।। 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
25 1994 - 2019 SILVER JUBILEE YEAR
ACADEMIC (1-BOARD OF STUDIES) SECTION
Phone: (02462) 229542
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Website: www.srtmun.ac.in
E-mail: bos.srtmun@gmail.com

संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील प्रथम वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०१९–२० पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, **दिनांक ०८ जून २०१९ रोजी संपन्न झालेल्या ४४व्या मा. विद्या परिषद बैठकीतील ऐनवेळचा विषय क्र.११/४४–२०१९** च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या **संलग्नित महाविद्यालयांतील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील प्रथम वर्षाचे** खालील विषयांचे **C.B.C.S. (Choice Based Credit System) Pattern** नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०१९–२० पासून लागू करण्यात येत आहेत.

1. Bioinformatics
2. Biotechnology
3. Boichemistry
4. Botany
5. Chemistry
6. Computer Management
7. Computer Science
8. Dairy Science
9. Environmental Science
10. Herbal Medicine
11. Information Technology
12. M.C.A.
13. Microbiology
14. Physics
15. Software Engineering
16. System Administration & Networking
17. Zoology

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/२०१९–२०/**४६४**
दिनांक : ११.०७.२०१९.

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. First Year
Zoology
(Structure and Syllabus)

Choice Based Credit System (CBCS) Course Structure
Semester Pattern Syllabus
Effective from June, 2019

INTRODUCTION

Revision of syllabi is an important aspect of curriculum designing; especially in view of current developments in the field. Biological sciences, especially genomics and bioinformatics, have experienced drastic changes over the last decade. Mankind has made immense advances in these fields. 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 and competitive edge of the students.

In view of the UGC recommendations on model curriculum and the Maharashtra Public Universities Act (2016), the Board of Studies (BoS) in Zoology has designed the following syllabus for M.Sc. Zoology under the Faculty of Science & Technology of SRTM 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 techniques relevant to their educational development and career ambitions. 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 then solve some of the problems in this subject. Graduates in this programme will be induced into critical thinking, and would be able to solve complex problems in Zoology. The students would also be inculcated with personal and problem-solving skills that will enhance their employability prospects.

Enhanced 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 genetics, evolution, physiology, biochemistry, ecology, immunology, cytology, developmental biology, and taxonomy 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.

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 has been found 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 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 surrounding study.
4. To prepare students to attract and develop interest in applied parasitology, animal physiology, genetics, cell biology, fisheries science, toxicology so that the students can select zoology as their career.

The BoS in Zoology expects that this new framework of curriculum caters the need of enabling students of subject to accept new challenges of dynamically changing modern era.

Swami Ramanand Teerth Marathwada University, Nanded
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN
Faculty of Science and Technology
w. e. f. Academic Year 2019-2020
PAPER NUMBER AND TITLE OF PAPER
M.Sc. Zoology-I Year First Semester

Paper No. / Title of the Paper	**Credit (Marks)**			**Periods**
	External : ESE	**Internal : CA**	**Total Credits (Marks)**	
Theory Paper – I: Invertebrates: 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 - II: Biosystematics, Taxonomy and Evolution	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Theory Paper - III: Economic Zoology and Animal Behavior	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Theory Paper** (Elective) **- IV:** Quantitative Biology and Bioinformatics ***Or Conservation Biology	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Theory Paper - V: Seminar ***Or*** **One SWAYAM – MOOCSs Online Course of 2 Credits (instead of two Seminars each of Semester I and Semester II)	---	Credit: 01 (Marks: 25)	Credit: 01 (Marks: 25)	---
TOTAL	**Credit: 12 (Marks: 300)**	**Credit: 05 (Marks: 125)**	**Credit: 17 (Marks: 425)**	**600**

M.Sc. Zoology-I Year Second Semester

Paper No. / Title of the Paper	**Credit (Marks)**			**Periods**
	External : ESE	**Internal : CA**	**Total Credits (Marks)**	
Theory Paper - VI: Animal Ecology, Toxicology and Environmental Pollution	Credit: 03 (Marks: 75)	Credit: 01(Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Theory Paper - VII: Gamete Biology and Animal Development	Credit: 03 (Marks: 75)	Credit: 01(Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Theory Paper - VIII: Biochemistry and Immunology	Credit: 03 (Marks: 75)	Credit: 01(Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Theory Paper - IX:** (Elective) Tools and Techniques for Biology ***Or Pathobiology & Medical Zoology	Credit: 03 (Marks: 75)	Credit: 01(Marks: 25) (2 Test: 15 Marks; Assignments: 10 Marks)	Credit: 04 (Marks: 100)	60
Theory Paper - X: Seminar ***Or*** **One SWAYAM – MOOCSs Online Course of 2 Credits (instead of two Seminars each of Semester I and Semester II)	---	Credit: 01 (Marks: 25)	Credit: 01 (Marks: 25)	---
TOTAL	**Credit: 12 (Marks: 300)**	**Credit: 05 (Marks: 125)**	**Credit: 17 (Marks: 425)**	**600**

(**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 V of Semester I and Paper X of Semester II.

M.Sc. Zoology-I Year (First and Second Semester) Laboratory Course Work (Annual Pattern)

Paper No. / Title of the Paper	Credit (Marks)		
	External : ESE	**Internal : CA**	**Total Credits (Marks)**
Laboratory Course Work-I: Based on Theory Paper- I & II: (I-Invertebrates: Structure and Function; II-Biosystematics, Taxonomy and Evolution)	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) Test on Practical=25 Marks	Credit: 04 (Marks: 100
Laboratory Course Work-II: Based on Theory Paper- III & IV: (III- Economic Zoology and Animal Behavior; IV (Elective*)- Quantitative Biology and Bioinformatics Or Conservation Biology;)	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) Test on Practical=25 Marks	Credit: 04 (Marks: 100
Laboratory Course Work-III: Based on Theory Paper- VI & VII: (VI-Animal Ecology, Toxicology and Environmental Pollution; VII-Gamete Biology and Animal Development)	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) Test on Practical=25 Marks	Credit: 04 (Marks: 100
Laboratory Course Work-IV: Based on Theory Paper- VIII & IX: (VIII- Biochemistry and Immunology; IX (Elective*)- Tools and Techniques for Biology **or** Pathobiology & Medical Zoology)	Credit: 03 (Marks: 75)	Credit: 01 (Marks: 25) Test on Practical=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. First Year (Theory & Practical)	**Credit: 36 (Marks: 900)**	**Credit: 14 (Marks: 350)**	**Credit: 50 (Marks: 125)**

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

Swami Ramanand Teerth Marathwada University, Nanded

FACULTY OF SCIENCE & TECHNOLOGY

M.Sc. Second Year
Zoology
(Structure)

Choice Based Credit System (CBCS) Course Structure
Semester Pattern Syllabus
Effective from June, 2020

Swami Ramanand Teerth Marathwada University, Nanded

CHOICE BASED CREDIT SYSTEM (CBCS)

SEMESTER PATTERN

Faculty of Science and Technology

w. e. f. Academic Year 2021-2022

PAPER NUMBER AND TITLE OF PAPER

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 and Arthropods 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)**	**600**

(**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

Faculty of Science and Technology

w. e. f. Academic Year 2021-2022

PAPER NUMBER AND TITLE OF PAPER

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 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** Entamology-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** Entamology-II Agriculture Entomology and Pest Management ***Or ***Theory Paper XIX-B** Fishery Science – II Fisheries and Fish Culture – II ***Or*** ***Theory Paper XIX-C** Applied Parasitology – II Animal Nematodes and Plant Nematodes ***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)**	**600**

(**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 - 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)

Total Credit & Marks of M.Sc. First & Second Year Zoology (Theory & Practical)

Total Credit Semester wise	Credit (Marks)		
	External : ESE	**Internal : CA**	**Total Credits (Marks)**
Total Credit & Marks of M.Sc. First Semester (Theory)	Credit: 12 (Marks: 300)	Credit: 05 (Marks: 125)	Credit: 17 (Marks: 425)
Total Credit & Marks of M.Sc. Second Semester (Theory)	Credit: 12 (Marks: 300)	Credit: 05 (Marks: 125)	Credit: 17 (Marks: 425)
Total Credit & Marks of M.Sc. First & Second Semester (Practical)	Credit: 12 (Marks: 300)	Credit: 04 (Marks: 100)	Credit: 16 (Marks: 400)
Total Credit & Marks of M.Sc. First Year (I & II Semester)(Theory & Practical)	***Credit: 36 (Marks: 900)***	***Credit: 14 (Marks: 350)***	***Credit: 50 (Marks: 1250)***
Total Credit & Marks of M.Sc. Third Semester (Theory)	Credit: 12 (Marks: 300)	Credit: 05 (Marks: 125)	Credit: 17 (Marks: 425)
Total Credit & Marks of M.Sc. Fourth Semester (Theory)	Credit: 12 (Marks: 300)	Credit: 05 (Marks: 125)	Credit: 17 (Marks: 425)
Total Credit & Marks of M.Sc. Third & Fourth Semester (Practical)	Credit: 12 (Marks: 300)	Credit: 04 (Marks: 100)	Credit: 16 (Marks: 400)
Total Credit & Marks of M.Sc. Second Year (III & IV Semester)(Theory & Practical)	***Credit: 36 (Marks: 900)***	***Credit: 14 (Marks: 350)***	***Credit: 50 (Marks: 1250)***
Total Credit & Marks of M.Sc. First & Second Year (Theory & Practical)	**Credit: 72 (Marks: 1800)**	**Credit: 28 (Marks: 700)**	**Credit: 100 (Marks: 2500)**

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Choice Based Credit System (CBCS) Course Structure
Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester -I

Paper I: Invertebrates: Structure and Function
Periods : 60 **No. of Credits: 04 (Marks: 100)**

Objectives:
1. To study the importance of biodiversity, habitat, adaptations, body organization and taxonomic status of non-chordates.
2. To study basic aspects of classification of non-chordates.
3. To understand and describe structural and functional details of anatomy of non-chordates.
4. To develop a correlated view of all non-chordate groups: extinct and living.

Unit-I
1. Organization of coelom : Acoelomates
2. Organization of coelom: Pseudocoelomates.
3. Organization of coelom : Protostomia and Dueterostomia
4. Locomotion : Flagellar and Ciliary movement in Protozoa
5. Locomotion : Hydrostatic movement in Coelenterata, Annelida, and Echinodermata

Unit-II
1. Nutrition in Protozoa
2. Patterns of feeding and digestion in lower Metazoan
3. Filter feeding in Polychaeta, Mollusca and Echinodermata
4. Respiration: Organs of respiration: Gills, lungs and trachea
5. Respiratory pigments
6. Mechanism of respiration

Unit-III
1. Organs of excretion: Coelom, Coelomoducts, Nephridia and Malphigian tubules
2. Mechanism of excretion
3. Excretion and Osmoregulation
4. Primitive nervous system: Coelenterata and Echinodermata
5. Advanced nervous system: Annelida, Arthropoda, (Crustacea and Insecta) and Mollusca (Cephalopoda)

Unit-IV
1. Larval forms of invertebrates
(Helminthes, Annelida, Arthropoda and Echinodermata)
2. Strategies and evolutionary significance of larval forms
3. Concept and significance of minor phyla
4. Organization and general characters of minor phyla
5. Hemichordata: Characters, Classification, Affinities and Economic importance.

Expected Outcomes:
1. Classify animals from different groups based on their features.
2. Explain the similarity and differences in structure and function of organs in different groups of animals.
3. Understanding about importance of integument and skeletal systems.
4. Compare the functional morphology different groups of invertebrates.

Suggested Reading

1. Hyman L.H. '**The Invertebrates. Vol I-Protozoa through Ctenophora',** McGraw Hill Co, New York.

2. Hyman, L.H. '**The Invertebrates Vol-II',** McGraw Hill Co., New York.

3. Hyman, L.H. '**The Invertebrates. Vol-VIII',** McGraw Hill Co., New York and London.

4. Barnes, R.D. '**Invertebrate Zoology, 3rd edition',** W.B. Saunders Co., Philadelphia.

5. Barrington, E.J.W. '**Invertebrate Structure and Function',** Thomas Nelson and Sons Ltd., London.

6. Sedgwick, A.A. '**Students Text Book of Zoology',** Vol. I, II and III. Central Book Depot, Allahabad.

7. Parker, T.J., Haswell, W.A. **'Text Book of Zoology',** Macmillan Co., London.

8. R.L.Kotpal **'Modern Text Book of Zoology Invertebrates'**. Rastogi Publications, Meerut.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Choice Based Credit System (CBCS) Course Structure
Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester -I
LABORATORY COURSE WORK BASED ON THEORY PAPER-I
Paper: Lab Course - I: Invertebrates: Structure and Function
Periods : 60 (15 Practical's) **No. of Credits: 02 (Marks: 50)**

1. Demonstration of Digestive, Reproductive and Nervous system of crab, Earthworms, Cockroach.
2. Mounting of Nephridium & Spermatheca of Earthworm: Trachea of Cockroach, Gills of Crab.
3. Mounting of larvae of insects and crustacea (Any five).
4. Museum specimens from invertebrate phyla: Salient characteristics, identification and classification of representative types of Invertebrate groups from Protozoa, Porifera, Coelenterata, Ctenophora, Platyhelminthes, Aschelminthes, Mollusca, Annelida, Arthropoda, Echinodermata and Hemichordata (Five specimens from each phylum).
5. Identification and study the larval forms all major phyla of Invertebrates.
6. Study of the following specimens to bring out their affinities; a. *Balanoglossus* b. *Cephalodiscus.*
7. Five permanent stained micro preparations prepared by the examinee are to be submitted at the time of practical examinations.

[Note-Demonstration of Dissections by Charts / Models/ Audio Visual Aids]

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Choice Based Credit System (CBCS) Course Structure
Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester -I
Paper II: Biosystematics, Taxonomy and Evolution
Periods : 60 **No. of Credits: 04 (Marks: 100)**

Objectives:
1. To learn the basics of taxonomy and classification of animals.
2. To upgrade knowledge of new taxonomical concepts.
3. To acquaint with different taxonomic databases.
4. To learn the different theories of evolution.
5. To study evolutionary relations and different phylogenetic methods.

Unit-I
1. Definition and basic concepts of Biosystematics and Taxonomy.
1.1 Brief historical resume of systematic.
1.2 Importance and applications of Biosystematics in Biology.
2. Trends in Biosystematics: Chemotaxonomy, Cytotaxonomy, Molecular Taxonomy and Immunotaxonomy.
3. Dimensions of speciation.
3.1 Mechanism of speciation.
4. Species concepts: Species category, different species concepts, sub-species and other infra-specific categories.
5. Theories of Biological classification; Hierarchy of categories.

Unit -II
1. Taxonomic characters: Different kinds, origin of reproductive isolation, biological mechanism of genetic incompatibility.
2. Taxonomic procedures: Taxonomic collections, preservation, curating, process of identification.
3. Taxonomic publications.
4. Taxonomic keys: Different kinds of keys, their merits and demerits.

Unit - III
1. International Code of Zoological Nomenclature (ICZN): operative principles, interpretation and application of important rules, formation of scientific names of various taxa.
2. Biodiversity- characterization, generation, maintenance and loss; magnitude and distribution of biodiversity, economic value, wildlife biology, conservation strategies.

Unit – IV
1. Concepts of Evolution. Darwin's Theory of evolution; Modern Synthetic Theory of evolution. Lamark's Theory of Evolution; Mutation Theory of Evolution by Hugo De Vries.

2. Population genetics: Bottleneck Effect (Founder Effect), Hardy-Weinberg law of genetic equilibrium. Destabilizing forces, natural selection, mutation, genetic drift, migration.
3. Pattern of changes in nucleotide sequences.
4. Molecular Evolution, Gene evolution, Evolution of gene families.

Expected Outcomes:

1. Classify animals from different groups based on their features.
2. Describe different taxa and elaborate on their anatomical and morphological features.
3. Identify and describe homologies between different groups of animals.
4. Identify and access taxonomic information in different online databases.
5. Describe evolutionary relationship between different taxa.
6. Explain about evolutionary distance between different taxa.
7. Infer phylogenetic information and prepare phylogenetic trees.

Suggested Readings

1. Kato, M. **'The Biology of Biodiversity**', Springer.
2. Avise, J.C. **'Molecular Markers, Natural History and Evolution'**, Chapman & Hall, New York.
3. Wilson, E.O. **'Biodiversity'**, Academic press, Washington.
4. Simpson, G.G. **'Principles of Animal Taxonomy'**, Oxford IBH publishing company.
5. Mayr, E. **'Elements of Taxonomy'**.
6. Wilson, E.O. **'The Diversity of life (College Edition)',** W.W. Northem & Co.
7. Tikadar, B.K. **'Threatened Animals of India'**, ZSI Publication, Caculatta.
8. Dobzhansky, Th. **'Genetics and Origin of Species'**, Columbia University, Press.
9. Dobzhansky, Th., F.J. Ayala, G.L. Stebbines and J.M. Valetine **'Evolution'**, Surjeet Publicaiton, Dehli.
10. Futuyama, D.J. **'Evolutionary Biology'**, Suinuaer Associates, INC Publishers, Dunderland.
11. Jha, A.P. **'Genes and Evolution'**, John Publication, New Delhi.
12. Merrel, D.J. **'Evolution and Genetics'**, Holt, Rinchart and Winston, Inc.
13. Lull 'Organic **Evolution'**.
14 Austin Balfour & Dominic Fasso- **Principles of Plant and Animal Taxonomy**. Syrawood Publishing House.
15 Ashok Verma-**Principles of Animal Taxonomy**. Alpha Science International Ltd
16 Kapoor V C-**Theory and Practice of Animal Taxonomy and Biodiversity**, 8th Edition Oxford & Ibh
17 Kapoor V C-**Principles and Practices of Animal Taxonomy**, Science Publishers.
18 R.C Dalela & R.S Sharma- **Animal Taxonomy & Museology**. Jai Prakash Nath & Co.

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Choice Based Credit System (CBCS) Course Structure
Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester -I
LABORATORY COURSE WORK BASED ON THEORY PAPER-II
Paper: Lab Course - II: Biosystematics, Taxonomy and Evolution
Periods : 60 (15 Practical's) **No. of Credits: 02 (Marks: 50)**

1. Composition assessment of taxonomic diversity/Bio-diversity in habitat, e.g. Grassland, Wetland, forest etc.
2. Equipments and Specimen Collection Methods.
3. Collection of Insects, Spreading, Pinning and Studying of Insects.
4. Methods of collection, preservation and identification of plankton and representative forms of terrestrial and aquatic fauna.
5. Study of Local Fauna- Collection & Preservation of Animals.
6. Systematic studies of Animals from Protozoa to Mammals (At least five Animals from each group.).
7. Museum preservation techniques of selected vertebrates and invertebrates.
8. Submission of Insects/Animals Collected (Compulsory.)
9. Studies on fossils, connecting links like *Peripatus, Archaeopteryx, Limulus.*
10. Study of Homologous Organs and Analogous Organs.
11. Excursion/Study Tour Compulsory- Visit to ZSI and other places.

[Note-Demonstration of Dissections by Charts / Models/ Audio Visual Aids]

Paper III: Economic Zoology and Animal Behavior

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

Objectives:

1. To learn about communicable and non-communicable diseases in humans.
2. To study the economic importance of animals and animal husbandry.
3. To know culture practices and economic importance of aquaculture.
4. To study different types of behaviour in animals.
5. To learn about application of behavioral knowledge in animal husbandry and other areas of interest.

Economic Zoology

UNIT -I

1. Protozoan Parasites Pathogenic to man

1.1 *Entamoeba histolytica*, *Trypanosoma*, Binomics, prevention & control.

2. Zooparasitic Helminths – Structure, Life cycle, Pathogenicity and control.

2.1. Trematoda – *Schistosoma haematobium*.

2.2. Cestoda – *Taenia solium and Taenia saginata.*

2.3. Nematodes – *Wuchereria bancrofti*.

3. Mosquitoes as vector of Human diseases with special reference to - Malaria, Dengue, Filaria, Chickengunya and control of Mosquitoes.

4. Introduction to Arthropods of Forensic importance.

UNIT -II

1. Apiculture –
   Social Organization of Honey Bees, Life Cycle, Bee keeping and Economic Importance.
2. Sericulture -
   Types of Silk moth, Life cycle and rearing of Silk moth.
3. Fresh Water Fish Culture –

3.1 Indian major Carps.

3.2 Management of fish farm.

3.3 Breeding Pond, Hatching Pit, Nursery and Stocking Pond.

4. Pearl Culture

4.1 Pearl producing molluscs.

4.2 Pearl formation and pearl industries.

5. Vermiculture and Vermicomposting.

6. Poultry: Breeds, biology of fowl, methods of rearing and maintenance, diseases of poultry and their control measures.

Animal Behavior

UNIT -III

1. Introduction.
1.1 Concept of Ethology, its Branches and Scope.
1.2 Classification of behavioral patterns.
a) Innate Behavior.
b) Acquired Behavior.
1.3 Motivated Behaviour
Goal Directed Behaviour
Different Types of Biological Drives
a) The Thirst Drive
b) The Hunger Drive
c) The Sleep Drive
d) Heat and Cold Drive
e) The Sexual Drive

UNIT -IV

1**.** Perception of environment and Animal communication.
1.1 Chemical.
1.2 Olfactory.
1.3 Auditory.
1.4 Visual.
2. Ecological aspects of Behavior-
2.1 Habitat selection – Optimal foraging theory, Anti predator defenses.
2.2 Role of Hormones in Behaviour
a) Sexual Behaviour
b) Aggressive Behavoiur
2.3 Pheromones- Categories; Role of pheromones in animals.
2.4 Social Organization in Insects and Primates.
3. Reproductive Behavior –
3.1 Evolution of Sex and Reproductive Strategies.
3.2 Mating Systems.
3.3 Courtship.
3.4 Parental care in Animals – Fish and Amphibians.

Expected Outcomes:

1. Identify animal pathogenic diseases in humans and suggest remedial measures.
2. Evaluate and describe the economic impact of animals on human society.
3. Describe different culture methods relevant to aquaculture.
4. Identify and describe economically important fish and other animals.
5. Identify and explain different types of behavior patterns in animals.
6. Describe the importance of different behaviors in animal husbandry.

Suggested Reading

1. Vinod Kumar, **'Animal Behaviour'** Himalaya Publishing House, Bombay.
2. Hinde, R.A, **'Animal Behaviour: A Synthesis of Ethology and Comparative Psychology'**, Mc Graw- Hill, New York.
3. Afcock, J, **'Animal Behaviour: An Evolutionary Approach'**, Sinauer Assoc. Sunderland Massachsets, USA.
4. H. S. Gundevia and H. G. Singh, **'A Text Book of Animal Behaviour'**, S. Chand & Company Ltd., 2001.
5. G.S.Shukla & V.B. Upadhyay, '**Economic Zoology'.**

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Choice Based Credit System (CBCS) Course Structure
Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester –I
LABORATORY COURSE WORK BASED ON THEORY PAPER-III
Paper: Lab Course - III: Economic Zoology and Animal Behavior
Periods : 60 (15 Practical's) **No. of Credits: 02 (Marks: 50)**

Economic Zoology

1. Study of Protozoan Parasites of Man –
   i) *Entamoeba histolytica*, ii) *Trypanosoma iii) Plasmodium.*
2. Study of Parasitic helminthes –
   i) Schistosoma haematobium. ii) Taenia solium. iii) *Taenia saginata. iv*) *Wuchereria bancrofti.*
3. Study of – i) Social organization of bees; ii) Life cycle of Honey bee; iii) Hive iv) Mosquitoes-Life cycle.
4. Identification of Food Fishes and Molluscs-
   i) *Labeo rohita;* ii) *Catla catla;* iii) *Cirrhina mrigala;* iv) *Channa;*
   v) *Perna indica;* vi) *Crassostrea.*
5. Visit to Fish breeding Farm.
6. Study of life cycle of Silk moth.
7. Study of Vermiculture.

Animal Behavior

8. Study of Positive and negative phototrophism.
9. To study the habituation to light stimulus in the earthworm *Pheritima.*
10. To study the distribution of light stimuli in the earthworm *Pheritima*
11. To demonstrate photo tactic and geotactic responses of the animal provided (House fly *Musca domestica*)
12. Study of Positive and Negative Chemotactic Response with suitable examples.
13. Righting response in crab or any other animal.
14. Communication – Examples from invertebrates and vertebrates (Terrestrial, Aerial, Aquatic habitats)
15. Ecological aspects – Food selection, optimal foraging, prey and predator, Host-Parasite relationship.
16. Social behaviour – Aggregations – Examples from fishes, birds and mammals, social organization – insects
17. Reproductive behaviour – mating systems, sexual selection, parental care in animals.

[Note-Demonstration of Dissections by Charts / Models/ Audio Visual Aids].

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Choice Based Credit System (CBCS) Course Structure
Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester -I
Paper IV(Elective): Quantitative Biology and Bio-Informatics
Periods : 60 **No. of Credits: 04 (Marks: 100)**

Objectives:

i. To study different methods of data processing.
ii. To develop skill of data handling using computer.
iii. To learn about different data representation methods.
iv. To study the different online databases of biological information.
v. To study the different DNA and Protein analysis software.

Quantitative Biology

Unit- I

1. Introduction to Biostatistics – Definition, Terms, Applications and Role of biostatistics in modern research.
2. Types of data and methods of data collection.
3. Classification and tabulation of Data.
4. Measures of Central Tendency- Mean, Median, Mode.

Unit- II

1. Data Dispersion, Correlation and Standard Deviation
2. Statistical Data Analysis Methods using Computer Programs- Excel, SPSS, Openoffice.
3. Data Presentation Methods usning Computer Programs- Power Point, Excel, SPSS, Openoffice.
4. Graphic Representation of Data- Line Graph, Bar Graph, Pie Chart.

Bio-Informatics

Unit- III

1. Bioinformatics: Definition & Scope.
2. Application Software: Sequence analysis- BLAST, Unipro Ugene; Protein analysis- Chimera.
3. Role of Internet in Bioinformatics.
4. Bioinformatics Databases-
   - 4.1 Genomic and Gene Databases- NCBI, Genbank.
   - 4.2 Protein Databases- Protein Data Bank (PDB), SwissProt.
   - 4.3 Metabolic Databases- ptools, reactome.

Unit- IV

1. Biological Search Engines.
2. Introduction to gene sequence search, comparison, alignment and analysis, its scope and applications.
3. Introduction to protein structure analysis, its scope and applications.
4. Introduction to drug discovery, Role of protein structure data in drug discovery, software used in drug discovery, general approach to drug discovery.

Outcomes:

1) Describe different methods of data handling using computers.
2) Feed and tabulate raw data using computer.
3) Explain and perform data representation using digital methods.
4) Access and download relevant information from different online databases of biological information.
5) Perform basic operations of gene sequence retrieval and compare them using different software.
6) Perform basic operations of protein structure retrieval and comparison using different software.

Suggested Reading

1. Batschetlet, E. '**Introduction to Mathematics for Life Scientists'** Springer-Verlag, Berling.
2. Jorgensen, S. E. **'Fundamentals of Ecological Modelling'** Ensevier, New York.
3. Swartzman, G. L. and S. P. O. Kaluzny, **'Ecological Simulation-Primer',** Macmillan, New York.
4. Lendren, D. **'Modelling in Behavioral Ecology'**, Chapman and Hal, London, U. K.
5. Sokal , R. R. and F. J. Rohlf, **' Biometry'**, Freeman San Francisco.
6. Snedecor, G. W. and W. G. Cochran, **'Statistical Methods'** Affiliated East- West Press, New Delhi (Indian ed.)
7. Green, R. H. **'Sampling Design and Statistical Methods for Environmental Biologists',** John Wiley and Sons, New York.
8. Murrary, J. D. **'Mathematical Biology'**, Springer Verlag, Berlin.
9. Pielou, E. C. **'The Interpretation of Ecological Data: A Primer on Classification and Ordination'.**
10. P. Rama Krishnan, **'Biostatics'**, Saras Publication, 2005.
11. Brown,S. M. **'Bioinformatics- A Biologists Guide to Biocomputing and Internet'** Eaton Publishing, New York, 2000.
12. Lesk, A. M. **'Introduction to Bioinformatics'**, Oxford, 2002.
13. Bioinformatics - **Methods and Protocols. In: Methods in molecular Biology,** Vol.132, Humana Press, 2001.
14. Higgins & Taylor. **'Bioinformatics - Sequence, Structure and Databanks'**, Oxford, 2000.
15. Baxevanis and Ouellete. **'Bioinformatics'** John Wiley & Sons, 1998.
16. Krane and Raymer, **'Fundamental concept of Bioinformatics',** Pearson Education, 2003.
17. Attwood and Parry-Smith, **'Introduction to Bioinformatics'**, Pearson Education, 2003.

Paper: Lab Course – IV(Elective): Quantitative Biology and Bio-Informatics
Periods : 60 (15 Practical's) **No. of Credits: 02 (Marks: 50)**

1. Classification of data
2. Preparation of Histograms.
3. Preparation of Bar Diagrams.
4. Preparation of Pie Chart.
5. Drawing Graphs and Tables on Computer.
6. Problems based on Mean, Median and Mode.
7. Problems based on Standard Deviation.
8. Problems based on Correlation.
9. Graphic representation of Data- Tables, Graphs, Scatter plots.
10. Searching given nucleotide sequence in a database using BLAST and reporting the results.
11. Comparison of given nucleotide sequences and reporting the results.
12. Searching, downloading and visualizing a protein structure file.
13. Comparison of given protein sequence files and reporting the results.
14. Searching a given metabolic pathway and visualizing it.
15. Searching biological information about a given gene sequence in an online database and report.
16. Searching biological information about a given protein in an online database and report.

[Note-Demonstration of Dissections by Charts / Models/ Audio Visual Aids]

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Choice Based Credit System (CBCS) Course Structure
Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester -I

Paper IV (Elective): Conservation Biology
Periods : 60 **No. of Credits: 04 (Marks: 100)**

Objectives:

1. To study concepts of biodiversity and its quantification methods.
2. To learn about factors affecting biodiversity index and Indian biodiversity hotspots.
3. To explore tools used in biodiversity conservation.
4. To study Laws governing management and conservation of biodiversity.
5. To get awareness of significance of biodiversity and be able to inform about its importance to others.

Unit- I

1. Concept of Biodiversity
2. Components of Biodiversity (Ecological, Genetic and Species diversity)
3. Value of Biodiversity
4. Biodiversity at global and national level- a comparative account.
5. Measures of species diversity: Species richness indices- Menhinick's index, Margalef's index, Species abundance indices- Simpson's index, Shannon index.
6. Biodiversity Hotspots in India- Himalayas, Indo-Burma, Sundalands and Western Ghats.

Unit- II

1. Threats to Biodiversity: Ecological- competition, predation, climate; and anthropogenic- habitat destruction, Human population growth, pollution, land use patterns.
2. Representative wild species of India.
3. Endemic Species of India- Marine species, Vertebrate and Invertebrate species.
4. Exotic and Invasive species, their effect on native species.
5. Endangered species of India; IUCN Red List Categories, Red Data Book and Threatened Animals of India.
6. Conservation of Biodiversity- In-situ conservation; Ex-situ conservation, Techniques used in In-situ & Ex-situ conservation.

Unit- III

1. Basic concept of wildlife
2. Biological Importance and Necessity for wild life conservation
3. Economic and other benefits of wild life
4. Causes for wildlife depletion
5. Aims and objective of wildlife conservation
6. Different approaches of wild life conservation
7. Modes and methods of wildlife conservation
8. National and International Organizations involved in wildlife conservation
9. Sanctuaries, National parks & Biosphere reserves in India.

Unit- IV

1. Conservation tools- Geographical Information System (GIS); Remote Sensing; Geographic positioning System (GPS) in brief.
2. Wildlife Health: Diseases of wild animals and their management- A brief account.

3. Legislative and Administrative measures for conservation of wildlife: Wildlife (Protection) Act of India (1972); International Union for Conservation of Nature (IUCN); World wildlife Fund (WWF)
4. Present status of wildlife in India.
5. Challenges in wildlife conservation and management in India-
6. Role of Educational institutes, NGO's and Government organizations in wildlife conservation.

Expected Outcomes:

1. Ability to describe biodiversity and its role in ecosystem health.
2. Ability to understand and analyze ecological factors affecting biodiversity.
3. Knowledge about different biodiversity hotspots of India and their unique characteristics.
4. An understanding of methods and tools used for wildlife conservation in India.
5. An understanding of and ability to interprete the Laws governing natural biodiversity in India.
6. Ability to disseminate knowledge about biodiversity in India and the significance of its conservation.

Suggested Reading

1. Anon. 2004. Indian Wildlife Protection Act 1972. Natraj Publishers, Dehra Dun. 104p.
2. Anon. 1992. Convention on Biological Diversity - Text and annexes. World Wide Fund for Nature - India.
3. Anon. 1997. Wildlife (Protection) Act of India, Nataraj Publishers, Dehradun
4. Caughley, G., and A. Gunn. 1995. Conservation Biology in Theory and Practice. Blackwell Publishers.
5. Cody, M.L. and J.M. Diamond 1975. Ecology and Evolution of Communities. Harvard University Press. Cambridge. 545p.
6. Gaston, K. J. 1996. Biodiversity- A Biology of Numbers and Difference. Blackwell Science, Oxford. 396 p.
7. Goutam Kumar Saha, Subhendu Mazumdar-Wildlife Biology : An Indian Perspective.PHI Learning.
8. Giles, H. 1984. Wildlife Management Techniques. Natraj Publishers, Dehra Dun.
9. Gopal, R. 1992. Fundamentals of Wildlife Management. Justice Home. Allahabad. 668p.
10. Groom bridge, B.1992.Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.
11. Handa, S.K. 1999. Principles of Pesticide Chemistry. Agrobios Publishers, Jodhpur. 309p.
12. Heyer, W.R. *et al* 1994. Measuring and Monitoring Biological Diversity, Standard methods for Amphibians. Smithsonian Institution Press. Washington. 364p.
13. Huffaker, C.B. and A.P. Gutierrez 1999. Ecological Entomology. John Wilely and Sons, New York. 756p.
14. H.R.Singh and Neeraj Kumar- Ecology and Environmental Science. Vishal Publishing Co. Jalandhar.
15. International Commission of Zoological Nomenclature 1999. International code of zoological nomenclature. 4th Edition. International Trust for Zoological Nomenclature, London. 306p.
16. IUCN, The World Conservation Union. http://www.iucn.org/.21
17. Kikkawa, J. and D.J. Anderson 1986. Community Ecology: Pattern and Process. Blackwell Scientific Publications, Oxford. 432p.
18. Meffe, G. K. and C. R. Carroll 1994.Principles of Conservation Biology, Sinauer Associates, USA
19. Michael, P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata Mc Graw Hill Publishing Company Limited, New Delhi. 404 p.
20. Odum, E.P. 1996. Fundamentals of Ecology. Natraj Publishers, Dehra Dun 574p. *M.Sc. Zoology-2018-19 onwards-UD-obe Annexure No:83 Page **44** of **62 SCAA Dated: 11.06.2018***
21. Primack, R. B. 2006. Essentials of Conservation Biology, Sinauer Associates, USA.
22. Reaka, M.L., Kudla, D. E. Wilson and E. O. Wilson 1997. Biodiversity II: Understanding and Protecting our Biological Resources. Joseph Henry Press, Washington, DC.
23. Rodgers, W.A. and H.S. Panwar 1988. Planning a Protected Area Network in India. Wildlife Institute o India, Dehra Dun.
24. Soule, M. E. 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA.
25. Sutherland, W. J., 1998. Conservation science and action. Blackwell Science, Oxford, England.
26. William J. Sutherland 1996. Ecological census: techniques, (Cambridge University press.
27. William Morris, Daniel Doak, Martha Groom et al., 1999. A Practical handbook for Population Viability Analysis, The Nature Conservancy.
28. Wilson, E. O., and D. Perlman. 2000. Conserving earth's biodiversity. Island Press, Washington, D.C.

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Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester -I
LABORATORY COURSE WORK BASED ON THEORY PAPER-IV(Elective)
Paper: Lab Course – IV (Elective): Conservation Biology
Periods : 60 (15 Practical's) **No. of Credits: 02 (Marks: 50)**

1. Collection and preservation of fauna.
2. Sampling Techniques (Transect and quadrate method).
3. Identification and use of keys – reference specimen.
4. Wildlife photography and documentation of locally occurring wild species of animals.
5. Remote sensing GIS and their modules for conservation.
6. IUCN Red List Exercise, VORTEX and SIS.
7. Statistical analysis – Shannon Weiner Index, Simpson's index, Species richness and evenness.
8. Museum study of Vertebrate Endangered Species or Threatened Wild Animals on the Basis of charts/ models/ photographs (Any Five).
9. Survey/Study of local/nearby natural habitat and reporting of its biodiversity and health status.
10.Submission of local biodiversity album (soft copy in ppt or pdf format).
11. Field Visit to wild life sanctuaries and National parks(Tour report submission)

[Note-Demonstration of Dissections by Charts / Models/ Audio Visual Aids]

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Choice Based Credit System (CBCS) Course Structure
Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester -II

Paper VI: Animal Ecology, Toxicology and Environmental Pollution
Periods : 60 **No. of Credits: 04 (Marks: 100)**

Objectives:
1) Study the greenhouse effect and global warming.
2) Learn about pollution and its effects on ecosystems.
3) Study the adaptations of animals to different ecosystems.
4) Explore different environmental conservation and management techniques.

UNIT -I
1. Ecology- Basic Concept.
2. Nature of Ecosystem-
2.1 Abiotic and Biotic Factors.
2.2 Energy Flow in Ecosystem.
3. The Abiotic Environment
3.1 Temperature, Water and Soil as an Ecological Factors.
4. Minimums, Tolerances and the Medium.
4.1 Liebig's Law of Minimum.
4.2 Law of Limiting Factors.
4.3 Shelford's Law of Tolerance.
5. Ecological Adaptations
5.1 Volant Adaptations
5.2 Aquatic Adaptations
5.3 Desert Adaptations

UNIT -II
1. Biogeochemical Cycles and Ecosystem
1.1 Carbon Cycle
1.2 Nitrogen Cycle
1.3 Sulphur Cycle
1.4 Phosphorous Cycle
1.5 Water Cycle
2. Population Ecology
2.1 Characteristics of Population
2.2 Population Growth
2.3 Population Fluctuations and Equilibrium
2.4 Population Regulation

UNIT -III
1. Introduction to Toxicology and Pollution
2. Environmental Toxicology
2.1 Common Toxic Manifestations
2.2 Toxic Metal Pollutants

2.3 Toxic Gaseous Pollutants
2.4 Toxic Inorganic and Organic Compounds
2.5 Environmental Carcinogens
3. Air Pollution
3.1 Introduction
3.2 Composition of the Atmosphere
3.3 Sources of Air Pollution
3.4 Effects of Air Pollution
3.5 Air Pollution Monitoring and Control.
4. Global Warming- Consequences and Effects.
5. Soil pollution sources, effect and control

UNIT -IV
1. Water Pollution
1.1 Sources & effects of Water Pollution
1.2 Physical and Chemical Examinations of Water
1.3 Water Pollution and Diseases
1.4 Waste Water Treatment Processes
a) Chemical Treatment and Biological Treatments
2. Noise Pollution – Sources, Effects and Control of Noise Pollution
3. Pollution by Solid Wastes.
3.1 Sources and Effects
4. Introduction to Indian legislations for pollution control.

Expected Outcomes:
1. Describe the role of different gases in greenhouse effect.
2. Identify and suggest remedial measures to deal with different types of pollution.
3. Identify and describe adaptations of animals to different ecosystems.
4. Suggest and develop conservation and management stategies for a particular ecological problem.

Suggested Reading

1. Odum – **'Ecology'**.
2. P.D. Sharma, **'Ecology and Environment'** Rastogi Publications, Meerut-250 002, India.
3. Edward J. Kormondy, **'Concepts of Ecology'**, Himalaya Publications House, Mumbai.
4. Mohan P. Arora, **'Ecology'** Himalaya Publications House, Mumbai.
5. H. Loggen, **'Environmental Pollution'** 2nd Edition, Holt Reinhort Wintson (1978).
6. APHA, **'Standard methods of Examinations of Water and Waste Water'** 20th Edition (2000).
7. J. H. Seinfield , **' Air Pollution; Physical and Chemical Fundamentals'**, Mc Graw Hill, New York (1975).
8. T. N. Tiwari,V. P. Kudesia, **' Noise Pollution and it's Control'** , Pragati Prakashan, New Delhi (1990).
9. G. R. Chatwal, M. C. Mehra, **' Environmeatal Radiation, Thermal Pollution** And Control' Amol Publication, New Delhi (1989).

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Choice Based Credit System (CBCS) Course Structure
Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester -II
LABORATORY COURSE WORK BASED ON THEORY PAPER-VI
Paper: Lab Course - VI: Animal Ecology, Toxicology and Environmental Pollution
Periods : 60 (15 Practical's) **No. of Credits: 02 (Marks: 50)**

1. Estimation of pH, Dissolved oxygen, Carbon di-oxide, Salinity and Carbonates and Bicarbonates in water samples.
2. Study of Population Growth by model assumption and problems.
3. Estimation of Carbonate or Nitrate from the soil sample.
4. Estimation of Sulphate or Phosphate in the water sample.
5. Animal Association - parasitism, mutualism and commensalisms.
6. Ecological Adaptations (Any two examples from each to be studied)
   a) Volant Adaptations; b) Aquatic Animals (from fresh water and marine environment); c) Desert Animals.
7. To study the effect of pollutant on heart beat on given animal (Crab/Fish/ Daphnia).
8. Estimation of Chlorides/Salinity/Hardness from given water sample.
9. Determination of LC_{50} in relation to any toxicant in given aquatic animal.
10. Study of rate of oxygen consumption by aquatic animals under environmental stresses.
11. Visit to treatment Plants- a) Drinking water treatment plant.
    b) Effluent Treatment.
    c) Sewage treatment

[Note-Demonstration of Dissections by Charts / Models/ Audio Visual Aids]

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Zoology
Semester -II

Paper VII: Gamete Biology and Animal Development
Periods : 60 **No. of Credits: 04 (Marks: 100)**

Objectives:
1. To study gametogenesis, fertilization, cleavage, and gastrulation. stages in developing embryo.
2. To acquaint students with basic knowledge of experimental embryology.
3. To understand metamorphosis and regeneration in various animals.
4. To study modern techniques used in infertility treatment in humans.
5. To learn about different types of infertility in humans.

UNIT -I
1) Spermatogenesis
1.1. Ultra structure of mammalian sperm.
1.2. Different phases of spermatogenesis.
1.3. Factors Controlling Spermatogenesis.
2) Oogenesis:
2.1. Morphology of generalized mature ovum.
2.2. Different phases of Oogenesis.
3) Fertilization
3.1 Pre fertilization events
3.2 Post fertilization events
3.3 Biochemistry of fertilization
4) Biochemistry of semen:
4.1. Semen composition and formation in human.
4.2. Assessment of sperm function.
4.3 Semen related disabilities.

UNIT -II
1) Ovarian follicular growth & differentiation
1.1 Morphology
1.2 Endocrinology
1.3 Molecular biology
1.4 Ovulation and ovum transport in mammals.
2) Multiple ovulation and Embryo transfer technology (MOET)
3.1 Invitro Oocyte maturation
3.2 Super ovulation
3.3 Invitro fertilization **(**IVF)
3.4 Care and breeding of experimental animals including bioethics.
4) Assisted reproductive technologies
4.1 Embryo sexing and cloning
4.2 Screening for genetic disorders
4.3 ICSI, ZIFT, GIFT etc.

4.4 Cloning of animals by nuclear transfer
5) Embryonic stem cells, renewal by stem cells, stem cell disorders: Brief Account.

UNIT -III

1) Chick embryology
1.1 Structure of egg of hen.
1.2 Fertilization
1.3 Cleavage
1.4 Blastulation
1.5 Gastrulation
1.6 Foetal Membranes in chick

UNIT -IV

1. Metamorphosis
1.1 Metamorphosis in amphibians & its hormonal control.
1.2 Metamorphosis in insects & its hormonal control.
2. Regeneration
2.1 Regeneration in invertebrate & vertebrate animals.

Expected Outcomes:

1. Understand and describe the different developmental processes.
2. Describe different techniques and methods used in experimental embryology.
3. Elaborate on metamorphosis and regeneration in various and relate these processes to abnormalities in animals.
4. Identify and evaluate application of different ART techniques to different infertility conditions.
5. Describe different types of infertility in humans.

1. Balinsky, B.I. **'Introduction to Embryology'**, Saunders, Philadelphia
2. Beril, N.J. and Karp, G **'Developmental Biology'** Tata McGraw Hill, New Delhi
3. Davidson, E.H. **'Gene activity during early development'** Academic press, New York
4. Gilibert, S.F. **'Developmental Biology'**, Sinaver Associated IAC; Massachusetts
5. Muthukaruppam **'Animal Development'** A laboratory Guide 1979 MKV Madurai.
6. Patten Foundation of Embryology
7. Suresh. C. Goel **'Principles of Animal Developmental Biology'** Himalaya Publishing House,
8. Vasudeo Rao **'Developmental Biology – A Modern Synthesis'** Oxford & IBH Pub. Co. Pvt Ltd.
9. Verma & Agarwal 'Chordate Embryology'.

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Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester -II
LABORATORY COURSE WORK BASED ON THEORY PAPER-VII

Paper: Lab Course - VII: Gamete Biology and Animal Development
Periods : 60 (15 Practical's) **No. of Credits: 02 (Marks: 50)**

1. Histological study of different stages of Gametogenesis.
2. Physical and chemical examination of semen
3. Microscopic examination of semen
4. Histological study of gonads of Frog/ Rat.
5. Demonstration of Reproductive system of Leech and Rat.
6. Study of types of eggs.
7. Estimation of calcium in egg shell by EDTA method
8. Mounting of Chick embryos of different hours (whole mount).
9. Study of permanent whole mount slides of Chick embryos of different hours.
10. Study of L.S/ T.S. of chick embryo through head and heart regions.
11. Study of Development of Frog/Embryology of Frog.
12. Studies on metamorphosis of Insect.
13. Experiments in regeneration in Hydra or Planaria.

[Note-Demonstration of Dissections by Charts / Models/ Audio Visual Aids].

Paper VIII: Biochemistry and Immunology
Periods : 60 **No. of Credits: 04 (Marks: 100)**

Objectives:

1. To understand the structure and working of vertebrate immune system.
2. To study the innate and adaptive immunity.
3. To study the different immunological disorders found in man.
4. To study the new techniques in immunology and application of antibodies in clinical therapy and biological research.

Biochemistry

UNIT -I

1. Biomolecules-
1.1. Classification, Structure and Properties of Carbohydrates.
1.2. Classification, Structure and Properties of Lipids.
1.3. Classification, Structure and Properties of Proteins.
2. Metabolism- Carbohydrate Metabolism
2.1 Steps of Glycolysis (EMP Pathway).
2.2 Energy and Electron balance sheet.
2.3 Regulation of Glycolysis.
2.4 Glycogenesis, Glycogenolysis and Glyconeogenesis.
3. Citric Acid Cycle-
3.1 Pyruvate oxidation.
3.2 Various steps in citric acid cycle.
3.3 Enzymes of citric acid cycle.
3.4 Energetics of citric acid cycle.
4. Pentose Phosphate Pathway (HMP shunt).

UNIT –II

1. Lipid Metabolism-
1.1 The _ Oxidation (beta oxidation) pathway.
1.2 Energy yield from fatty acid oxidation.
1.3 Oxidation of unsaturated fatty acids.
1.4 Control of fatty acid oxidation.
1.5 Ketosis, Ketolysis and Ketogenesis.
2. Fatty Acid Biosynthesis-
2.1 Biosynthesis of Palmitate from acetyl Co A.
2.2 Control of fatty acid synthesis.
3. Nitrogen Metabolism-
3.1 Amino acid degradation
3.2 Transamination, deamination and decarboxylation reactions of amino acids.
3.3 Disposal of Ammonia (Detoxification & Excretion) – Krebs-Henseleit Urea Cycle

Immunology

UNIT –III

1. Innate (Non-specific) Immunity.
2. Adaptive or Acquired (Specific) Immunity-
2.1 Passive & Active Acquired Immunity.
3. Cells & Organs of Immune System-
3.1 T- cell & T- cell receptor.
3.2 T- cell maturation, activation & differentiation.
3.3 B-Cell, B-cell generation, activation and differentiation.
4. Immunoglobulin:
4.1 Introduction
4.2 Structure of Antibody
4.3 Classification, Structure and Functions of Immunoglobulin.
5. Nature of antigen & super antigens-
5.1 Epitopes & haptens.
5.2 Antigenicity & immunogenicity.
5.3 Factors influencing immunogenicity.
5.4 Antigen- antibody interaction & their applications.

UNIT -IV

1 Hypersensitivity
1.1 Introduction & Factors causing Hypersensitivity.
1.2 Types of Hypersensitivity.
1.3 Type-I : Anaphylactic Hypersensitivity
1.4 Type-II: Antibody Dependent Cytotoxic Hypersensitivity
1.5 Type-III: Immune Complex Mediated Hypersensitivity
1.6 Type-IV: Cell Mediated Delayed Hypersensitivity
1.7 Type-V: Stimulatory Hypersensitivity
2. Cytokines-
2.1 Properties of cytokines.
2.2 General structure of cytokines, functions of cytokines.
3. Complement System-
3.1 Complement components.
3.2 Classical & alternative pathway.
3.3 Significance of complement system.
4. Hybridoma Technology-
4.1 Monoclonal antibodies- production & clinical uses.
4.2 Polyclonal antibodies.
5. Immunodeficiency Disorders-Reticular Dysgenesis, AIDS.
Autoimmune Diseases- Haemolytic anaemia, Myasthenia gravis and Lupus erythromatosis

Expected Outcomes:

1. Describe the structure and working of different components of vertebrate immune system.
2. Elaborate about the innate and adaptive immune responses in vertebrates.
3. Describe the different immunological disorders found in man.
4. Explain the different techniques in immunology
5. Elaborate about structure and application of antibodies in clinical therapy and biological research.

1. Principles of Biochemistry- Lehninger, Nelson & Cox, CBS Publishers, New Delhi.
2. Biochemistry- Lubert Stryer.
3. Biochemistry- Voet D. & Voet J. G. John Wiley & Sons.
4. Text Book of Biochemistry- Devlin, T. M. John Wiley & Sons.
5. Biochemistry- Zubay, CBS Publication.
6. Fundamentals of Biochemistry- J. L. Jain, Sanjay Jain & Nitin Jain, S. Chand and Company.
7. Harpers Illustrated Biochemistry- Robert K. Murray, Daryll K. Cranner, Peter A. Mayes & Victor W. Rodwell, International Edition, LANGE- Mc Graw Hill.
8. Biochemistry- Christopher K. Mathews, K. E. Van Holde & Kelvin G. Ahern- Pearson Education.
9. Modern Experimental Biochemistry, Rodney Boyer, Pearson Education Third Edition.
10. A Biologists Guide to Principles & Techniques of Biochemistry- K. Wilson & K.H. Goulding.
11. Hawks Physiological Chemistry- B. L. Oser, Tata Mc Graw Hill Company, New Delhi.
12. Practical Biochemistry- Wilson and Walker, Cambridge.
13. Experimental Biochemistry- Clark- Swizer.

Immunology

14. Kuby Immunology- Richard A. Goldsby, Thomas J. Kindt & Barbara A.Osborne, W. H. Freeman & Company, New York.
15. Essential Immunology- Roitt I. M., ELBS Edition.
16. Fundamentals of Immunology- Paul W.
17. Modern Immunology- Das Gupta.
18. Immunology & Serology- Carpenter.
19. The Immune System- Hobert & Mc Cornel.
20. Practical Immunology- Hay & Hudson.
21. Immunology- Donald M. Weir & John Stewart, ELBS Publication.
22. Practical Immunology- Volume I & II, Talwar and Gupta.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Choice Based Credit System (CBCS) Course Structure
Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester -II
LABORATORY COURSE WORK BASED ON THEORY PAPER-VIII
Paper: Lab Course - VIII: Biochemistry and Immunology
Periods : 60 (15 Practical's) **No. of Credits: 02 (Marks: 50)**

Biochemistry

1. Determination of Glycogen/ Glucose.
2. Determination of Lipids/ Cholesterol.
3. Separation of serum proteins /tissue proteins by Electrophoresis.
4. Estimation of SDH & LDH activity.
5. Estimation of free amino acids / Proteins/Urea/Uric Acid.
6. Routine examination of urine (physical examination of urine)
7. Determination of specific gravity of urine by urinometer and refractormeter.
8. Chemical examination of urine.
9. Microscopic examination of urine
10. Estimation of an Enzyme – Amylase, Protease, Acetylcholine Esterase (AchE) activity (Any one).

Immunology

11. Identification of Blood Groups: A, B, AB, O with Rh factor.
12. Qualitative test for ABO Blood grouping with antisera by slide method
13. Separation of Proteins (alpha, beta, gamma) by Paper / Gel Electrophoresis.
14. Differential Leucocytes Count (DLC).
15. Identification of histological slides of lymphoid tissue - Spleen, thymus, lymph node and bone marrow.
16. Preparation and Observation of Bone Marrow Smear.
17. ELISA (Enzyme Linked Immuno Sorbent Assay).
18. HIV test (Tridot method).

[Note-Demonstration of Dissections by Charts / Models/ Audio Visual Aids].

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Choice Based Credit System (CBCS) Course Structure
Faculty of Science& Technology
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Zoology
Semester -II

Paper IX: (Elective) Tools and Techniques for Biology
Periods : 60 **No. of Credits: 04 (Marks: 100)**

Objectives:

1. To study the different tools used in biology and research.
2. To learn about the operatitonal handling and maintenance of laboratory instruments and glassware.
3. To study different types of microscopy used in biology.
4. To learn about different molecular and cellular separation techniques and their application in biological research.
5. To study principles and methods of microtechnique.

UNIT -I

Operation, Maintenance and care of Equipment
1. Distillation units
2. Incubators and Ovens
3. Digital Balances
4. Heating equipment- Water bath, Heating mantle, Hot plate.
5. Handling and cleaning of Laboratory glassware.

UNIT -II

1. Importance of Tools and Techniques for Biology.
2. Principles, Working Mechanisms and Uses of Analytical Instruments – Balances, pH Meter, Colorimeter, Spectrophotometer, Ultracentrifuge, Spectroflurometer, Radioactive Counters.

UNIT -III

1. Microscopy: Principles and Application of Light, Phase Contrast, Fluorescence, Scanning and Transmission Electron Microscopy. Operation and maintenance of simple and compound microscopes.
2. Microtomy: Types and applications; Collection & Preservation of animal tissue – Fixation, Embedding, Section Cutting, Staining and Mounting.
3. Staining Techniques for different histochemical studies.
4. Cryotechniques: History and applications of Cryotechniques,

UNIT -IV

1. Importance of Separation Techniques in Biology
2. Separation by Chromatography- Paper, Thin Layer, Column, Affinity chromatography and HPLC.
3. Electrophoresis- Agarose Gel Electrophoresis, PAGE, Iso-electric focusing.
4. Centrifugation- Ultra centrifugation, Density Gradient Centrifugation
5. Cell Separation- Flow Cytometry

Expected Outcomes:

1. Identify and describe the different equipment and tools used in a biology laboratory.
2. Correctly operate different laboratory instruments.
3. Correctly operate different types of microscopes.
4. Prepare tissue for section cutting and correctly operate a microtome.
5. Choose and perform correct staining technique for any given tissue sections.
6. Describe cellular separation techniques.
7. Properly handle and maintain glassware.
8. Properly operate laboratory equipment.

1. Robert Braun, **'Introduction to Instrumental Analysis'**, Mc Graw Hill International Editions.
2. K. Wilson and K. H. Golding, A Biologists Guide, **'Principles and Techniques of practical Biochemistry'**, ELBS Editions.
3. Keith Wilson and John Walker, **'Practical Biochemistry' (Principles and Techniques)**.
4. Mido and Satake, **'Introduction to Nuclear Chemistry'**.
5. John R. W., **'A Practical Approach- Animal Cell Culture'**, IRL Press.
6. Arora M. P. and Singh, **'Nuclear Chemistry'**.

LABORATORY COURSE WORK BASED ON THEORY PAPER-IX

Paper: Lab Course – IX(Elective): Tools and Techniques for Biology

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

1. Cleaning and overhauling a microscope.
2. Operation of any three different types of microscopes.
3. Fixing, embedding and block preparation of given tissue.
4. Section cutting of given tissue blocks using a microtome.
5. Staining and mounting of given tissue sections.
6. Operation of distillation plant.
7. Operation of oven and incubator.
8. Separation of pigments by paper chromatography.
9. Separation of Amino Acids from tissue extracts by chromatography.
10. Separation of Proteins using Gel Electrophoresis.
11. Principles, Uses and Working Mechanism of High Performance Liquid Chromatography (HPLC).
12. Centrifugation of given sample using a laboratory centrifuge.
13. Colorimetric estimation of Protein / Glucose from given tissue sample.

[Note-Demonstration of Dissections by Charts / Models/ Audio Visual Aids].

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Choice Based Credit System (CBCS) Course Structure
Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester -II
Paper IX (Elective): Pathobiology & Medical Zoology
Periods : 60 **No. of Credits: 04 (Marks: 100)**

Objectives:

1. To learn about communicable and non-communicable diseases in humans.
2. To learn about pathological agents causing disease in man.
3. To study parasitic diseases in man and farm animals.
4. To understand biology of disease carrying vectors and their mode of transmission of pathogens.
5. To learn about changes taking place in human body upon infection by pathogens.

UNIT—1.

Human Diseases.
Categories of Diseases
Symptoms and preventive measures of-

1. Communicable Diseases: Influenza, Cholera, Tuberculosis.
2. Non-communicable Diseases: Diabetes, Cancer, Arthritis.
3. Genetic Diseases: Hemophilia, Color blindness, Muscular dystrophy.

UNIT—2.

Important human and veterinary parasites (Protozoan and helminthes)
Life cycle, biology, symptoms and control of *Plasmodium vivax, Entamoeba histolytica, Trypanosoma gambiense, Leishmania donovani, Schistosoma haematobium, Taenia solium, Ascaris lumbricoides.*
Host - Parasite interactions

UNIT—3.

Biology of house fly (*Musca domestica*) and mosquitoes (*Culex, Anophiles*)
Arthropods as vectors of human diseases (Mosquitoes, Lice, Flies and Ticks)
Mode of transmission of pathogens by vectors
Vector Control methods- Chemical, Physical, and Biological control.

UNIT—4.

Important tests for diagnosis of pathogenesis- blood cell counts, enzyme tests, and other tests.
Changes in the blood during infection & disease.
Types of anaemia, Biochemical and Microscopic changes in tissues.
Basic concepts of immunology–vaccines; HIV and AIDs; Adolescence, drug and alcohol abuse.

Expected Outcomes:

1. Explain about the different pathogens causing disease in man.
2. Describe the different parasites causing disease and disability in man and animals.
3. Ability to elaborate about the life cycle and biology of disease carrying vectors; suggest preventive and control measures for the said diseases.
4. An understanding of the relationship between changes in physiology of host and progress of pathogenesis in human beings and animals.

1. Animal parasites, their life cycles and ecology - O. W. Oslsen.
2. Clinical Haematology - Dy. L. Aksencu &A. Dranaikota, 1972.
3. Principles of Pathobiology - Lavia, Mariano F.Hill, Rolla B. Oxford University Press, London, 1975.
4. Text book of Pathology - an introduction to medicine 6th edition Philadelphia. Lea & Febiger, 1953.
5. Veterinary clinical pathology, E.H. Coles D 1967.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Choice Based Credit System (CBCS) Course Structure
Faculty of Science& Technology
M. Sc. First Year Syllabus w.e.f. June, 2019
Zoology
Semester -II
LABORATORY COURSE WORK BASED ON THEORY PAPER-VIII

Paper: Lab Course - IX(Elective): Pathobiology/ Medical Zoology
Periods : 60 (15 Practical's) **No. of Credits: 02 (Marks: 50)**

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1) Estimation of blood glucose
2) Measurement of Blood Pressure.
3) Identification, classification and description of Protozoan Parasites through permanent slides/photomicrographs- a) *Plasmodium vivax,* b) *Entamoeba histolytica, c)Trypanosoma gambiense,* d)*Leishmania donovani e)Trichomonas vaginalis*.
4) Collection, staining, identification and description of Parasitic protozoa from Blood sample of Human/ suitable animals –a)Flagellates, b) Malarial parasites c) Coccidian Parasites
5) Identification, classification and description of Parasitic Helminths through permanent slides/photomicrographs or specimens- *a)Schistosoma haematobium b)Taenia solium c)Ascaris lumbricoides d) Wuchereria bancrofti*.
6) Collection, Preservation, Staining, Mounting, identification and description of Parasitic Helminths from locally available different hosts.
7) Study of following arthropods through permanent slides/ photographs: *Aedes, Culex, Anopheles*, *Pediculus humanus, Xenopsylla cheopis, Cimex lectularius Phlebotomus argentipes, Musca domestica*.
8) Collection, preservation, Preparation of permanent slides and description of mouth-parts of – i. House fly ii. Mosquito iii. Bed bug iv. Head louse.
9) Estimation of total proteins, carbohydrates and lipids in Human blood sample.
10) Estimation of total proteins, carbohydrates and lipids in Helminths.
11) Blood smear preparation and identification of lymphocyts.
12) Estimation of Haemoglobin in Human blood sample.

[Note-Demonstration of Dissections by Charts / Models/ Audio Visual Aids].

Swami Ramanand Teerth Marathwada University, Nanded
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER PATTERN
Faculty of Science and Technology
Winter 2019/Summer 2020
M.Sc. Theory Examination – (First Year, Semester – I & II)
THEORY QUESTION PAPER PATTERN
Subject: Zoology

Time: 03 Hours Maximum Marks: 75

N.B.:-*(i)* Attempt *All* question.
(ii) All question carry equal marks
(iii) Illustrate your answer with suitable labeled diagrams wherever necessary.

Q.1 Long Answer Question (Based on Unit No. I) (15)

OR

Long Answer Question (Based on Unit No. I)

Q. 2 Long Answer Question (Based on Unit No. II) (15)

OR

Long Answer Question (Based on Unit No. II)

Q. 3 Long Answer Question (Based on Unit No. III) (15)

OR

Long Answer Question (Based on Unit No. III)

Q. 4 Long Answer Question (Based on Unit No. IV) (15)

OR

Long Answer Question (Based on Unit No. IV)

Q. 5 Write short notes on *any three*: (15)

a) Based on Unit No. I

b) Based on Unit No. II

c) Based on Unit No. III

d) Based on Unit No. IV

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