosquito iii. Bed bug iv. Head louse
13. Study of permanent mounts of arthropod parasites and pests.
14. Study of permanent mounts of Insect vectors- Housefly, Mosquito, Lice, Bed-bug, Flea.
15. Study of Arthropod parasites and pests (Adult, Larvae and mouth parts).
16. Observation of temporary and permanently mounted specimens of microbes.

Visit to quality control lab / pharmaceutical industry manufacturing drugs/vaccines/antibiotics etc and report submission of the same.

Outcomes

1. Identify, classify and describe microbes and Arthropods of medical importance.
2. Explain about vector-host-pathogen relationships in arthropod-borne diseases.
3. Elaborate about arthropod vectors and their control measures.
4. Appreciate the principles of controlling microbial and arthropod caused diseases.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

Swami Ramanand Teerth Marthwada University, Nanded
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN
Faculty of Science
w. e. f. Academic Year 2020-2021
M.Sc. In Zoology
Detailed Syllabus
Third Semester
Course Code- XIII-B
Theory Paper- XIII-B
Fishery Science- I
Title of the Paper: Fish Morphology, Anatomy and Physiology- I

Periods: 60 Credits: 04

Objectives

1) To understand the structure of and relation between different groups of fish.
2) To acquire skill to identify and broadly classify fish.
3) To learn and understand the feeding and digestive mechanisms in fish.
4) To appreciate the respiratory mechanisms in different groups of fish.
5) To understand the significance of biological rhythms in fish growth.

Unit- I **15**

1. Scope and Significance of Fishery Science.
2. Classification of fishes.
3. General characters of Elasmobranchii, Teleostomi- Actinopterygii, Crossopterygii.
4. Integument and Exoskeleton- Fish skin and functions, Exoskeleton- Types of scales.

Unit- II **15**

5. Endoskeleton of typical cartilaginous and Bony fishes- Skull, Vertebral column, Appendicular skeleton.
6. Colouration in fishes- Chromatophores, Biological Significance of colouration
7. Food, feeding habits and digestion- Feeding habit of Teleosts, Alimentary canal and its modification, Physiology of digestion.

Unit- III **15**

8. Respiration- Organs of respiration in fishes, Types and structure of gills, Accessory respiratory organs.
9. Circulation- Structure and working of teleostean heart, Afferent and efferent branchial vessels in Teleosts

Unit- IV **15**

10. Excretion and Osmoregulation- In freshwater fish, In marine fish.
11. Biological rhythms in fish- Circadian rhythms, Circannual rhythms, Role of rhythms in Reproduction and Migration.

Outcomes

1. Explain the inter-relation between different groups of fish.
2. Be able to identify and broadly classify fish.
3. Appreciate the relation between environment and feeding and digestion in fish.
4. Describe the respiratory mechanisms in different groups of fish.
5. Explain the significance of biological rhythms in fish growth and reproduction.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. Fish and fisheries of India - V. J. Jhingran.
3. A manual of freshwater fish culture - R. Santharmma N. Sakuran and Natrajan.
4. A Text Book of Fishery Science in India - C. B. L. Srivastava
5. An Introduction to Indian Fisheries. - Sharma and Grover
6. Introduction of Fishes by - S. S. Khanna
7. Bal D.V. and Rao K.V. 1989 - Marine Fisheries
8. Hand Book Breeding of Indian Major carps by Chondar S.Z.
9. Huet M. 1972 Text Book of Fish culture Breeding and cultivation of fish fishing New (Books) Ltd. Surrey England.
10. Jayaram K.C. 1978 Fresh Water Fishes of India, Pakistan, Bangladesh, Burma and Srilanka - Hand Book Zoological Survey of India Calcutta.
11. C.V. and Sebastian V.O. 1986 Prawns and Fisheries of India Hindustan Publishing Corp, Delhi.
12. Moyle P.B. and Cech. J.J. Jr 1988 - Fishes an Introduction to Ichthyology - Prentice all, Englewood cliffs N.J.
13. Norman J.R. 1975 A History of Fishes Third Edn by PH.
14. Balkrishnan N.N. and Thampy D.M. 1980 A Text Book of Marine Ecology, Macmillan India.
15. A Text Book of Fish Biology and Fisheries - by S.S. Khanna and H.R. Singh.
16. Anatomy and Physiology of Fishes - by Santosh Kumar and Manju Tembhre
17. Practical Manual on Fish Biology by Ashok Kumar, Jaiswal, S.K. Chakraverthy, CIFE Publication.
18. An Introduction to Fishes - by S.S. Khanna.
19. Ichthyology - by Lagler
20. Behaviour and Physiology of Fish- Sloman, K. A., Wilson, R. W., & Balshine, S. (2005). (1st Ed., Vol. 24). Academic Press.

M.Sc. In Zoology

Detailed Syllabus

Third Semester

Laboratory Course: XIII-B based on THEORY PAPER- XIII-B

Fishery Science- I

Laboratory Course- XIII-B: Fish Morphology, Anatomy and Physiology- I

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To learn morphology of fish of different groups.
2. To study structure of different types of scales in fish.
3. To observe skeletal components of fish.
4. To learn about different feeding habits of fish based on their gut content.
5. To expose and study internal anatomy of fish of different groups.

Practicals

1. Identification of any **four** specimens from Elasmobranchs.
2. Identification of any **four** specimens from Actinopterygii.
3. Identification of any **two** specimens from Crosspterygii.
4. Identification of caudal fin types in Fishes.
5. Mounting of placoid scales- temporary and permanent preparations.
6. Mounting of cycloid and ctenoid scales- temporary and permanent preparations.
7. Identification of skull, vertebrae and girdles in bony fish.
8. Identification of skull, vertebrae and girdles in cartilagenous fish.
9. Study of aggregation and dispersion phenomena of chromatophores in fish.
10. Study of digestive system of herbivorous and carnivorous fish.
11. Study of gut content of herbivorous and carnivorous fish.
12. Study of heart, ventral aorta and afferents arteries of cartilagenous fish.
13. Study of heart, ventral aorta and afferents arteries of bony fish.
14. Study of accessory respiratory organs in Clarius, Channa, Anabas and Heteropneustus fossilis.
15. Study of circadian rhythms in suitable fish.
16. Preparation and mounting of any two fish skeletons.

Submission of all permanent slides and other models prepared at the time of exam.

Outcomes

1. Describe morphology of fish from different groups.
2. Explain the structure of different types of scales in fish.
3. Identify and describe skeletal components of fish.
4. To learn about different feeding habits of fish based on their gut content.
5. To expose and study internal anatomy of fish of different groups.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

M.Sc. In Zoology

Detailed Syllabus

Third Semester

Course Code- XIII-C

Theory Paper- XIII-C

Title of the Paper: INSECT STRUCTURE & FUNCTION

Periods: 60 Credits: 04

Objectives

1. To understand anatomy and morphology of head and mouth parts of insects.
2. To learn about thorax and its parts in insects.
3. To explore the structure and functions of digestive, circulatory and excretory systems.
4. To study the structure and working of the respiratory, nervous and reproductive systems.

UNIT- I **15**

1. Insect: General morphology and exoskeleton in insect.
2. Integument- Structure, composition & function; molting.
3. The Head- Segmentation, exo and endo skeleton; head appendages.
4. Different types of mouth parts and mechanism of feeding in insects.
   - 4.1. The chewing mouth parts- cockroach.
   - 4.2. The piercing & sucking mouth parts- mosquito.
   - 4.3. The sponging mouth parts- housefly.
   - 4.4. The siphoning mouth parts- butterfly.

UNIT- II **15**

5. The thorax : structure, exo and endo skeleton.
6. Wings: structure, modification, halteres, wing venation and coupling apparatus.
   - 6.1. The legs: general structure, types of legs, modification for locomotion on land and in water.
   - 6.2. Abdomen: structure, external genitalia of male and female insects.

UNIT- III **15**

7. The digestive system: the alimentary canal: its morphology, histology and modification; digestive glands and enzymes, microfauna, digestion of organic compounds, keratin and wax.
8. Circulatory system and circulation: structure of circulatory system, structure of heart, haemolymph: composition; course of circulation.
9. Excretory system and osmoregulation: structure of Malpighian tubules; nitrogenous excretion; water and ionic regulation.

UNIT- IV **15**

10. Respiratory system and respiration: tracheal system; spiracles, trachea, tracheoles and air sacs; respiration in aquatic insects and endo-parasitic insects: mechanism of ventilation.
11. Nervous system and nerve co-ordination: Brain, ganglia, nerve cord and nervous integration.
12. Reproductive system and reproduction: Reproductive organs of male and female in Honey bee.

Outcomes

1. To describe the anatomy & morphology of head and mouth parts of insects.
2. To explain the structure of thorax & appendages and their functions in insects.
3. To represent the structure and functions of digestive, circulatory and excretory systems.
4. To elaborate about structure & working of respiratory, nervous & reproductive systems.

Suggested Reading.

1. **Online resources like academic, research databases etc are recommended.**
2. K. K. Nayar, T. Anant Krishnan and B.W. David : General and Applied Entomology.
3. G. L. Metcalf and W. P. Fling : Destructive and useful inset.
4. Hemsingh Pruthi : A Textbook of Agricultural Entomology.
5. Wigglesworth : Principles of insect physiology.
6. ESSIG : College entomology.
7. M. S. Mani : A text book of General Entomology.
8. Government of Maharashtra publ : Crop pests and how to fight them.
9. Oldroyd : Collection, Preserving and Studying insects.
10. Roger P. and Anderson : Forest and shade tree entomology.
11. D. B. Tembhare : Modem Entomology.
12. RE. Fradt : Fundamentals of applied entomology.
13. K.G.V. Smith : Insects and other Arthropods of Medical importance.
14. D.N. ray and A.W.A. Brown : Entomology medical& veterinary.
15. Chandler. A.C. and Read C.P. : Introduction to Parasitology.
16. R. Debatch : Biological control of natural Enemies.
17. Apple J.L. and Smith R.F. : Integrated pest management.
18. Cheny : General Parasitology.
19. Corbet J.R. : The biochemical mode of action Pesticides.
20. Champman RF : Insects-structure and function O.W. Richards .
21. R.G.Davies; Imms : Text book of Entomology.
22. BursellE : An introduction to insect physiology.
23. Rockstein M. Vol. (1-VI) : The physiology of Insects.
24. Shrivastave K.P.Vol (I-H) : A text book of applied Entomology.
25. Johanson O. A. : Embryology of insects & Myriopods.
26. Ross, H. A. : Text book of Entomology.
27. Roddick : Insect physiology.

LABORATORY COURSE- XIII-C based on THEORY PAPER- XIII-C

ENTOMOLOGY- I

Laboratory Course XIII-C: INSECT STRUCTURE & FUNCTION

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. Study anatomical and morphological structures of insects.
2. Learn dissecting skills required in study of insect anatomy.
3. Develop skills of microtechnique and prepare permanent slides of insect organs.

Practicals

1. Study of external morphology of locally available insect (any five).
2. Study of insect head and its segmentation.
3. Study of types of insect head and its appendages.
4. Study and mounting of trachea, antennae, wings, halteres and legs of insects.
5. Study of structure of thorax and abdomen in male and female insects.
6. Study of wing venation and modification of wings in insects.
7. Study of genitalia and ovipositor in insects.
8. Dissection of Digestive system in Cockroach, Grasshopper, Honey bee or Nepa.
9. Dissection of Nervous system in Cockroach, Grasshopper, Honey bee or Nepa.
10. Dissection of Reproductive system in Cockroach, Grasshopper, Honey bee or Nepa.
11. Dissection of Excretory system in Cockroach, Grasshopper, Honey bee or Nepa.
12. Estimation of digestive and other enzymes from suitable insect.
13. Mounting of mouth parts of mosquito, housefly, butterfly, cockroach and; sting apparatus of honey bee.
14. Qualitative survey of digestive enzymes present in salivary glands and gut.
15. Detection of uric acid as end product of excretion in terrestrial insects.
16. Histological study of any five insect organs by microtechnique.

    Students should submit at least 10 slides of mounting and microtomy at the time of examination.

Outcomes

1. Describe the various anatomical and morphological structures of insects.
2. Demonstrate dissecting skills required in study of entomology.
3. Prepare permanent slides of insect organs.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

M.Sc. In Zoology

Detailed Syllabus

Third Semester

Course Code- XIII-D

Theory Paper- XIII-D

Animal Physiology- I

Title of the Paper: GENERAL PHYSIOLOGY- I

Periods: 60 Credits: 04

Objectives

1. To understand significance and mechanism of homeostasis in animals.
2. To learn about neuron structure and function.
3. To study respiratory aspects of high altitude and diving.
4. To realize the importance of physiology of physical exercise and Yoga.

UNIT- I: Homeostasis and Thermo-regulation **15**

1. Definition and concept of homeostasis.
2. Characteristics of homeostasis.
3. Factors destabilizing homeostasis mechanism (Fever and Diabetes mellitus).
4. Physiology of homeostatic mechanism with suitable examples.
5. Temperature compensation in poikilotherms and their regulatory mechanism.
6. Temperature compensation in homeotherms and their regulatory mechanism.

UNIT- II: Nerve Physiology **15**

7. Types and structure of neurons; Glial cells.
8. Functional properties of the nerve fiber.
9. Physiology of modulated and non modulated transmission of nerve impulse, Action potential.
10. Ultrastructure of synapse and synaptic transmission.
11. Biosynthesis, storage and release of neurotransmitter – Acetylcholine, Acetylcholinesterase.
12. The reflex action and the reflex arc.
13. Properties and types of reflexes.

UNIT- III: Physiology of High Altitude **15**

14. Layers of the Atmosphere.
15. Effects of high altitude on humans.
16. Acclimatization to high altitude.
17. Physiological disorders at high altitude- Dyspnoea and Asphyxia.
18. Physiological polycythemia.
19. Underwater Physiology- Introduction, effects of gases on body
20. Underwater Respiration, SCUBA Diving.

UNIT- IV: Work Physiology **15**

21. Types of exercise- Severe and Moderate Exercise
22. Circulatory and cardiovascular changes during muscular exercise
23. Blood pressure during exercise
24. Respiratory responses to exercise
25. Endocrine response to exercise, Muscle Fatigue.
26. Meditation, Yoga and their benefits.

Outcomes

1) To describe the different mechanisms of homeostasis in animals.
2) To elaborate about and relate the structure and functions of neurons.
3) To explain respiratory functions under conditions of high altitude and under water.
4) To explain the relation between physiology of body with physical exercise and Yoga.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. Bell & Davidson, Text Book of Physiology and Biochemistry.
3. Bolander F. F., Molecular Endocrinology.
4. Cole S.W., The Practical Physiological Chemistry.
5. Eckert, Marsall, Animal Physiology Mechanism and Adaptations.
6. Eckert & Ranadak, Animal Physiology (CBS), 2nd Ed. (1978).
7. Garden M.S., Animal Physiology, Principal and Adaptations.
8. Hill R.W., Comparative Physiology of Animals.
9. Hoar W.S., General and Comparative Physiology.
10. Houssay, Human Physiology, McGraw Hill Books Company.
11. Hunter & Bornford, Hutchinson's Clinical Methods.
12. Heil E. Joets N., Physiology, Oxford University Press (1982).
13. Chatterjee C.C., Human Physiology, Vol. 1 & 2.
14. Mill Peter J., Comparative Neurobiology (Ed. Hrbord London).
15. Mitchell P.H., Text Book of General Physiology.
16. Norman A.W., Hormones.
17. Philips G., Environmental Physiology.
18. Prosser C.L., Comparative Animal Physiology.
19. Smith, Patterson, Text Book of Physiology (ELBS) Read & Scratched (1988) 11th Ed.
20. West, Best & Taylor's, Physiological Basis of Medical Practice.
21. Wilson J.A., Principles of Animal Physiology.
22. Wod Dennus W., Principles of Animal Physiology (Ed. Arbod) London.

M.Sc. In Zoology

Detailed Syllabus

Third Semester

LABORATORY COURSE XIII-D based on THEORY PAPER- XIII-D

Animal Physiology- II

Laboratory Course XIII-D: GENERAL PHYSIOLOGY- I

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To learn about relationship between respiration and external factors in animals.
2. To study structure of neuro-endocrine function in animals.
3. To study haemotological parameters of animals.

Practicals

1. To study the rate of oxygen consumption by aquatic animals in relation to salinity.
2. To study the rate of oxygen consumption by aquatic animals in relation to temperature.
3. To study the changes of blood glucose level under environmental stresses in a vertebrate species.
4. Estimation of acetylcholine in given blood sample.
5. Study of nerve cells and neurosecretory cells of cockroach (temporary slide).
6. Study of nerve cells and neurosecretory cells of cockroach (permanent slide).
7. Demonstration of reflex action in frog.
8. Demonstration of knee-jerk reflex in human.
9. Study of heart beat and respiration in man at high altitude.
10. Study of physiological polycythemia in man.
11. Study of blood pressure under normal condition and during exercise.
12. Effect of temperature on muscle activity.
13. Effect of load on muscle activity.
14. Effect of low atmospheric pressure on heart rate in suitable animal.
15. Effect of exercise on breathing rate, pulse rate and blood lactate in human.
16. Visit to Yoga Centre / Demonstration by expert.

Visit to zoology research center and submission of report at the time of exam.

Outcomes

1. Correlate respiration with external environmental factors in animals.
2. Describe structure of neuro-endocrine function in animals.
3. Explain the different haemotological parameters of animals.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

M.Sc. In Zoology

Detailed Syllabus

Third Semester

Paper XIV-A: Applied Parasitology- II

Title of the Paper: PROTOZOANS OF MEDICAL IMPORTANCE

Periods : 60 **No. of Credits: 04 (Marks: 100)**

Objectives:

1. To introduce students to the basic concepts of Protozoan Parasitology.
2. To provide a broad-based knowledge and understanding of Parasitology with special emphasis on Protozoans of medical importance.
3. To study about protozoans of public health importance.
4. To understand the morphology, life cycle, pathogenicity and control measures of important Protozoans.
5. To understand and apply the principles of controlling diseases caused by Protozoans.

Unit I **15**

1. **Introduction to Parasitology**: Brief introduction to Parasitology, its scope and branches; Animal associations- Symbiosis, Commensalism, Phoresis and Parasitism; Host parasite relationship.
2. Types of Parasites; Types of hosts- Definitive and intermediate, primary secondary specific host, Paratenic, Carrier, Susceptible, Resistant, Accidental, Vectors etc.
3. Origin and evolution of parasitic Protozoa. Parasitism in Protozoa.
4. **Parasitic Protozoa:** Classification of protozoa as proposed by Levine et al, 1980.
5. General organization of Protozoa- Sarcodina, Flagellata, Ciliata and Sporozoa.
6. Methods of feeding, digestion, nutritional requirements and culture of parasitic protozoa.

Unit II **15**

7. Locomotion in Protozoa.
8. Growth and methods of multiplication in the protozoan parasites.
9. **Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of-**
    1. Sarcodine amoeba *(Entamoeba histolytica, Entamoeba coli*)
    2. Opalinids *(Opalina* spp).
    3. Coccidia and coccidiosis in birds with special reference to *Eimeria telella*

Unit III **15**

10. **Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of-**
    1. Sporozoan *(Toxoplasma* spp, *Isospora belli Plasmodium vivax and P. falciparum*, *Sarcocystis cruzei*)
    2. Ciliates *Balantidium coli*, *Nyctotherus* spp and *Ichthyopthirius* spp)

Unit IV **15**

11. **Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of-**
    1. Haemoflagellates *(Trypanosoma gambiense; Trypanosoma cruzi* and *Leishmania donovanii*)
    2. Intestinal Flagellates *(Giardia lamblia, Trichomonas vaginalis* and *Trichomonas foetus*)

Expected Outcomes:

1. Students are able to identify Protozoans of medical importance.
2. Describe basics of Protozoans of public health importance.
3. Able to understand and apply the principles of controlling Protozoan diseases.
4. Explain about Host-Parasite relationship.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. An Introduction to Protozoology by Dogiel
3. Chemical Zoology Vol I by Florkin and Sheer
4. Protozoology by Grell
5. Protozoology by Hall
6. The Coccidia by Hammond and Long
7. Parasitic Protozoa Vol, I-II by Krier et al
8. Protozoology by Kudo
9. An Introduction to Prozoan Parasities of domestic animals and man by Levine
10. An Introduction to Protozoa by Manwell
11. Essential Parasitology by Scmidt
12. Biology of Protozoa by Sleigh
13. Parasitism by Cameron
14. Animal Parasitism by Read
15. Medical Parasitology N.C. Dey, T.K. Dey, ALLIED AGENCY 36, Dr. Sundari Mohan Avenue Calcutta-7000014.
16. Medial Parasitology by K.D. Chatterjee
17. Parasitology by G.D. Smith
18. Parasitoogy by Coble Raymand, Bombay Allied Pacific Pvt. Ltd.
19. Parasitology The Biology of Animal Parasites by Nofel E.R., Philadelophia, Lea & Febiger.
20. Parasitic protozoa by Baker J.R. London, Hutchinson U'ty, Library.
21. Parasites & Parasitism by Chameron Thanas W.A.M. Londan, the English Language Book Society.
22. Medical Parasitology by Markell, Voge and John 8th ed. W.B. Saunders Co.
23. Text book of medical parasitology by Sawitz
24. Parasitology by Nobel and Nobel

M.Sc. In Zoology

Detailed Syllabus

Third Semester

Laboratory Course XIV-A based on Theory Paper- XIV-A

Applied Parasitology- II

Lab Course XIV-A: PROTOZOANS OF MEDICAL IMPORTANCE

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To study protozoans of medical importance.
2. To learn techniques of micropreparation, microscopy and micrography of protozoans.
3. To develop skill of identification of pathogenic protozoans.
4. To learn techniques of isolation of pathogenic protozoans.

Practicals

1. Standardization of microscope; drawings of protozoans to scale, measurement of protozoans.
2. Different types of stains used in study of protozoans.
3. Study of different type of animal associationship with a suitable example.
4. Study of different types of parasites, vectors etc.
5. **Identification, classification and description of Protozoan Parasites through permanent slides/photomicrographs-** Sarcodine amoeba *(Entamoeba histolytica*); Opalinids *(Opalina* spp);Coccidean (*Eimeria telella)*.
6. **Identification, classification and description of Protozoan Parasites through permanent slides/photomicrographs-** Sporozoan *(Toxoplasma* spp, *Isospora belli, Plasmodium vivax and P. falciparum.;*Ciliates *Balantidium coli*, *Nyctotherus* spp and *Ichthyopthirius* spp)
7. **Identification, classification and description of Protozoan Parasites through permanent slides/photomicrographs-** Haemoflagellates *(Trypanosoma gambiense; T. cruzi* and *Leishmania donovanii*); Intestinal Flagellates *(Giardia lamblia, Trichomonas vaginalis* and *Trichomonas foetus*)
8. Study of flagellates in alimentary canal and urinogenital tract of vertebrates and invertebrates.
9. Collection, fixation, staining and preservation of protozoa by wet and dry methods.
10. Demonstration of silver line system of staining ciliate protozoans by Klein's method.
11. Study of haemoflagellates from vertebrate's blood.
12. Preparation of blood smear, staining and identification of haemosporina.
13. Preparation of specimens for the study of Fecal smear, Alimentary tract and Blood smear (At least 5 slides)
14. Study of different mosquito species and *Glossina palpalis* vectors of protozoan parasites.
15. Zine sulphate floatation technique for protozoan cyst.
16. Autopsy and recovery of protozoan parasites from suitable hosts.

Submission of permanent slides at the time of exam.
Visit to parasitology research center and submission of report at the time of exam.

Outcomes

1. Describe protozoans of medical importance.
2. Perform micropreparation, microscopy and photo-micrography of protozoans.
3. Identify pathogenic protozoans.
4. Isolate of pathogenic protozoans.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

Swami Ramanand Teerth Marthwada University, Nanded
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN
Faculty of Science
w. e. f. Academic Year 2020-2021
M.Sc. In Zoology
Detailed Syllabus
Third Semester
Course Code- XIV-B
Theory Paper- XIV-B
Fishery Science- II
Title of the Paper: Fish Morphology, Anatomy and Physiology- II

Periods: 60 Credits: 04

Objectives

1. Understanding structure and functions of the fish nervous system & reproductive system.
2. Learning about the migration patterns, growth & age determination of fish species.
3. Exploring specialized organs in fish like swim bladder, electric & acoustic organs.
4. Studying the endocrine and venom glands in fish.

Unit- I **15**

1. Nervous System- Structure and function of Brain, Lateral Line Canal System.
2. Reproduction- Organs of reproduction, Maturation and spawning, Seasonal changes in gonads, Fecundity & Spawning periodicity. Parental Care in Fishes.

Unit- II **15**

3. Migration of Fishes- Types of migration, Patterns of migration, Causes of migration, Advantages of migration, Factors influencing migration.
4. Age and growth in Fishes- Methods of determining age & growth- Tagging, marking, scale & otolith method, Factors influencing growth of fish.

Unit- III **15**

5. Swim bladder and its modifications- Structure of the swim bladder, Structural modifications, Function of the swim bladder.
6. Electric Organs- Structure of the electric organs in various fishes, Mechanism of electric discharge, Function of electric organs.
7. Bioluminescence and Sound Production- Luminiscent organs in fishes, Physiology of light production, Sound producing organs in fishes, Significance of Sound production.

Unit- IV **15**

8. Endocrine glands- Pituitary gland : Structure and functions of Pituitary gland, Thyroid gland: Structure and functions of Thyroid gland, Adrenal gland: Structure and functions of Adrenal gland.
9. Fish Venoms and poisons- Venom apparatus in Stingray, Scorpion Fishes and Weavers, Dangerous Fishes- Puffer fish, Lion fish (Pterois spp.), Candiru, (*Vandellia cirrhosa*), Stonefish (*Synanceja spp.*).

Outcomes

1. Ability to describe the structure and functions of the nervous & reproductive systems.
2. Elaborate the migration patterns, growth & age determination methods of fish species.
3. Describe the specialized organs like swim bladder, electric & acoustic organs in fish.
4. Explain the working of endocrine and venom glands in fish.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. Fish and fisheries of India - V. J. Jhingran.
3. A manual of freshwater fish culture - R. Santharmma N. Sakuran and Natrajan.
4. A Text Book of Fishery Science in India - C. B. L. Srivastava
5. An Introduction to Indian Fisheries. - Sharma and Grover
6. Introduction of Fishes by - S. S. Khanna
7. Bal D.V. and Rao K.V. 1989 - Marine Fisheries
8. Hand Book Breeding of Indian Major carps by Chondar S.Z.
9. Huet M. 1972 Text Book of Fish culture Breeding and cultivation of fish fishing New (Books) Ltd. Surrey England.
10. Jayaram K.C. 1978 Fresh Water Fishes of India, Pakistan, Bangladesh, Burma and Srilanka - Hand Book Zoological Survey of India Calcutta.
11. C.V. and Sebastian V.O. 1986 Prawns and Fisheries of India Hindustan Publishing Corp, Delhi.
12. Moyle P.B. and Cech. J.J. Jr 1988 - Fishes an Introduction to Ichthyology - Prentice all, Englewood cliffs N.J.
13. Norman J.R. 1975 A History of Fishes Third Edn by PH.
14. Balkrishnan N.N. and Thampy D.M. 1980 A Text Book of Marine Ecology, Macmillan India.
15. A Text Book of Fish Biology and Fisheries - by S.S. Khanna and H.R. Singh.
16. Anatomy and Physiology of Fishes - by Santosh Kumar and Manju Tembhre
17. Practical Manual on Fish Biology by Ashok Kumar, Jaiswal, S.K. Chakraverthy, CIFE Publication.
18. An Introduction to Fishes - by S.S. Khanna.
19. Ichthyology - by Lagler
20. Behaviour and Physiology of Fish- Sloman, K. A., Wilson, R. W., & Balshine, S. (2005). (1st Ed., Vol. 24). Academic Press.

LABORATORY COURSE based on THEORY PAPER-XIV-B:

Fishery Science- II

Laboratory Course XIV-B: Fishery Science- II

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To understand methods of determination of fecundity, age and biometric constants in fish.
2. To learn about anatomy of internal organs of fish.
3. To study migratory and fish with specialized organs.
4. To learn about histology of endocrine glands in fish.

Practicals

1. Estimation of Fecundity.
2. Study of spawning periodicity of fish by ova diameter method.
3. Determination of age of given fish by scale method.
4. Study of relationship between length and weight of fish; and condition factor of fish.
5. Determination of gonado-somatic index (GSI) of given fish.
6. Study of structure of brain in bony and cartilaginous fish.
7. Study of structure of membranous labyrinth in bony fish.
8. Study of structure of membranous labyrinth in cartilaginous fish.
9. Study of structure of cranial nerves in bony fish.
10. Study of structure of cranial nerves in cartilaginous fish.
11. Study of structure of reproductive system in bony fish.
12. Study of structure of reproductive system in cartilaginous fish.
13. Study of structure of Weberian ossicles in bony fish.
14. Study of structure of air bladder in bony fish.
15. Identification of migratory fish, electric fish and poisonous fish (any two of each).
16. Identification of parental care by observing fish.
17. Histological identification of pituitary, thyroid, adrenal glands, ovary and testes in fish (permanent slide).

Visit to fish breeding/farming/research center and submission of report at the time of exam.

Outcomes

1. Perform determination of fecundity, age and biometric constants in fish.
2. Describe anatomy of internal organs of fish.
3. Explain about migratory fish and specialized organs in fish.
4. Identify different endocrine gland micropreparations based on their histology.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

Swami Ramanand Teerth Marthwada University, Nanded
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN
Faculty of Science
w. e. f. Academic Year 2020-2021
M.Sc. In Zoology
Detailed Syllabus
Third Semester
Course Code- XIV-C
Theory Paper- XIV-C
Title of the Paper: INSECT TAXONOMY, INSECT DEVELOPMENT AND ECOLOGY

Periods: 60 Credits: 04

Objectives

1. To learn techniques of collection & processing of insect specimens.
2. To understand taxonomy of insects.
3. To explore the developmental biology of insects.
4. To study the ecological and social aspects of insect life.

UNIT- I **15**

1. Collection, preservation, curation and study of insects. General principles of insect classification, taxonomic procedures, newer trends in insect taxanomy.
2. Classification of Apteryogte insect: Thysanura.
3. Pterygota: Exopterygota groups: (diagnostic characters & examples)
   3.1. Order: Odonata, Order: Orthoptera
   3.2. Order: Isoptera, Order: Hemiptera

UNIT- II **15**

4. Endopterygota groups: (diagnostic characters & examples of)
   4.1. Order: Lepiodeptera, Order: Coleoptera
   4.2. Order: Diptera, Order: Hymenoptera

UNIT- III: Insect development **15**

5. Spermatogenesis and oogenesis; structure of insect eggs. Cleavage and early development.
6. Post embryonic development and metamorphosis, types of metamorphosis, significance of metamorphosis, endocrinal control of metamorphosis.
7. Types of Insect larvae and pupae.

UNIT- IV **15**

8. Insect Ecology- Effect of temperature and humidity on insect life; Diapause; Insect migration-locust migration.
9. Social life in insects; Communication in insects; Host pest interaction; Host plant preference of insects.
10. Food as a limiting factor for distribution and abundance. Insect galls- formation structure and ecology.

Outcomes

1. Ability to collect & process insect specimens.
2. Explain the detailed classification of insects.
3. Describe types of development and its stages in insects.
4. Elaborate about the ecology and social organization of insects.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. K. K. Nayar, T. Anant Krishnan and B.W. David : General and Applied Entomology.
3. G. L. Metcalf and W. P. Fling : Destructive and useful inset.
4. Hemsingh Pruthi : A Textbook of Agricultural Entomology.
5. Wigglesworth : Principles of insect physiology.
6. ESSIG : College entomology.
7. M. S. Mani : A text book of General Entomology.
8. Government of Maharashtra publ : Crop pests and how to fight them.
9. Oldroyd : Collection, Preserving and Studying insects.
10. Roger P. and Anderson : Forest and shade tree entomology.
11. D. B. Tembhare : Modem Entomology.
12. RE. Fradt : Fundamentals of applied entomology.
13. K.G.V. Smith : Insects and other Arthropods of Medical importance.
14. D.N. ray and A.W.A. Brown : Entomology medical& veterinary.
15. Chandler. A.C. and Read C.P. : Introduction to Parasitology.
16. R. Debatch : Biological control of natural Enemies.
17. Apple J.L. and Smith R.F. : Integrated pest management.
18. Cheny : General Parasitology.
19. Corbet J.R. : The biochemical mode of action Pesticides.
20. Champman RF : Insects-structure and function O.W. Richards .
21. R.G.Davies; Imms : Text book of Entomology.
22. BursellE : An introduction to insect physiology.
23. Rockstein M. Vol. (1-VI) : The physiology of Insects.
24. Shrivastave K.P.Vol (I-H) : A text book of applied Entomology.
25. Johanson O. A. : Embryology of insects & Myriopods.
26. Ross, H. A. : Text book of Entomology.
27. Roddick : Insect physiology.

LABORATORY COURSE based on THEORY PAPER- XIV-C:

Entomology- II

Laboratory Course XIV-C: Insect Taxonomy, Insect Development and Ecology

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To develop the skills of collection, curation and preservation of insect specimens.
2. To understand the systematics and taxonomy of insects.
3. To develop skill of rearing insects of economic and academic importance.
4. To identify and study pestilence of insects on plants.

Practicals

1. Insect collection, preservation, curation and identification of insects belonging to different Exopterygote orders (any five).
2. Insect collection, preservation, curation and identification of insects belonging to different Endopterygote orders (any five).
3. Study of representative species of insects from Exopterygota (any five).
4. Study of representative species of insects from Endopterygota (any five).
5. Study of insect eggs, larvae and pupae.
6. Rearing of insects in the laboratory (at least one species to be reared)
7. Study of metamorphosis steps of insects (Rearing of at least one insect to be done).
8. Collection and study of insect induced maladies in plants.
9. Study of different castes in honey bee and termite colonies.
10. Study of effect of temperature on egg laying and egg hatching of insect.
11. Study of effect of moisture on egg laying and egg hatching of insect.
12. Study of insect host plant relationship, host range.
13. Study of insect species diversity indices and species richness.
14. Study of insect species Simpson index and Shannon-Weiner index.
15. Candidates should submit at least 25 locally available insects at the time of examination.

    Submission of processed insect collection at the time of exam.

Outcomes

1. Perform collection, curation and preservation of insect specimens.
2. Explain the systematics and taxonomy of insects.
3. Culture insects of economic and academic importance in the laboratory.
4. Identify and describe insect pests on plants.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

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CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN
Faculty of Science
w. e. f. Academic Year 2020-2021
M.Sc. In Zoology
Detailed Syllabus
Third Semester
Course Code- XIV-D
Theory Paper- XIV-D
Animal Physiology-II
Title of the Paper: GENERAL PHYSIOLOGY- II

Periods: 60 Credits: 04

Objectives

1. To learn about the distinctions between prokaryote and eukaryote structure.
2. To study the relation between different aspects of metabolism.
3. To explore different enzymes, their properties, functions and interactions.
4. To understand energy pathways, intermediaries and dynamics in cells.

UNIT- I: Nature of Prokaryotic and Eukaryotic cells **15**

1. Origin, structure and composition of Prokaryotic cells.
2. Origin, structure, organisation and composition of Eukaryotic cells.
3. Permeability of plasma membrane to water.
4. Methods of studying permeability of cell membrane.
5. Osmosis, Osmotic pressure and solute requirements of living tissues.

UNIT- II: Metabolism **15**

6. Introduction and Definition.
7. Energy Metabolism.
8. Methods for determination of energy output.
9. Respiratory Quotient (R. Q.)
10. Basal Metabolism – Factors affecting B.M.R.
11. Mineral Metabolism – Calcium, Phosphorous and Sodium.

UNIT- III: Enzymology **15**

12. Units of enzyme activity; Co-enzymes and cofactors; energy of activation, enzyme specificity.
13. Enzyme kinetics: Michaelis-Menten Equation and Lineweaver-Burk equation. Factors affecting enzyme reaction.
14. Enzyme inhibition, enzyme isoforms – structural basis and functional significance, LDH, hexokinase.
15. Application of enzymes: Clinical, industrial, therapeutic, enzymes in recombinant DNA technology.

UNIT- IV: Bioenergetics **15**

16. Redox potential, free energy and free energy change, high energy compounds.
17. Electron transport chain.
18. Oxidative phosphorylation: Sites, Energetics and Mechanism of Oxidative phosphorylation.
19. Inhibitors of Oxidative phosphorylation.
20. Enzymes involved in Biological Oxidation.

Outcomes

1. Ability to distinguish between prokaryotes and eukaryotes.
2. Trace relation between different aspects of metabolism.
3. Knowledge of different types of enzymes, their properties, functions and interactions.
4. An appreciation of energy pathways, intermediaries and dynamics in cells.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. Bell & Davidson, Text Book of Physiology and Biochemistry.
3. Bolander F. F., Molecular Endocrinology.
4. Cole S.W., The Practical Physiological Chemistry.
5. Eckert, Marsall, Animal Physiology Mechanism and Adaptations.
6. Eckert & Randall, Animal Physiology (CBS), 2nd Ed. (1978).
7. Garden M.S., Animal Physiology, Principal and Adaptations.
8. Hill R.W., Comparative Physiology of Animals.
9. Hoar W.S., General and Comparative Physiology.
10. Houssay, Human Physiology, McGraw Hill Books Company.
11. Hunter & Bornford, Hutchinson's Clinical Methods.
12. Heil E. Joets N., Physiology, Oxford University Press (1982).
13. Chatterjee C.C., Human Physiology, Vol. 1 & 2.
14. Mill Peter J., Comparative Neurobiology (Ed. Hrbord London).
15. Mitchell P.H., Text Book of General Physiology.
16. Norman A.W., Hormones.
17. Philips G., Environmental Physiology.
18. Prosser C.L., Comparative Animal Physiology.
19. Smith, Patterson, Text Book of Physiology (ELBS) Read & Scratched (1988) 11th Ed.
20. West, Best & Taylor's, Physiological Basis of Medical Practice.
21. Wilson J.A., Principles of Animal Physiology.
22. Wod Dennus W., Principles of Animal Physiology (Ed. Arbod) London.

M.Sc. In Zoology

Detailed Syllabus

Third Semester

LABORATORY COURSE XIV-D based on THEORY PAPER- XIV-D:

Animal Physiology-II

Laboratory Course XIV-D: GENERAL PHYSIOLOGY- II

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To understand response of animals to stress.
2. To observe and study eukaryotic cells using a microscope.
3. To acquire skills of estimation of organic biomolecules from animal tissues.
4. To study toxicity of chemicals on animal physiology.

Practicals

1. Study of osmosis by using RBCs of vertebrate animals.
2. Study of eukaryotic cell structure by mounting buccal epithelial cell.
3. Active transport of glucose through intestinal wall of vertebrates (Collection of fresh intestine from slaughter house).
4. Determination of respiratory quotient (R.Q.) of any aquatic animal.
5. To study effect of hormone on respiratory metabolism in any aquatic animal.
6. Estimation of blood glucose in human.
7. Estimation of haemoglobin in human.
8. Study of effect of pH and temperature on enzyme activity (Salivary amylase).
9. Study of effect of inhibitors on enzyme activity.
10. Estimation of ATPase.
11. Quantitative estimation of Calcium, Sodium and Potassium in blood serum / plasma.
12. Quantitative estimation of digestive enzymes in hepatopancreas of crab or liver of vertebrate.
13. Estimation of Succinic Dehydrogenase (SDH) (Fresh tissue from slaughter house).
14. Effect of selected toxicant on RBC and WBC of fish.
15. Effect of selected toxicant on hemoglobin of fish.
16. Study effect of adrenaline on heat generation in suitable animal.

Visit to a pathology lab / research center and submission of report at the time of exam.

Outcomes

1. Elaborate about responses of animals to different types of stress.
2. Identify and describe eukaryotic cells organelles using a microscope.
3. Estimate organic biomolecules from animal tissues and body fluids.
4. Perform toxicity testing for chemicals in animals.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

Swami Ramanand Teerth Marthwada University, Nanded
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN
Faculty of Science
w. e. f. Academic Year 2020-2021
M.Sc. In Zoology
Detailed Syllabus
Fourth Semester
Course Code: XVI
Theory Paper- I
Title of the Paper: GENETICS AND GENETIC ENGINEERING

Periods: 60 Credits: 04

Objectives

1. Study principles of Mendelian genetics.
2. Learn about gene and chromosomal inheritance and associated disorders.
3. Study the different tools and techniques used in recombinant DNA technology.
4. Study the different tools used in cloning and gene transfer technology.

UNIT- I **15**

1. Mendel's Laws of inheritance
   - 1.1. Law of Dominance
   - 1.2. Law of Segregation
   - 1.3. Law of independent assortment
   - 1.4. Test cross, Back cross.
2. Interaction of genes and modifying genes
   - 2.1. Complementary gene factors
   - 2.2. Supplementary gene factors
   - 2.3. Inhibitory factors
   - 2.4. Lethal gene factors
3. Sex chromosomes and sex linked inheritance
   - 3.1. Types of sex chromosomes and sex chromatin
   - 3.2. Sex linkage in Drosophila
   - 3.3. Sex linkage in man
   - 3.4. Sex linked lethal genes
4. Sex determination in-
   - 4.1. Heterogametic males
   - 4.2. Heterogametic females

UNIT- II **15**

5. Linkage and crossing over
   - 5.1. Kinds of linkages and significance
   - 5.2. Mitotic and meiotic crossing over
   - 5.3. Mechanism of crossing over
   - 5.4. Kinds of crossing over
6. Mutations
   - 6.1. Gene mutation
   - 6.2. Chromosome mutation- Deletion, Duplication, Inversion, Translocation, Polyploidy, Aneuploidy
   - 6.3. Induced mutation
   - 6.4. Mutagenic agents

7. Multiple Alleles and Inheritance
    7.1. Multiple allelism A–B–O blood groups
    7.2. Inheritance of A-B-O blood groups and medico–legal applications
    7.3. Rh-factor and Erythroblastosis foetalis

UNIT- III **15**

Human Genetics

8. Numerical abnormalities of human chromosomes and related syndromes
    8.1. Non-disjunction, Aneuploidy
    8.2. Patau syndrome
    8.3. Down syndrome
9. Sex chromosomes
    9.1. Turner's syndrome
    9.2. Klinefilter's syndrome
10. Structural abnormalities of human chromosomes and related syndromes
    10.1. Cri-du-chat syndrome
    10.2. Robertsonian translocation
    10.3. Prader-Willi Syndrome
    10.4. William's Syndrome
11. Human metabolic disorders
    11.1. Phenylketouria
    11.2. Alcaptoneuria, Tay-Sach's disease
    11.3. Glucose–6–phosphate dehydrogenase deficiency, Emphysemia
12. Polygenic inheritance
    12.1. Cob length in maize.
    12.2. Kernel color in wheat.
    12.3. Skin color in human.

UNIT- IV **15**

13. Introduction to recombinant DNA technology
14. Enzymes used in DNA technology
15. Cloning vectors- Plasmids, Phages, Cosmids
16. Cloning techniques- Isolation and purification of genomic and plasmid DNA and RNA, Gel electrophoresis of nucleic acids.
17. Gene transfer techniques- Electroportation and microinjection
18. Applications of recombinant DNA technology. Monitoring of gene expression in live Cells, crop and live stock improvement.

Outcomes

1. Explain the principles of Mendelian inheritance.
2. Describe gene and chromosomal inheritance and their disorders.
3. Elaborate about different tools and techniques used in recombinant DNA technology.
4. Discern the different tools used in cloning and gene transfer technology.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. Genetics – P. K. Gupta (Rastogi Publication, Meerut).
3. Genetics – Verma P. S. and Agarwal V. K. (S. Chand Publication Delhi).
4. Cytology, Genetics and Evolution – P. K. Gupta (Rastogi Publication Delhi).
5. Elementary Genetics – Single tone.
6. Genetics – Winchester (Oxford LBH Publication).
7. Genetics and Evolution – A. P. Jha (Macmillon India).
8. Concepts of genetics – W. S. Clug (Pearson Education ISBN).
9. Genetics – Strickberger (Prentice – Hall).
10. Principle of genetics – R. H. Tamarin (Tata Mc Graw Hill Publication India).
11. Concepts of Genetics – R. L. Kotpal (Rastogi Publication).
12. Genetics and Genetic Engineering – Dr. R. P. Meyyan (Saras Publication).
13. Foundations of Genetics – Pai A. C. (Mc Graw Hill Publication).
14. Molecular Genetics – Gunther, S. Stent, (Macmillon).
15. Principles of Genetics – Sinnott, Dunn and Dobzansky (Tata McGraw Hill Pub. Delhi).
16. Genetic – Sarin C. (Tata McGraw Hill Publication Delhi).
17. Principles of Gene Manipulation and Introduction of Genetic Engineering – R.W. Old and S. B. Primerose.
18. Text Book of Genetics – H.S. Bhamrah (Amol Publication, New Delhi).
19. Genetics – M. P. Arora (Himalaya Publication).
20. Genetics and Evolution – N. Armugam (Saras Publication).
21. Genetic – Veer Bala (Rastogi Publication).
22. Cytology and genetics – Dyansagar V.R. (Tata McGraw Hill Pub. 1992 Reprint).
23. Text Book of Fundamental Genetics-Dr.D.B.Bhure, Dr.S.S.Nanware & M.U.Barshe 2016. Aruna Prakashan Latur, M.S. ISBN: 978-93-5240-035-5,Publication16th June, 2016

LABORATORY COURSE XVI based on THEORY PAPER- XVI

Laboratory Course XVI- GENETICS AND GENETIC ENGINEERING

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. Learn methods of preparing and analyzing pedigree charts and karyograms.
2. Understanding Mendelian and polygenic inheritance.
3. Study of sex chromatin, meiotic, mitotic and polytene chromosomes by preparing slides.
4. Learn the methods of visualization and estimation of DNA/RNA.

Practicals

1. Preparation of pedigree chart of some phenotypic characters of human.
2. Study and observation of sex-chromatin from buccal epithelial cells in humans.
3. Identification and preparation of human Karyogram.
4. Study of hereditary disorders with the aid of chromosome karyotyping.
5. Study of monohybrid, dihybrid crosses and interaction of genes with suitable examples.
6. Problems based on polygenic inheritance.
7. Identification of sex-linked and mutant characters in drosophila.
8. Study chromosomal abnormalities in human.
9. Survey of frequency of PTC tasters and non-tasters in local human population.
10. Study of mitosis using onion root tip cells.
11. Study of meiosis in grasshopper testis.
12. Study of polytene chromosomes in chironomous larval salivary glands.
13. Estimation of blood sugar in normal and diabetic patients.
14. Estimation of DNA by spectrophotometer.
15. Isolation of DNA/RNA from blood.
16. Gel electrophoresis of nucleic acids (DNA/RNA). Isolation and detection of DNA/RNA on agarose gel.

Outcomes

1. Preparing and analyzing pedigree charts and karyograms from provided data.
2. Describe Mendelian and polygenic inheritance.
3. Elaborate about sex chromatin, meiotic, mitotic and polytene chromosomes.
4. Visualize and estimation of DNA/RNA using appropriate techniques.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

M.Sc. In Zoology

Detailed Syllabus

Fourth Semester

Course Code- XVII

Theory Paper- XVII

Title of the Paper: MAMMALIAN ENDOCRINOLOGY

Periods: 60 Credits: 04

Objectives

1. To study nature, functions and classification of hormones.
2. To study general structure and functions of endocrine glands in mammals.
3. To understand functional relation between pituitary and other endocrine glands.
4. To learn about endocrine role of adrenal, pancreatic and pineal tissue in humans.
5. To study the function of gastro-intestinal and reproductive hormones in humans.
6. To learn about the different endocrine disorders in humans.

UNIT- I **15**

1. Introduction to Endocrinology

1.1. Chemical nature and classification of hormones.
1.2. Hormones as chemical messengers.
1.3. Feedback control of hormone action.
1.4. Hypothalamo-Hypophysial portal system.
1.5. Pituitary gland- location and anatomy.
1.6. Histology and hormones of Adenohypophysis.
1.7. Histology and hormones of Neurohypophysis.
1.8. Disorders of pituitary hormones.

UNIT- II **15**

2. Adrenal Gland

2.1. Structure and histology of Adrenal gland
2.2. Adrenal cortex hormones- Mineralocorticoids and Glucocorticoids and Renin-Angiotensin system.
2.3. Hormones of Adrenal Medulla- Epinephrine and Norepinephrine.
2.4. Disorders of adrenal steroids hormones.
2.5. Hormones of Pancreas- Insulin and Glucagon
2.6. Types of Diabetes: Insulin Dependent Diabetes Mellitus (IDDM) and Insulin Independent Diabetes Mellitus (IIDM)

UNIT- III **15**

3. Thyroid and other endocrine systems

3.1. Endocrine Role of Pineal Gland- Melatonin.
3.2. Properties and role of Local hormones- NO (Nitric oxide), Histamine, Endorphins, neuropeptides.
3.3. Structure and Histology of Thyroid Gland, Hormones of Thyroid- Thyroxine and Triiodothyroxine biosynthesis.
3.4. Disorders of hormones of thyroid.
3.5. Structure and histology of parathyroid gland; Parathyroid hormones- Parathormone and calcium metabolism.
3.6. Gastrointestinal Hormones- Gastrin, Secretin, Cholecystokinin (CCK), Gastric Inhibitory Peptide (GIP), Vasoactive Intestinal Peptide (VIP).

UNIT- IV **15**

4. Reproductive and Gastro-intestinal endocrinology

4.1. Hormones of Female Reproductive Physiology- Estrogens and Progesterone
4.2. Hormonal regulation of pregnancy, parturition and lactation.
4.3. Structure of placenta, functions of hormones of placenta- HCG.
4.4. Hormones of Male Reproductive Physiology- Testosterone, Dihydrotesterone.
4.5. Male and female contraceptives and their mode of functioning.
4.6. Disorders of reproductive steroid hormones.
4.7. Infertility in humans and their remedial measures.

Outcomes

1. Appreciate the nature, functions and classification of hormones.
2. Describe general structure and functions of endocrine glands in mammals.
3. Trace the relation between pituitary and other endocrine glands.
4. Elaborate about endocrine role of adrenal, pancreatic and pineal tissue in humans.
5. Explain about functions of gastro-intestinal and reproductive hormones in humans.
6. Elaborate about the different endocrine disorders in humans.

Suggested Readings

1. **Online resources like academic, research databases etc are recommended.**
2. Williams Text Book of Endocrinology – 10th Ed, Saunders, 2003.
3. Endocrinology – Mac E. Hadley, 5th Ed, Pearson Education, 2004.
4. Molecular Endocrinology – Bolander, F.F., Academic, Son–Diego, 1989.
5. Textbook of Endocrinology – Griffin J.E., S.R. Ojeda, Oxford, New York, 1988.
6. Basic and Clinical Endocrinology – Greenspan, F.S., 3rd Ed., Appleton and Lange.
7. Basic Medical Endocrinology – Goodman, H.M., Raven, New York, 1988.
8. Hormones - From Molecules to Diseable, Bailiene, E.E. & P.A. Kelly, Herman, New York, 1991.
9. Text Book Medical Physiology – Guyton Hall, 10th Ed, Saunders, 2003.

LABORATORY COURSE XVII based on THEORY PAPER- XVII

Laboratory Course XVII: MAMMALIAN ENDOCRINOLOGY

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To study anatomical location and surgical removal of endocrine glands in vertebrates.
2. To learn skills of micro-preparation of endocrine glands of vertebrates.
3. To study functional role of hormones in physiology of animals.
4. To study hormonal control of reproductive system in mammals.

Practicals

1. In-situ demonstration of endocrine glands in any suitable vertebrate.
2. Determination of protein and glycogen in endocrine material (using spectrophotometer).
3. Determination of sugar level in diabetic and non-diabetic blood and urine samples.
4. Microtomy of endocrine glands (Tissue preservation, fixation, dehydration, impregnation, block preparation, section cutting, staining and mounting).
5. Histology of Rat / Rabbit / Mammal Endocrine glands- Observation of permanent slides of different endocrine glands.
6. Histology of Rat / Rabbit / Mammal placenta by observation of permanent slides.
7. Histology of Rat / Rabbit / Mammal uterus by observation of permanent slides.
8. Demonstration of Hypophysectomy, Thyroidectomy, Adrenalectomy in Rat / Mammal.
9. Demonstration of Orchidectomy, Ovariectomy, Hysterectomy, Vasectomy in Rat / Mammal.
10. Pregnancy testing from urine sample in any suitable mammal.
11. Effect of thyroxin on oxygen consumption of a suitable animal or fish.
12. Effect of adrenaline on oxygen consumption of a suitable animal or fish.
13. Separation of plasma proteins by electrophoresis.
14. Estimation of at least one hormone from sample.
15. Detection of steroid hormones in urine sample from suitable mammal.
16. Preparation of vaginal smear, staining and identification of reproductive phase in Rat.

Outcomes

1. Pinpoint anatomical location and surgical removal of endocrine glands in vertebrates.
2. To learn skills of micro-preparation of endocrine glands of vertebrates.
3. To study functional role of hormones in physiology of animals.
4. To study hormonal control of reproductive system in mammals.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

Paper XVIII-A: Applied Parasitology- I

Title of the Paper: Trematodes And Cestodes

Periods: 60 **No. of Credits: 04 (Marks: 100)**

Objectives:

1. To provide students with knowledge about biological, epidemiological and ecological aspects of parasites of veterinary and medical importance.
2. To enable students to understand the pathogenesis, symptoms and complications of Trematode and Cestode parasites.
3. To enable students to reach a diagnosis and know the general outline of treatment, prevention and control of helmith infections.
4. To understand and apply the principles of controlling diseases caused by Trematode and Cestodes.
5. To provide students with adequate knowledge about endemic parasites and national parasitic problems, as well as, reemerging parasitic infections.
6. To introduce basic concepts of immunity and understanding the role of immunity in animal and human well being.

Unit I **15**

1. General organization of Trematodes and its classification upto family level.
2. General organization of Monogenea, Aspidobothria and Digenea.
3. Ultra structure and functions of Tegument.
4. Functional anatomy of Male and Female reproductive system in Digenea.
5. Biology of Egg, Egg Shell formation, Chemistry of egg shell formation, factors influencing embryonation and hatching in Trematodes.
6. General metabolism of helminthes.

Unit II **15**

7. Parasitism and parasitic adaptations in helminths.
8. Larval forms in Trematodes.
9. Immunology- Basic concept, Antigen Antibody reaction, Innate and Acquired immunity.
10. Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of-
    - *10.1. Fasciolopsis buski*
    - *10.2. Schistosoma japonicum*
    - *10.3. Schistosoma mansoni*
    - *10.4. Clonorchis sinensis*
    - *10.5. Paragonimus wetermani.*

Unit III **15**

11. General organization of cestodes and its classification up to order level.
12. Structural organization of cestodarians.
13. General important features of the following orders:
    - 13.1. Proteocephalidea
    - 13.2. Tetraphyllidea
    - 13.3. Davaineidea
    - 13.4. Hymenolepidea
14. Hold fast organs in Cestodes.
15. Modification of uterus in Cestodes.

Unit IV **15**

16. Larval forms in Cestodes.
17. Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of-.
    - 17.1. Taenia solium
    - 17.2. Taenia saginata
    - 17.3. Echinococcus granulosus
    - 17.4. Diphyllobothrium latum
    - 17.5. Hymenolepis nana
    - 17.6. Dipylidium caninum
18. Factors influencing parasitism- influence of season and other phenological factors on parasitic population (prevalence, intensity of infection).
19. Helminthes of livestock with emphasis on *Fasciola hepatica* and *Moniezia* spp.
20. General organization in Acanthocephala.

Expected Outcomes:

1. Students will understand morphology, life cycle and pathogenesis of Trematode and Cestode infections.
2. Students will be able to identify clinical signs and suggest preventive measure in parasitic infections.
3. Students will understand structure and working of immunity system and appreciate its role in resistance to parasitic infections.
4. Students will have the knowledge of endemic and national parasitic problems.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. Animal parasitology – J. D. Smyth (Cambridge Univ. Press., 1976).
3. Foundations of Parasitology 6th Ed.- L.S.Roberts & J.Janovy Jr (McGraw Hill Publ., 2000).
4. Parasitism- A. O. Bush, J.C. Fernandez & J. R. Seed (Cambridge Univ. Press, 2000).
5. Helminthology- Eds. N. Chaudhury & I. Tada (Narosa Publg. House, 1994).
6. Helminthes, Arthropods, & Protozoa of domesticated animals 6th Ed.- EJL Soulsby (ELBS,1976).
7. Introduction to parasitology- B.E. Matthews (Cambridge Univ. Press. 1998).
8. The physiology of Trematodes- JD. Smyth & D.W. Halton (Cambridge Univ. Press, 1983).
9. The physiology and Biochemistry of Cestodes – J.D. Smyth & D.P. MEmanus, (Cambridge Univ.Press, 1989).
10. T.B.Fish Diseases- (Tr.)- D.A. Convoy & R.L. Herman (Narendra Publg. House, 1997).
11. Handbook of Medical Parasitology- V. Zaman & L.H.Keong (K.C. Ang Publishing Pvt. Ltd., 1989).
12. T.B. Medical parasitology – P. Chakraborty (New Central Book Agency, 2004).
13. Ecological Animal Parasitology – C. R. Kennedy (Black well Scientific Publ., 1975).
14. Infectious Diseases of fish – S. Egusa (Oxonian Pvt. Ltd., New Delhi, 1978).
15. A.T.B. of Parasitology 2nd Ed.- S.S.Kelkar & R.S.Kelkar (Bombay Popular Prakshan, 1993).
16. An Introduction to Parasitology– By chandler
17. General Parasitology– By Cheng T. C.
18. Biology of Parasites– By Cheng
19. Systema Helminthum– By S. Yamaguti
20. Biology of Animal parasites– By Saunders.
21. Clinical Parasitology– By Faust
22. Medical Helminthology– By Watson
23. Parasitology – By K. D. Chatterjee
24. Medical Parasitology– By N. C. Dey, T. K. Dey.

M.Sc. In Zoology

Detailed Syllabus

Fourth Semester

Laboratory Course based on Theory Paper- XVIII-A

Applied Parasitology- I

Lab Course XVIII-A: Trematodes and Cestodes

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To familiarize students with morphologic criteria to differentiate the most common Trematode and Cestode parasites.
2. To improve diagnostic skills by studying mophology and pathogenesis of helminth parasites.
3. To develop skills of micro-preparation and microscopy of parasitic worms for identification and study.

Practicals

1. Preparation of stains: Haematoxylin, Acetocarmine, Borax caramine, Bouins fluid and alcohols grades.
2. Collection, fixation, preservation of metacercaria from suitable animal.
3. Collection, Preservation, Staining, Mounting, identification and description of Trematodes from locally available different hosts (Gills & intestines).
4. **Identification, classification and description of Parasitic Trematodes through permanent slides/photomicrographs or specimens-** *Fasciolopsis buski; Schistosoma japonicum; Schistosoma mansoni; Clonorchis sinensis; Paragonimus wetermani. Fasciola hepatica*
5. Pathology in host tissue caused by Trematode parasites to study host parasite relation.
6. Collection and examination of molluscan hosts for larvae of Trematodes.
7. Effect of light, and temperature on the emergence of cercaria.
8. Collection, Preservation, Staining, Mounting, identification and description of Cestodes from locally available different hosts.
9. **Identification, classification and description of Parasitic Cestodes through permanent slides/photomicrographs or specimens-** *Taenia solium; Echinococcus granulosus; Diphyllobothrium latum; Hymenolepis nana; Dipylidium caninum* **a**nd *Moniezia* spp
10. Pathology of host tissue caused by Cestode parasites to study host parasite relation.
11. Study of different Hold fast organs in Helminthes.
12. Demonstrate/Measure the effect of season/phenological factors as the prevalence, intensity, density and index of helminth parasites.
13. Examination of faecal sample for different helminthes ova and their identification.
14. Estimation of glycogen, protein and lipids in parasite and its host tissue.
15. Histochemical demonstration of alkaline phosphatase activity in tissues of parasitic helminthes.
16. Autopsy of hosts for helminth parasite infection.

Submission of permanent slides at the time of exam.
Visit to veterinary & medical Parasitology (Pathology lab).

Outcomes

1. Familiarity with laboratory techniques of micro-preparation and microscopy.
2. Knowledge of morphologic criteria to differentiate Trematode and Cestode parasites.
3. Diagnosis of helminth parasites by studying mophology and pathogenesis.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

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CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN
Faculty of Science
w. e. f. Academic Year 2020-2021
M.Sc. In Zoology
Detailed Syllabus
Fourth Semester
Course Code- XVIII-B
Theory Paper- XVIII-B
Title of the Paper: Fisheries and Fish Culture- I

Periods: 60 Credits: 04

Objectives

1. General study of capture and culture fishery of India and methods adopted.
2. Understand design, management and maintenance of fish farm.
3. Learn about the principles and methods of artificial fish breeding and weed control.
4. Study of various fish disease treatment, fish preservation and fish by-products.

Unit- I **15**

1. Introduction, Scope and importance of Capture and Culture Fisheries.
2. Study of commercially important cultivable fresh water fishes- Growth, Food and Feeding habits, Maturity, Spawning; Indian major carps and Exotic Carps.
3. Monoculture, Composite culture and Polyculture.
4. Economics of Fishery in India- Freshwater fishery & Marine fishery.

Unit- II **15**

5. Fish Farm Engineering- Topography, Soil type, Water supply, Design
6. Fish Farm Management- Types of Ponds required, Management of Hatcheries, Types of Hatcheries- Hatching pit, Hapa, Chinese Hatchery System
7. Pre-stocking, Stocking and Post-stocking management of Nursery, Rearing & Stocking ponds
8. Aquatic weeds and their Control- Types of Aquatic Weeds, Advantages and Disadvantages of Aquatic Weeds, Weed Control by manual, mechanical, chemical and biological methods

Unit- III **15**

9. Induced breeding by hormones- Selection of breeders, hormone injection and dosage, Breeding happa and spawning.
10. Collection of breeders from natural Bundh- Bundh breeding, Wet and Dry bundh
11. Fish Transport- Scope and requirement of fish transport, Tools and Techniques used for fish transport, Problems in fish transport.
12. Fish sedatives and anesthetics- Scope of sedatives and anesthetics in fishery, Natural and synthetic sedatives and anesthetics, Application of sedatives and anesthetics in fishery

Unit- IV **15**

13. Fish Pathology- Symptoms and treatment of Parasitic diseases, Non Parasitic diseases, Miscellaneous diseases.
14. Fish Preservation- Causes of Fish spoilage, Various methods of Fish preservation.
15. Fish by-products: Fish meal, Isinglass, Fish fillets, Pearl essence, Shark fin rays, Surgical sutures from fish gut, etc.
16. Fish Feed- Formulation and manufacture.

Outcomes

1. Knowledge of capture and culture fishery practices of India and methods adopted.
2. Suggest design and management procedures for a fish farm.
3. Carry out artificial fish breeding and weed control in a fish farm.
4. Identify various fish diseases and suggest treatments.
5. Elaborate about different fish preservation methods.
6. Evaluate suitability of different fish for making by-products.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. A Text Book of Fishery Science in India - C. B. L. Srivastava
3. Fish and fisheries of India - V. J. Jhingran.
4. A manual of freshwater fish culture - R. Santharmma N. Sakuran and Natrajan.
5. An Introduction to Indian Fisheries. - Sharma and Grover
6. Introduction of Fishes by - S. S. Khanna
7. Bal D. V. and Rao K. V. 1989 - Marine Fisheries
8. Hand Book Breeding of Indian Major carps by Chondar S.Z.
9. Huet M. 1972 Text Book of Fish culture Breeding and cultivation of fish fishing New (Books) Ltd. Surrey England.
10. Jayaram K.C. 1978 Fresh Water Fishes of India, Pakistan, Bangladesh, Burma and Srilanka- Hand Book Zoological survey of India Calcutta.
11. C.V. and Sebastian V.O. 1986 Prawns and Fisheries of India Hindustan Publishing Corp-Delhi.
12. Moyle P. B. and Cech J. J. Jr 1988 - Fishes an Introduction to Ichthyology - Prentice Hall, Englewood cliffs N.J.
13. Norman J.R. 1975 A History of Fishes Third Ed. by PH.
14. Balkrishnan N.N. and Thampy D.M. 1980 A Text Book of Marine Ecology, Macmillan India.
15. A Text Book of Fish Biology and Fisheries - by S.S. Khanna and H.R. Singh.
16. Anatomy and Physiology of Fishes - by Santosh Kumar and Manju Tembhre
17. Practical Manual on Fish Biology by Ashok Kumar, Jaiswal, S.K. Chakraverthy, CIFE Publication.
18. An Introduction to Fishes - by S.S. Khanna.
19. Ichthyology - by Lagler
20. Behaviour and Physiology of Fish- Sloman, K. A., Wilson, R. W., & Balshine, S. (2005). (1st Ed., Vol. 24). Academic Press.

LABORATORY COURSE XVIII-B based on THEORY PAPER- XVIII-B

Laboratory Course XVIII-B: Fisheries and Fish Culture- I

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. Study of Indian Major Carps, Exotic Carps and their developmental stages.
2. Learn about design of fish farm.
3. Learn the different soil tests in farm management.
4. Study about fish parasites, fish by-products, fish feed formulations and their processing.

Practicals

1. Identification of Indian Major Carps & Exotic Carps.
2. Study of Layout of Fish Farm, drafting a layout.
3. Determination of water holding capacity, pH, total alkalinity of soil.
4. Identification of different types of Hatcheries (Model Study).
5. Identification of Aquatic weeds infesting a fish farm.
6. Identification of Predatory & Weed Fish infesting a fish farm.
7. Identification of Aquatic insects infesting a fish farm.
8. Identification of Spawn, Fry and fingerlings of Indian Major Carps.
9. Identification of Spawn, Fry and fingerlings of exotic carps.
10. Collection and preservation of Pituitary gland.
11. Preparation of Pituitary extract and injection of Pituitary extract – by demonstration
12. Identification and mounting of fish ecto-parasites and their control.
13. Identification and mounting of fish endo-parasites and their control.
14. Study of different methods of fish preservation.
15. Preparation of (any two) fish by-products like pearl essence, fish manure, fish meal, isinglass etc.
16. Preparation of artificial fish feed for herbivorous and carnivorous fish.

Visit to fish breeding/farming/research center and submission of report at the time of exam.

Outcomes

1. Able to identify and describe the Indian Major Carps and Exotic Carps.
2. Drafting the layout of a fish farm.
3. Perform different soil tests used in farm management.
4. Describe the different fish parasites and suggest their control measures.
5. Discuss different fish by-products and their processing methods.
6. Elaborate on method of preparation of different fish feed formulations.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

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CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN
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w. e. f. Academic Year 2020-2021
M.Sc. In Zoology
Detailed Syllabus
Fourth Semester
Course Code- XVIII-C
Theory Paper- XVIII-C
Title of the Paper: ECONOMIC ENTOMOLOGY

Periods: 60 Credits: 04

Objectives

1. To explore the principle and practices in sericulture and lac culture.
2. To learn about methods and techniques in apiculture and butterfly farming.
3. To understand the importance of insects in forensic science and medicine.
4. To learn about household insect pests, and their control.

UNIT- I **15**

1. Sericulture: Mulberry silkworm: life history, seed production, silkworm rearing, silk glands and silk production, cocoon formation, cocoon harvesting and reeling, silkworm diseases and management, non-mulberry sericulture, sericulture as a cottage industry.
2. Lac culture: Biology of lac insects, lac cultivation and economic importance of lac.

UNIT- II **15**

3. Apiculture: types of honey bees, life cycle, apiary products, bee keeping and techniques, bee rearing management, movable frame hive; economic importance of honey, wax and apiary products.
4. Insects as- pollinators, food, source of drugs and dyes.
5. Insects in research
6. Butterfly farming
7. Insects in forensic entomology

UNIT- III **15**

8. Medical entomology: morphology, vectorship, pathogenecity & control of: mosquito, housefly, ratfleas, head louse.
9. Morphology, vectorship, pathogenicity & control of: pests of domestic animals, horse and cattle.

UNIT- IV **15**

10. Household pests: Morphology, damage caused & Control measure of: Cockroach, Cricket, Carpet beetle, Ants and termites, Bed bugs, Lepisma, Wasps.

Outcomes

1. Describe the principle and practices in sericulture and lac culture.
2. Explain and demonstrate techniques used in apiculture and butterfly farming.
3. Elaborate application of entomology in forensic science and medicine.
4. Identify and initiate control measures against household insect pests.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. Nayer, K.K., T. Anant Krishnan and B.W. David : General and Applied Entomology
3. Metcalf, G.L. and W.P. Fling : Destructive and Useful Insects
4. Hemsingh Pruthi : A Text Book of Agricultural Entomology
5. Wigglesworth : Principles of Insect Physiology
6. ESSIG : College Entomology
7. M.S. Mani : A Text Book of General Entomology
8. Government of Maharashtra Publication : Crop Pests and How to Fight Them
9. Oldroyd : A Collection, Preserving and Studying Insects
10. Roger P. and Anderson : Forest and Shade Tree Entomology
11. Tembhare, D.B. : Modem Entomology
12. Fradt, R.E. : Fundamentals of Applied Entomology
13. Smith, K.G.V. : Insects and Other Arthropods of Medical Importance
14. Ray, D.N. and A.W.A. Brown : Entomology Medical & Veterinary
15. Chandler, A.C. and Read, C.P. : Introduction of Parasitology
16. Debatch, R. : Biological Control of Natural Enemies
17. Apple, J.L. and Smith, R.F. : Integrated Pest Management
18. Cheny : General Parasitology
19. Corbet, J. R. : The Biochemical Mode of Action of Pesticides
20. Champaman, R.F. : Insects – Structure and Function
21. Richards, O.W. and R.G. Davies, IMMS : Text Book of Entomology
22. Bursel, E. : An Introduction to Insect Physiology
23. Rockstein M. : The Physiology of Insects (Vol. 1–VI)
24. Shrivastava, K.P. : A Text Book of Applied Entomology (Vol. I–H)
25. Johnson, O.A. : Embryology of Insects and Myriopods
26. Ross, H.A. : Text Book of Entomology
27. Roddick : Insect Physiology

Laboratory Course XVIII-C: ECONOMIC ENTOMOLOGY

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To familiarize students with insects of economic importance.
2. To acquire knowledge of culture of honey bees and lac insects.
3. To study morphology of forensically important and domestic pest insects.

Practicals

1. Study of silk worm adult, caterpillar and cocoon.
2. Study of sericulture practices, equipment used in sericulture.
3. Study of silk worm diseases and its management.
4. Study of honey bees and their castes.
5. Study of bee keeping techniques and equipment.
6. Study of by-products of apiculture and their economic importance.
7. Study of equipment used in apiculture.
8. Study of life cycle of lac insects
9. Study of lac cultivation, equipment used in lac culture and lac products.
10. Study of household pests *viz.* House fly, Cockroach, Lepisma, Ants, termites, Cricket.
11. Study of insect vectors like Mosquito, bed bug, flea, body louse, Rat flea.
12. Study of beneficial insects (predatory and parasite insects) and their importance.
13. Study of pollinating insects (any five)
14. Collection and study of forensically important insects (any five).
15. Collection and study of medically important insects (any five).
16. Study & rearing of biological control agents (at least one).

Visit to any entomology research institute / entomology farm and submission of report.

Outcomes

1. Knowledge of economically important insects.
2. Ability to culture honey bees and lac insects.
3. Appreciation of insects of forensic importance and domestic insect pests.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

M.Sc. In Zoology

Detailed Syllabus

Fourth Semester

Course Code- XVIII-D

Theory Paper- XVIII-D

Title of the Paper: Mammalian Physiology- I

Periods: 60 Credits: 04

Objectives

1. To study digestive system structure, functions, its regulation & related disorders.
2. To understand respiratory system function and its pathological conditions.
3. To learn about circulatory system, its components, functions & diseases.
4. To study excretory system structure, functions & related disorders.

UNIT- I: Digestive System **15**

1. Digestive Tract
2. Histology of stomach and small intestine.
3. Liver – Structure and Functions.
4. Pancreas – Structure and secretion of enzymes and hormones.
5. Gall Bladder – Role and Physiology.
6. Gastro Intestinal Hormones and their role.
7. Secretion of HCl by parietal cells – Mechanism
8. Physiology of digestion of protein, carbohydrate and lipid.
9. Brush Border Enzymes.
10. Physiology of Absorption of Proteins, Carbohydrates and Lipids.
11. Disorders- i) Peptic Ulcers, ii) Cirrhosis, iii) Hepatitis, iv) Gallstones

UNIT- II: Respiratory System **15**

12. Structure of Respiratory System– Nose, Pharynx, Larynx, Trachea, Bronchi, Lungs.
13. Mechanism of breathing.
14. Lung volume and lung capacities.
15. Transport of oxygen and carbon dioxide between blood and tissues.
16. Chemical and nervous control of respiration.
17. Disorders– i) Asthma, ii) Emphysema, iii) Pneumonia, iv) Cystic Fibrosis.

UNIT- III: Cardiovascular System **15**

18. Composition and functions of blood
19. Formation of blood cells – Erythropoiesis, Leucopoiesis
20. Blood Volume, Erythrocyte Sedimentation Rate (E.S.R.)
21. Bone Marrow- Definition and Functions, Methods of examination
22. Lymph and Lymph Nodes – Structure, composition and Functions
23. Disorders – Anaemia, Leukaemia
24. Blood Cholesterol
25. Heart –Internal structure, conducting system, heart beat and regulation of heart beat
26. Cardiac cycle, cardiac output and ECG
27. Disorders – Heart attack: causes & treatment; Coronary Artery Disease (CAD)

UNIT- IV: Excretory System- Kidney **15**

28. Kidney– Anatomy and Functions
29. Blood supply to Kidney
30. Renal Physiology- Mechanism of urine formation- Glomerular Filtration, Tubular Reabsorption and Tubular Secretion
31. Structure and histology of Nephron
32. Counter – Current mechanism
33. Dialysis therapy- Definition and types
34. Renal function tests
35. Disorders– i) Urinary tract infections, ii) Acute and Chronic Renal Failure
36. Physiology of Micturition

Outcomes

1. An understanding of digestive system structure, functions & its disorders.
2. Knowledge of respiratory system function and its pathological conditions.
3. Ability to describe circulatory system, its components, functions & diseases.
4. Appreciation of excretory system structure, functions & related disorders & their tests.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. Review of Medical Physiology- W.F. Ganong 16th Edition, 1993, Appleon and Lange (A Publishing Division of Prentice Hall).
3. Text Book of Medical Physiology- Arthur C. Guyton and John E. Hall, 10th Ed., 2000, Saundus An Imprint of Elsevier.
4. Human Physiology- Lauralee Sherwood, 6th Edition 2007, Thomson, India Edition.
5. Human Physiology- Vander, Sherman, Luciano, 6th Edition, McGraw-Hill Inc., International Ed. 1994.
6. Principles of Anatomy and Physiology- Gerard J. Tortora and Sandra Reynolds Grabowsky Harper Collins College Publishers, 8th Edition, 1996.
7. Text Book of Physiology- Smith, Patterson, Read and Scratched, ELBS, 11th Edition, 1988.
8. Marshall's Physiology of Reproduction- Vol. 1 to 5, Amming C.E., Edition, Churchill Livingstone, 1984.
9. Physiology- Bullock, J. Boyle, Harward Pull, 1991.
10. Essential Endocrinology- Laycock, J.F., and Wise, Peter, H. ELBS, 1983.
11. Hole's Human Anatomy and Physiology, 7th Edition By David Shier.
12. Human Physiology- Stuart Ira Fox, McGraw Hill, 6th Edition, 1999.
13. Human Physiology- David Moffett, Stacia Moffett Charles Schauf, Mosby International Ed. 1993.
14. Human Anatomy and Physiology- Elaine N. Marieb, 3rd Ed., The Benjamin / Cummings Publishing Inc., 1995.
15. Physiology- Berne, R.M. and M.N. Levy, Mosby, 3rd Ed., St. Louis.

LABORATORY COURSE based on THEORY PAPER- XVIII-D

Animal Physiology- I

Laboratory Course XVIII-D: Mammalian Physiology- I

Periods: 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To learn analytical techniques for study of animal tissue and body fluid composition.
2. To study relation between body fluid composition and health of animals.
3. To learn about effect of environmental factors on body functions.

Practicals

1. Estimation of serum amylase.
2. Estimation of SGOT / SGPT.
3. Estimation of serum / plasma glucose by colorimetric method.
4. Estimation of total proteins in blood.
5. Estimation of total cholesterol in blood.
6. Estimation of Low Density Lipoproteins (LDL) and High Density Lipoproteins (HDL) in blood.
7. Microscopic examination of urine.
8. Detection of excretory product in suitable animals.
9. Estimation of serum urea.
10. Estimation of blood chlorides in suitable animal acclimated to different osmotic conditions.
11. Detection of normal and abnormal constituents of urine.
12. Effect of adrenaline on heart rate of any suitable animal.
13. Effect of temperature on heart rate of any suitable animal.
14. Detection of salivary amylase in human saliva.
15. Detection of protein digesting enzymes.
16. Detection of carbohydrate digesting enzymes.

Visit to medical pathology testing laboratory and submission of report.

Outcomes

1. Perform analysis of animal tissue and body fluids like saliva, blood and urine.
2. Explain the relation between body fluid composition and health status of animals.
3. Elaborate about relation between environmental factors on body functions and health.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

M.Sc. In Zoology

Detailed Syllabus

Fourth Semester

Paper XIX-A: Applied Parasitology- II

Title of the Paper: Animal Nematodes and Plant Nematodes

Periods : 60 **No. of Credits: 04 (Marks: 100)**

Objectives:

1. To provide knowledge and understanding of Parasitology with special emphasis on Nematodes.
2. To provide an overview of plant nematology with an emphasis on disease caused by plant parasitic nematods.
3. To acquire insight into structural and functional organization of nematodes.
4. To study pathogenesis of nematode parasites of plants and animals.
5. To understand broad methods of nematode disease prevention.
6. To learn about the ecology of larval and adult nematodes.

Unit I **15**

1. Introduction, Classification, General organization of Animal Nematodes.
2. Ultra structure of Cuticle-Chemical Composition and Organization
3. Feeding and Nutrition in Nematodes.
4. Carbohydrate and Protein Metabolism in Nematodes.
5. Nematode egg, Development, Hatching, Moulting.
6. Functional anatomy of reproductive system of Nematodes.

Unit II **15**

7. Larval forms in Nematodes with special reference to Pathogenicity.
8. Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of-
   i) *Ancylostoma duodenale*
   ii) *Wucheria bancrofti*
   iii) *Dracunculus medinensis*
   iv) *Trichinella spiralis,*
   v) *Strongyloides stercoralis.*
   vi) *Enterobius vermicularis.*
9. General account of entomophilic Nematodes- Characteristics and classification.
10. Nematode as model organism (Toxicity, Gerantology, Parasitic, Genetic)

Unit III **15**

11. Introduction, Classification, General organization of Plant Parasitic Nematodes.
12. Plant parasitic Nematodes- symptoms of nematode injuries to plants.
    i) Above ground symptoms.
    ii) Below ground symptoms.
13. Nematode ecology and population dynamics.
14. Controlling of the Nemic Diseases of Plant- Heat, fallow, crop rotation, Biological control, organic matter and mulching, Root Diffusates, natural enemies.
15. Chemical Control- Nematicidal chemicals, Application of Nematicides; Procedure in soil fumigation.
16. Techniques in Nematology: Methods of sampling (soil & plant samples), Methods of extracting nematodes from soil & plant samples, Methods of processing nematodes for observation.

Unit IV **15**

17. Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of-
    i) *Anguina (seed gall- nematode)*
    ii) *Meloidogyne (root knot nematode)*
    iii) *Heterodera (cyst nematode)*
    iv) *Tylenchulus (citrus nematode)*
    v) *Pratylenchus (lesion nematode)*
    vi) *Radopholus (burrowning nematode)*

Expected Outcomes:

1. A good understanding of parasitology in general and Nematodes in particular.
2. Knowledge of plant nematology, especially of disease caused by parasitic nematods.
3. Understanding of structural and functional organization of nematodes.
4. Knowledge of pathogenesis of plant and animal nematode parasites.
5. An understanding of methods of nematode disease prevention.
6. Knowledge of life history and ecology of larval and adult nematodes.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. Principles of nematology- by Chitwood B.G. and Chitwood M.B.
3. Nematode parasites of domestic animals and of man- by Levine Norman D Burgess publishing Co. Minneapolis.
4. The natural history of Nematodes by Pionar G.O., Prentice Hall, New Jersey.
5. The organization of nematodes by Croll N.A., Acdemic press.
6. The physiology of nematodes by Lee D. L. & At. Kinson, Columbia University Press, New York.
7. Agricultural Helminthology- Filipjev I. N.
8. General Parasitology by Cheng T.C.
9. Introduction to animal parasitology by J. D. Smith.
10. Entomophilic nematodes and their role as biological control of pest insects by George Poiner, Pub. INC Engle wood cliffs, New Jersey.
11. Parasitology by Noble & Noble.
12. Parasitology by K. D. Chatterjee.
13. Parasitology by Chandler.
14. Human Helminthology- by Faust.
15. Medical Zoology by Sobti.
16. General Parasitology by Cheng T. C.
17. Biology of Parasites by Cheng
18. Systema Helminthum by S. Yamaguti
19. Biology of Animal parasites by Saunders.

Laboratory Course based on Theory Paper- XIX-A
Applied Parasitology- II
Lab Course XIX-A: Animal Nematodes and Plant Nematodes

Periods : 60 (15 Practical's) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To identify diagnostic stages of nematode parasites in blood, urine, tissue and stool samples of animals.
2. To acquire skills of collection, preservation, processing and identification of nematodes.
3. To understand the importance of nematodes and their role in spread of plant diseases.
4. To learn about methods of analysis of population dynamics data of nematodes.
5. To learn about analytical, histochemical, histopathological and biochemical methods used in nematology.

Practicals

1. Basic techniques of preservation and mounting of Nematodes.
2. Collections of Nematodes from locally available animals.
3. **Collection, Preservation, Mounting, identification and description of Animal Nematodes from locally available different hosts (intestines).**
4. **Identification, classification and description of Animal Parasitic Nematodes (Animals) through permanent slides/photomicrographs or specimens-** *Ancylostoma duodenale*; *Wucheria bancrofti*; *Dracunculus medinensis; Trichinella spiralis; Strongyloides stercoralis; Enterobius vermicularis.*
5. Identification of collected Nematodes.
6. Fecal sample analysis for collection and identification of ova.
7. **Collection, Preservation, Mounting, identification and description of Plant Nematodes from soil samples.**
8. Collection & Identification of Phytonema.
9. **Identification, classification and description of Plant Parasitic Nematodes through permanent slides/photomicrographs or specimens-** *Anguina (Seed Gall- nematode); Meloidogyne (root knot nematode); Heterodera (cyst nematode); Tylenchulus (citrus nematode); Pratylenchus (Lesion nematode)*
10. Techniques of collection, fixation, mounting and preparation of permanent slides- Baerman's funnel techniques and Oostenbrinks Cottonwool Filter Method (1954 &1960).
11. Quantitative estimation of Carbohydrates in normal, infected tissues and parasites.
12. Quantitative estimation of Proteins in normal,infected tissues and parasites.
13. Quantitative estimation of Lipids in normal,infected tissues and parasites.
14. Histochemical demonstration of polysacharides, proteins, lipids, alkaline & acid phosphatase in tissue of parasitic nematods.
15. Ecology and biostatistical calculation- Prevalence, density, intensity and index of Nematode parasites.
16. Autopsy of hosts for parasitic nematode infection.

Submission of permanent slides at the time of examinations.
Visit to parasitology research center and submission of report at the time of exam.

Outcomes

1. Identify different stages of nematodes in body fluids, tissue and stools of animals.
2. Demonstrate skills of collection, preservation, processing and identification of nematodes.
3. Elucidate the importance of nematodes in spread of plant diseases.
4. Describe methods of analysis of population dynamics data of nematodes.
5. Perform histochemical, histopathological and biochemical analysis of nematodes.
6. Recognize safety procedures relevant to parasitic diseases.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

Swami Ramanand Teerth Marthwada University, Nanded
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN
Faculty of Science
w. e. f. Academic Year 2020-2021
M.Sc. In Zoology
Detailed Syllabus
Fourth Semester
Course Code- XIX-B
Theory Paper- XIX-B
Title of the Paper: Fisheries and Fish Culture- II

Periods: 60 Credits: 04

Objectives

1. Understand the aquaculture and fishery resources of India.
2. Learn about the culturable organisms and culture methods.
3. Explore the anthropogenic threats to fishery industry in India.
4. Survey of marine fishery of India and legislative framework to regulate capture fishery.

Unit- I **15**

1. Scope and importance of Aquaculture
2. Inland Fishery- Riverine & Reservoir Fisheries (general introduction)
3. Culture methods- Cage Culture, Pen Culture.
4. Integrated Fish Farming- Paddy cum Fish Culture

Unit- II **15**

5. Sewage Fed Fish Culture
6. Mussel Culture & Pearl oyster Culture
7. Prawn Culture and allied activities – Feed for Prawn seed, Transport of Prawn seed, Prawn seed diseases.
8. Ornamental fishery- Aquarium fish species, Genetically modified ornamental fish, Ornamental fish breeding, Export potential, Aquarium management.

Unit- III **15**

9. Man made hazards and Aquaculture.
10. Alien invasive species of fish in India, their effect on local fish fauna, their control measures.
11. Methods of Fishing- Craft and Gear, Electric Fishing, Light Fishing, Fish finder.
12. Economics of Aquaculture in India- Freshwater aquaculture & Mariculture.

Unit- IV **15**

13. Marine Fisheries- Mackerel Fishery, Oil Sardine Fishery, Bombay Duck Fishery, Prawn Fishery.
14. Legislative framework for Fishery in India- Biological Diversity Act, 2002, with reference to fish diversity, Illegal, Unreported, and Unregulated (IUU) Fishing – Indian Scenario, Endangered fishes of India.
15. Fishery education- National Fishery Research Institutes (CIFE, CMFRI, CIFT, NIO, FSI)

Outcomes

1. Describe the fishery resources of India.
2. Knowledge about culturable organisms and different culture methods.
3. Identify and assess the anthropogenic threats to fishery industry.
4. Knowledge of marine capture and culture fishery of India and legislative framework to regulate it.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. A Text Book of Fishery Science in India - C. B. L. Srivastava
3. Fish and fisheries of India - V. J. Jhingran.
4. A manual of freshwater fish culture - R. Santharmma N. Sakuran and Natrajan.
5. An Introduction to Indian Fisheries. - Sharma and Grover
6. Introduction of Fishes by - S. S. Khanna
7. Bal D. V. and Rao K. V. 1989 - Marine Fisheries
8. Hand Book Breeding of Indian Major carps by Chondar S.Z.
9. Huet M. 1972 Text Book of Fish culture Breeding and cultivation of fish fishing New (Books) Ltd. Surrey England.
10. Jayaram K.C. 1978 Fresh Water Fishes of India, Pakistan, Bangladesh, Burma and Srilanka-Hand Book Zoological survey of India Calcutta.
11. C.V. and Sebastian V.O. 1986 Prawns and Fisheries of India Hindustan Publishing Corp-Delhi.
12. Moyle P. B. and Cech J. J. Jr 1988 - Fishes an Introduction to Ichthyology - Prentice Hall, Englewood cliffs N.J.
13. Norman J.R. 1975 A History of Fishes Third Ed. by PH.
14. Balkrishnan N.N. and Thampy D.M. 1980 A Text Book of Marine Ecology, Macmillan India.
15. A Text Book of Fish Biology and Fisheries - by S.S. Khanna and H.R. Singh.
16. Anatomy and Physiology of Fishes - by Santosh Kumar and Manju Tembhre
17. Practical Manual on Fish Biology by Ashok Kumar, Jaiswal, S.K. Chakraverthy, CIFE Publication.
18. An Introduction to Fishes - by S.S. Khanna.
19. Ichthyology - by Lagler
20. Behaviour and Physiology of Fish- Sloman, K. A., Wilson, R. W., & Balshine, S. (2005). (1st ed., Vol. 24). Academic Press.

LABORATORY COURSE based on THEORY PAPER- XIX-B

Laboratory Course XIX-B: Fisheries and Fish Culture- II

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To study types of cages used in culture of fish and other organisms.
2. To learn about economically important fish and shell fish.
3. To explore different craft and gear used in fishery activity.
4. To learn about the water analysis techniques used in fish farm management.

Practicals

1. Study of different types of cages and pens used in aquaculture (Model Study).
2. Identification of mussels of economic importance.
3. Identification of prawns of economic importance.
4. Identification of pearl oysters of economic importance.
5. Determination of protein and lipid content of edible tissues of mussels and prawns.
6. Identification of prawn seed of different species.
7. Study of craft used in fishery- Catamaran, Masula boat, Coracle, Trawler.
8. Study of gear used in fishery- line & hook, cast net, gill net, drag net, hand net, Chinese dip net.
9. Identification of freshwater food fish.
10. Identification of marine food fish.
11. Identification of sewage fed fish.
12. Analysis of sewage water- pH, dissolved O_2, dissolved CO_2 total suspended solids.
13. Estimation of Primary productivity of freshwater and sewage water by Light and Dark bottle method.
14. Visit to rivers, reservoirs to study riverine & reservoir fisheries.
15. Study of alien invasive fish species in India (any three).
16. Study of endangered fishes of India.
17. Study of electric fishing and light fishing.
18. Identification of aquarium fish (5 indigenous and 5 exotic species)
19. Aquarium fabrication and setting.

Visit to fish landing/marketing/research center and submission of report at the time of exam.

Outcomes

1. Identify and describe different types of cages used in aquaculture.
2. Describe the different economically important fish and shell fish.
3. Explain the structure and operation of different craft and gear used in fishery activity.
4. Perform water analysis tests used in fish farm management.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

Swami Ramanand Teerth Marthwada University, Nanded
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN
Faculty of Science
w. e. f. Academic Year 2020-2021
M.Sc. In Zoology
Detailed Syllabus
Fourth Semester
Course Code- XIX-C
Theory Paper- XIX-C
Title of the Paper: AGRICULTURE ENTOMOLOGY & PEST MANAGEMENT

Periods: 60 Credits: 04

Objectives

1. To learn about insect pests of agricultural crops.
2. To study agricultural insect pests and their control measures.
3. To explore different types of pesticides used in agriculture.
4. To study integrated pest management in agriculture.

UNIT- I **15**

1. Concept of pest; origin of pest; types of pests; nature of damage; pest resurgence.
2. Classification, morphology, bionomics, damage and control measures of
   2.1. Pests of cotton: Cotton bollworms; Red cotton bug; Cotton whitefly.
   2.2. Pests of sugarcane: sugarcane leafhopper.
   2.3. Pests of paddy: Yellow stem borer.

UNIT- II **15**

3. Classification, Morphology, bionomics, damage and control measures of-
   3.1. Pests of Jowar: Jowar stem borer, Jowar shoot fly, Jowar midge fly; armyworm.
   3.2. Pests of fruit crops: Lemon butterfly, mango stem borer, coconut borer.
   3.3. Pests of oil seed crops: Safflower aphid.
   3.4. Pests of stored grains: Rice weevil, Red flour beetle, pulse beetle.
   3.5. Defoliaters, sap suckers & fluid sucker pests of forest trees.

UNIT- III **15**

4. Pest Management
   4.1. Physical and mechanical control, cultural control, legal control.
   4.2. Chemical control: Insecticidal formulations, classification of insecticides, mode of action of insecticide, merits and demerits of chemical control, plant protection equipments.
   4.3. Quarantine regulations for import of agricultural products.

UNIT- IV **15**

5. Biological control: Principles, procedure, Biological agents; success and limitations.
6. Hormonal control of insect pests, Genetic control of insect pests.
7. Integrated Pest Management (IPM)- Principles, modeling and application.

Outcomes

1. Describe morphology and life stages of insect pests of agricultural crops.
2. Identify agricultural insect pests and suggest control measures.
3. Knowledge about different types of pesticides used in agriculture.
4. Identify agents and chemicals used in integrated pest management.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. Nayer, K.K., T. Anant Krishnan and B.W. David : General and Applied Entomology
3. Metcalf, G.L. and W.P. Fling : Destructive and Useful Insects
4. Hemsingh Pruthi : A Text Book of Agricultural Entomology
5. Wigglesworth : Principles of Insect Physiology
6. ESSIG : College Entomology
7. M.S. Mani : A Text Book of General Entomology
8. Government of Maharashtra Publication : Crop Pests and How to Fight Them
9. Oldroyd : A Collection, Preserving and Studying Insects
10. Roger P. and Anderson : Forest and Shade Tree Entomology
11. Tembhare, D.B. : Modem Entomology
12. Fradt, R.E. : Fundamentals of Applied Entomology
13. Smith, K.G.V. : Insects and Other Arthropods of Medical Importance
14. Ray, D.N. and A.W.A. Brown : Entomology Medical & Veterinary
15. Chandler, A.C. and Read, C.P. : Introduction of Parasitology
16. Debatch, R. : Biological Control of Natural Enemies
17. Apple, J.L. and Smith, R.F. : Integrated Pest Management
18. Cheny : General Parasitology
19. Corbet, J. R. : The Biochemical Mode of Action of Pesticides
20. Champaman, R.F. : Insects – Structure and Function
21. Richards, O.W. and R.G. Davies, IMMS : Text Book of Entomology
22. Bursel, E. : An Introduction to Insect Physiology
23. Rockstein M. : The Physiology of Insects (Vol. 1–VI)
24. Shrivastava, K.P. : A Text Book of Applied Entomology (Vol. I–H)
25. Johnson, O.A. : Embryology of Insects and Myriopods
26. Ross, H.A. : Text Book of Entomology
27. Roddick : Insect Physiology

LABORATORY COURSE based on THEORY PAPER- XIX-C

Laboratory Course XIX-C: AGRICULTURE ENTOMOLOGY & PEST MANAGEMENT

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To learn about insect pests and damage caused by them to different crop plants.
2. To study techniques of pest quantification.
3. To study integrated pest management techniques.
4. To learn about equipment used in agricultural pest management.

Practicals

1. Study of morphology, identification and nature of damage of pests of Jowar, Cotton and Paddy.
2. Study of morphology, identification, nature of damage of pests of stored grains, vegetables and fruit crops.
3. Detection and estimation of infestation losses in different crops.
4. Study of chemical insecticidal formulations (emulsion, dust and suspension) and insect control appliances.
5. Study of equipment used in mechanical control of insect pests.
6. Bio-assay of insecticides on insects (LC50).
7. Bio-assay to determine respiratory quotient (RQ) of insect under the influence of exposure to sublethal concentration of pesticide.
8. Collection and study of insect infested / damaged parts of plants.
9. Collection and study of parasitic and predatory insects.
10. Collection and study of pollinator insects & biological control agents.
11. Study of parasitoid insects as agricultural pest control agents.
12. Culture of parasitoid insect species for biological control of agricultural pests.
13. Identification of common insect pathogens.
14. Preparation of plant extracts for larvicidal activity.
15. Study of life history stages of different pests.
16. Study of plant protection equipment.

Visit to center of agricultural entomology / IPM and submission of report at the time of exam.

Outcomes

1. Identify and describe insect pests and damage caused by them.
2. Explain the different techniques of pest quantification.
3. Describe and suggest strategies for integrated pest management.
4. Identify and describe equipment used in agricultural pest management.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

Swami Ramanand Teerth Marthwada University, Nanded
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN
Faculty of Science
w. e. f. Academic Year 2020-2021
M.Sc. In Zoology
Detailed Syllabus
Fourth Semester
Course Code- XIX-D
Theory Paper- XIX-D
Title of the Paper: Mammalian Physiology- II

Periods: 60 Credits: 04

Objectives

1. To learn about nervous system components and their functions.
2. To understand reproductive system structure, functions, related conditions and remedies.
3. To study muscle structure, functioning mechanism, and disorders
4. To learn about the sensory system, their working, and disorders.

UNIT- I: Nervous System (CNS, PNS and ANS) 15

1. Meninges – Dura mater, Arachnoid mater and Pia mater
2. Central Nervous System- Structure and functions of forebrain- Olfactory lobes, Cerebrum and Diencephalon
3. Structure and functions of midbrain- Corpora quadrigemina and Crura cerebri
4. Structure and functions of hindbrain- Pons varolli and medulla oblongata (Brain Stem)
5. Electroencephalogram, sleep and learning physiology.
6. Spinal Cord
7. Peripheral Nervous System- Nerves and their functions
8. Autonomic Nervous System (ANS)- Sympathetic and Parasympathetic Nervous System

UNIT- II: Reproductive System 15

9. Male Reproductive System- external morphology and histological structure of testis
10. Spermatogenesis, hormonal control of spermatogenesis
11. Accessory sex glands
12. Semen- composition and functions of seminal fluids
13. Female Reproductive System – external morphology and histological Structure of ovaries
14. Oogenesis, hormonal control of oogenesis
15. Mammary Glands – Anatomy, histology and development of mammary glands, physiology breast cancer
16. Female Reproductive Cycle – Phases of female reproductive cycle and their hormonal control
17. Birth Control Measures – Sterilization in male and female
18. Hormonal Methods
19. Intra Uterine Devices
20. Barrier Methods
21. Chemical Methods
22. Physiological Methods
23. Abortion

UNIT- III: Muscle Physiology 15

24. Types, functions and characteristics of muscles.
25. Ultra structure of skeletal muscle and protein activities

26. Chemical composition of muscle fiber, neuromuscular junction
27. Contraction of muscle – Sliding filament mechanism
28. Role of calcium and regulator proteins
29. Power stroke and the role of ATP
30. Twitch contraction, Tetanus, Staircase effect CT
31. Muscle Metabolism- Phosphagen system and Glycogen-Lactic acid system
32. Disorders- i) Muscular dystrophy, ii) Myasthenia gravis.

UNIT- IV: Special Senses **15**

33. Ear- External, Middle and Internal Structure and Physiology of hearing
34. Properties of Sound and Sound Perception
35. Physiology of Equilibrium- Otolithic organs, Semicircular canals and path of vestibular impulses
36. Eye- Accessory structures and anatomy of the eyeball
37. Physiology of Vision- Refraction of light rays, accommodation of near point vision, constriction of pupil.
38. Disorders of ear and eye.

Outcomes

1. To describe and elaborate about nervous system components and their functions.
2. To outline reproductive system structure, functions, related conditions and remedies.
3. To delineate muscle structure, functioning mechanism, and disorders
4. To represent about the sensory system, their working, and disorders.

Suggested Reading

1. **Online resources like academic, research databases etc are recommended.**
2. Review of Medical Physiology- W.F. Ganong 16th Edition, 1993, Appleon and Lange (A Publishing Division of Prentice Hall).
3. Text Book of Medical Physiology- Arthur C. Guyton and John E. Hall, 10th Ed., 2000, Saundus An Imprint of Elsevier.
4. Human Physiology- Lauralee Sherwood, 6th Edition 2007, Thomson, India Edition.
5. Human Physiology- Vander, Sherman, Luciano, 6th Edition, McGraw-Hill Inc., International Ed. 1994.
6. Principles of Anatomy and Physiology- Gerard J. Tortora and Sandra Reynolds Grabowsky Harper Collins College Publishers, 8th Edition, 1996.
7. Text Book of Physiology- Smith, Patterson, Read and Scratched, ELBS, 11th Edition, 1988.
8. Marshall's Physiology of Reproduction- Vol. 1 to 5, Amming C.E., Edition, Churchill Livingstone, 1984.
9. Physiology- Bullock, J. Boyle, Harward Pull, 1991.
10. Essential Endocrinology- Laycock, J.F., and Wise, Peter, H. ELBS, 1983.
11. Hole's Human Anatomy and Physiology, 7th Edition By David Shier.
12. Human Physiology- Stuart Ira Fox, McGraw Hill, 6th Edition, 1999.
13. Human Physiology- David Moffett, Stacia Moffett Charles Schauf, Mosby International Ed. 1993.
14. Human Anatomy and Physiology- Elaine N. Marieb, 3rd Ed., The Benjamin / Cummings Publishing Inc., 1995.
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LABORATORY COURSE based on THEORY PAPER- XIX-D

Animal Physiology- II

Laboratory Course XIX-D: Mammalian Physiology- II

Periods : 60 (15 Practicals) **No. of Credits: 02 (Marks: 50)**

Objectives

1. To experimentally study structure and function of muscles.
2. To learn about techniques of separation and estimation of carbohydrates and proteins from tissues.
3. To learn methods of localization of carbohydrates, proteins and lipids in tissues.

Practicals

1. Preparation of simple muscle curve.
2. Mounting and study of muscle fibers.
3. To study the effect of fatigue on muscle contraction.
4. Dissection of male reproductive system of Rat (demonstration only).
5. Dissection of female reproductive system of Rat (demonstration only).
6. Dissection of brain of Rat (demonstration only).
7. Separation and identification of amino acids (in plasma/ tissue extracts) by paper chromatography.
8. Separation of plasma proteins/tissue proteins by Paper Electrophoresis/Gel Electrophoresis.
9. Demonstration of proteins (in tissue paraffin sections) by Nile Blue Sulphate, Best Carmine and Sudan Black method or any other histochemical staining method.
10. Demonstration of glycogen (in tissue paraffin sections) by Nile Blue Sulphate, Best Carmine and Sudan Black method or any other histochemical staining method.
11. Demonstration of lipids (in tissue paraffin sections) by Nile Blue Sulphate, Best Carmine and Sudan Black method or any other histochemical staining method.
12. Demonstration of tests for color blindness in humans.
13. Quantitative estimation of Na and K in provided sample.
14. Quantitative estimation of Ca and P in provided sample.
15. Pregnancy Test (using commercially available pregnancy test kits).
16. Estimation of serum creatinine and serum urea.

Visit to pathology laboratory/medical hospital and submission of report at the time of exam.

Outcomes

1. Perform experiments to demonstrate structure and function of muscles.
2. Separate and estimate carbohydrates and proteins from tissues.
3. Demonstrate localization of carbohydrates, proteins and lipids in tissues.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.