



પરિપત્ર:

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટીની સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજોનાં આચાર્યશ્રીઓને સવિનય જણાવવાનું કે સાયન્સ વિદ્યાશાખા હેઠળનો NEP-2020 અંતર્ગતનો લાઈફ સાયન્સ વિષયનો (બી.એસસી. ઝૂલોજી વિથ ઓનર્સ) સેમેસ્ટર-૩ અને સેમેસ્ટર-૪ નો અભ્યાસક્રમ આ સાથે સામેલ છે.

માનનીય કુલપતિશ્રીની મંજૂરી અનુસાર સદર અભ્યાસક્રમ શૈક્ષણિક વર્ષ જુન, ૨૦૨૪ થી અમલવારી કરવાની રહે છે. સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમ ચલાવતી તમામ સંલગ્ન કોલેજો ધ્વારા તેની અમલવારી કરવા જણાવવામાં આવે છે.



[Signature]
૨૧/૦૮/૨૦૨૪
ખાસ ફરજ પરના અધિકારી
(એકેડેમિક)

ક્રમાંક/બીકેએનએમયુ/ એકેડેમિક/૧૧૫૭/૨૦૨૪

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી,

સરકારી પોલીટેકનિક કેમ્પસ,

ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી રોડ,

ખડીયા, જૂનાગઢ-૩૬૨૨૬૩

તા.૨૧/૦૮/૨૦૨૪

પ્રતિ,

- ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી સંલગ્ન સાયન્સ વિદ્યાશાખાનાં અભ્યાસક્રમો ચલાવતી તમામ કોલેજોના આચાર્યશ્રીઓ તરફ....

નકલ સાદર રવાના:-

- માન.કુલપતિશ્રી/કુલસચિવશ્રીનાં અંગત સચિવશ્રી.
- પરીક્ષા નિયામકશ્રી, ભક્તકવિ નરસિંહ મહેતા યુનિવર્સિટી, જુનાગઢ

નકલ રવાના જાણ તથા યોગ્ય કાર્યવાહી અર્થે:

- સીસ્ટમ મેનેજરશ્રી, આઈ.ટી.સેલ વિભાગ (વેબસાઇટ ઉપર પ્રસિદ્ધ થવા અર્થે.)



**BHAKTA KAVI NARSINH MEHTA UNIVERSITY
JUNAGADH**



**BOARD OF LIFE SCIENCE STUDIES
FACULTY OF SCIENCE
SYLLABUS FOR
B.Sc (ZOOLOGY) (HONOURS) PROGRAMME
(SEMESTER- III & IV)
MAJOR/MINOR/MULTIDISCIPLINARY
EFFECTIVE FROM JUNE, 2024**

BHAKTA KAVI NARSINH MEHTA UNIVERSITY
Major/Minor/Multidisciplinary
Syllabus of B.Sc. (Honors) as per NEP-2020
Faculty of Science
Effective from June 2024
Subject: Zoology
SEMESTER-III & IV

FORWARD

In academics, syllabus serves as a roadmap for teaching various topics in a well-defined manner. Along with constant changes in the field of subject, it is always required to review and update the syllabus so as to meet changing scenario at regional, national and global levels. In science, higher education at degree level creates base for students to sharpen their skills and enable them for securing employment. Moreover, for a few this also opens a new realm of research and education at post-graduation level. Hence, finalizing degree level syllabus requires to keep all these facts in mind.

The NEP 2020 states, “Assessments of educational approaches in undergraduate education that integrate the humanities and arts with Science, Technology, Engineering and Mathematics (STEM) have consistently shown positive learning outcomes, including increased creativity and innovation, critical thinking and higher-order thinking capacities, problem-solving abilities, teamwork, communication skills, more in-depth learning and mastery of curricula across fields, increases in social and moral awareness, etc., besides general engagement and enjoyment of learning”.

Here, the current syllabus is finalized after elaborate discussions amongst well qualified and experienced teachers. The syllabus is prepared according to the guidelines of UGC under NEP 2020. We delighted to share the curriculum and credit framework for B.Sc. Zoology Sem-3 and Sem-4. The present syllabus encompasses latest trends in the subject. We are hopeful that students will be able to enhance their knowledge and understating of the subject well.

Board of Studies, Zoology
Bhakta Kavi Narsinh Mehta University,
Junagadh – 362 001

BHAKTA KAVI NARSINH MEHTA UNIVERSITY**Major/Minor/Multidisciplinary****Syllabus of B.Sc. (Honors) as per NEP-2020****Faculty of Science****Effective from June 2024****Subject: Zoology****SEMESTER-III & IV****SUMMARY OF THE SYLLABUS**

Sem No.	Sr. No.	Category of Course	Course Title	Course Level	Credit	Teaching Hrs.	SEE Marks	CCE Marks	Total Marks	Exam Duration
Semester-3	1	Major-5	Non-Chordates-II, Cell Biology and Wildlife	5.0	4	60 Hrs.	50	50	100	2:00 Hrs.
	2	Major-6	Chordates – II, Histology, Physiology and Ecology	5.0	4	60 Hrs.	50	50	100	2:00 Hrs.
	3	Major-7	Non-Chordates-II, Cell Biology, Wildlife, Chordates – II, Histology, Physiology and Ecology	5.0	4	120 Hrs.	50	50	100	4:00 Hrs.
	4	MDC-3	Fundamentals of Zoology-III	5.0	3T + 1P	75 Hrs. (45 + 30 Hrs)	50	50	100	4:00 Hrs. (2:00 + 2:00 Hrs.)
				Total	16					

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Sem. No.	Sr. No.	Category of Course	Course Title	Course Level	Credit	Teaching Hrs.	SEE Marks	CCE Marks	Total Marks	Exam Duration
Semester-4	1	Major-8	Non-chordates-III, Genetics, Developmental Biology and Applied Zoology	5.0	4	60 Hrs.	50	50	100	2:00 Hrs.
	2	Major-9	Fisheries, Animal Husbandry, Biotechnology and Toxicology	5.0	4	60 Hrs.	50	50	100	2:00 Hrs.
	3	Major-10	Non-chordates-III, Genetics, Developmental Biology, Applied Zoology, Fisheries, Animal husbandry, Biotechnology and Toxicology	5.0	4	120 Hrs.	50	50	100	4:00 Hrs.
	4	Minor-3	Non-Chordates-II, Cytology and Wildlife Management	5.0	3T + 1P	75 Hrs. (45 + 30 Hrs.)	50	50	100	4:00 Hrs. (2:00 + 2:00 Hrs.)
				Total	16					

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SEMESTER-III & IV

Semester-III and Semester-IV

Pattern of Examination for Major-5/6/8/9

EVALUATION OF 100 MARKS (4 CREDIT PAPER)

Continuous and Comprehensive Evaluation (CCE)-50 Marks		Semester End Evaluation (SEE)-50 Marks
Mid Semester Exam (Mandatory)-25 Marks	1. Class assignment -- 05 2. Home assignment -- 05 3. Field Assignment -- 05 4. Viva/Oral exam -- 05 5. Attendance -- 05	Semester End Theory Examination 50 Marks
Total 25 Marks	Total 25 Marks	Total 50 Marks

Pattern of Examination for Major-7/10

EVALUATION OF 100 MARKS (4 CREDIT PAPER)

Continuous and Comprehensive Evaluation (CCE)-50 Marks		Semester End Evaluation (SEE)-50 Marks
Mid Semester Exam (Mandatory)-25 Marks	1. Class assignment -- 05 2. Home assignment -- 05 3. Field Assignment -- 05 4. Viva/Oral exam -- 05 5. Attendance -- 05	Semester End Practical Examination 50 Marks
Total 25 Marks	Total 25 Marks	Total 50 Marks

**Pattern of Examination for Minor (DSM-401) and
Multidisciplinary (MDC-301)**

EVALUATION OF 100 MARKS (4 CREDIT PAPER)

Continuous and Comprehensive Evaluation (CCE)-50 Marks		Semester End Evaluation (SEE)-50 Marks
Practical Exam (Mandatory)-25 Marks	1. Class assignment -- 05 2. Home assignment -- 05 3. Test -- 10 4. Attendance -- 05	Semester End Practical Examination 50 Marks
Total 25 Marks	Total 25 Marks	Total 50 Marks

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SEMESTER-III & IV

Zoology Program Outcomes Objectives:

- The programme in Zoology aims to equip students with recent advances in Zoology from organismic to reductionist biology.
- It also aims to empower students to understand the challenges of society and the country that falls into the realms of Zoology, such as Aquaculture, environment and health, animal behaviour, wildlife conservation, etc.
- It also offers students to a series of multidisciplinary and skill-based courses so that they can choose to specialize in the specific area of their interests in Zoology.
- The open elective has been chosen to attract students from diverse interdisciplinary areas of sciences, such as fisheries, Environmental studies, Economic zoology, etc.
- This course is designed to ignite the inquisitive mind to enter into research in interdisciplinary areas.
- It is expected that a student after successfully completing the programme would sufficiently be skilled and empowered to solve the problems in the realms of Zoology and its allied areas.
- They would have plethora of job opportunities in the education, environment, agriculture based, and wildlife related sectors.
- The bright and ignited mind may enter research in the contemporary areas of Zoological/Biological Sciences.

Program Specific Outcomes:

- Understand the nature and basic concepts of cell biology, genetics, taxonomy, physiology, biochemistry, ecology, evolutionary biology, developmental biology and applied and economic zoology.
- Analyse the relationships among animals, plants, and microbes.
- Perform procedures as per laboratory standards in the areas of Taxonomy, Physiology, Ecology, Cell biology, Genetics, Applied Zoology, tools and techniques of Zoology, Toxicology, Entomology, Nematology, Sericulture, Biochemistry, Fish biology, Animal biotechnology.
- Understand the applications of biological sciences in Apiculture, Aquaculture, Sericulture, Animal Husbandry, Poultry Farm, wildlife conservation.
- Gains knowledge about effective communication and skills of problem-solving methods.
- Contributes the knowledge for Nation building.

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Subject: Zoology
SEMESTER-III & IV

Course Level	5.0		Internal Marks	50
Programme	Zoology		External Marks	50
Semester	III		Practical Internal	--
Category of Course	Discipline Specific Core Courses (Major-5)		Practical External	--
Course Credit	04		Prac. External Exam Duration	--
Teaching Hours	60		Total	100
Course Code			Exam Duration	2.0 hrs
Course Title	Non-Chordates-II, Cell Biology and Wildlife			

COURSE OBJECTIVES:

- The course would provide an insight to the learner about the existence of different lifeforms on the Earth, and appreciate the diversity of animal life. It will help the student to understand the features of Kingdom Animalia and systematic organization of the animals based on their evolutionary relationships, structural and functional affinities.
- The course will provide basics of structural organisation of cell organelles and their functions, cell division and cell signalling.
- The course will also make the students aware about Biogeographic classification of India, Planning Protected Area network in India, Strategies and guidelines for management planning of Protected Areas in India and will create interest among them to explore the animal diversity in nature.

COURSE OUTCOMES:

- Upon completion of the course, students should be able to:
- Learn about the importance of systematics, taxonomy and structural organization of animals. Appreciate the diversity of invertebrates living in varied habit and habitats. Critically analyze the organization, life cycle and pathogenicity of *Ascaris lumbricoides* and *Wuchereria bancrofti* making them familiarize with diseases spread by them.
- Learn major study types in zoology viz. Leech and Mosquito.
- Learn about the cell organelles, cell division, cell cycle and cell signaling.
- Will able to get basic knowledge of Biogeographic classification of India, Planning Protected Area network in India, Strategies and guidelines for management planning of Protected Areas in India and will create interest among them to explore the animal diversity in nature.

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COURSE CONTENT		
Units	Syllabi	Teaching hours
Unit 1	Platyhelminthes and Nematoda 1.1 General characteristic and classification up to class 1.2 Study type: Liver fluke – Habits and Habitat, External morphology, Body wall, Digestive system, Respiration, Excretory system, Nervous system, Reproductive system, Lifecycle and development. 1.3 Parasitic adaptations of flatworms 1.4 Life cycle and pathogenicity of <i>Ascaris lumbricoides</i> and <i>Wuchereria bancrofti</i>	10
Unit 2	Annelida and Arthropoda 2.1 General characteristics and classification up to class 2.2 Peripatus: the connecting link between Annelida and Arthropoda 2.3 Type Study: Leech: Classification, External characters, body wall, Digestive System, Nervous system, Haemocoelomic system, Excretory and Reproductive system and development, Locomotion and Respiration. 2.4 Type Study: Mosquito (i) Life cycle of Culex & Anopheles Mosquito (ii) Mouth parts of Culex & Anopheles mosquito	12
Unit 3	Cell Biology 1.1 Cell organelles: (i) Endoplasmic reticulum (ii) Mitochondria and Peroxisomes (iii) Cytoskeleton (iv) Nucleus (v) Ribosomes 1.2 Cell Division: Mitosis, Meiosis, Cell cycle and its regulation 1.3 Transport of nutrients, ions and macromolecules across cell membrane. 1.3 Introduction to cell signalling	12
Unit 4	Wildlife 4.1 Biogeographic classification of India 4.2 Planning Protected Area network in India 4.3 Strategies and guidelines for management planning of Protected Areas in India 4.4 Categories and functioning of Protected Areas other than National Parks and Sanctuaries- Tiger Reserves, Elephant Reserves, Biosphere Reserves, Conservation Reserves, Community Reserves.	11

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Subject: Zoology
SEMESTER-III & IV

REFERENCE BOOKS:

1. Invertebrate Zoology.....E. L. Jordan & Dr. P. S. Verma
2. Invertebrate Zoology.....P. S. Dhami & J. K. Dhami
3. A modern textbook of Zoology Invertebrate Zoology.....R. L. Kotpal
4. A textbook of Practical Zoology Invertebrates.....S. S. Lal
5. A Manual of Practical Zoology, Invertebrates.....P. S. Verma
6. Cell Biology.....Dr. Satyeshchandra Roy
7. Cytology & Genetics.....P. K. Gupta
8. Cell & Molecular Biology.....De Robertis
9. Biotechnological Cell Biology.....V. B. Rastogi
10. Molecular Biology.....V. B. Rastogi
11. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology.....
.....P. S. Varma & V. K. Agrawal
12. Cytology, Genetics & Evolution.....P. K. Gupta
13. Wild Life of Gujarat.....H. S. Singh
14. Wildlife Conservation and management.....R.Mathur
15. Biodiversity and wildlife of India and its conservation, Ecology and
Environment.....P.D.Sharma
16. A Guide to Planning Wildlife Management in Protected Areas and Managed
Landscapes. V.B. Savarkar
17. Textbook of wildlife management..... Singh, S.K.
18. Wildlife management and conservation..... Krasuman, P.R. &
Cain, J.W.
19. Wildlife Ecology, Conservation, and Management.....J.M.Fryxell, A.R.E. Sinclair,
G. Caughley

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Course Level	5.0		Internal Marks	50
Programme	Zoology		External Marks	50
Semester	III		Practical Internal	--
Category of Course	Discipline Specific Core Courses (Major-6)		Practical External	--
Course Credit	04		Prac. External Exam Duration	--
Teaching Hours	60		Total	100
Course Code			Exam Duration	2.0 hrs
Course Title	Chordates – II, Histology, Physiology and Ecology			

Course Objectives:

- The course is designed with an aim to provide general account of chordates including major phenomenon of ecology, behaviour and adaptation with peculiar characteristics of mammals.
- The course will create a deep understanding of major study type Calotes as a completely air breathing vertebrate. Additionally, course includes knowledge about venomous & non-venomous snakes, biting mechanism in snakes and preventive measures.
- The students will be introduced to the principles and techniques of microtomy and histology. Course also provides knowledge of human cardio-vascular physiology and the concepts of ecology.

Course Learning Outcome: Upon completion of the course, students should be able to:

- Understand different ecological adaptations and behaviour strategies in major vertebrate animals i.e. Pisces, Amphibia, Reptilia, Aves and Mammalia.
- Understand of major study type Calotes as a completely air breathing vertebrate, knowledge about venomous & non-venomous snakes, biting mechanism in snakes and preventive measures.
- Students will understand the principles and techniques of microtomy and histology, human cardio-vascular physiology and the concepts of ecology.

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Subject: Zoology
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COURSE CONTENT		
Units	Syllabi	Teaching hours
Unit 1	Chordata: General Account 1.1 Pisces: Osmoregulation and Parental care in fishes 1.2 Amphibia: Parental care in Amphibia 1.3 Reptilia: Sphenodon - a living fossil 1.4 Aves: Types of beaks and claws, flight adaptation and migration 1.5 Mammalia: Peculiarities and affinities of Marsupialia, Adaptations in Aquatic Mammals	12
Unit 2	Forms and functions in animals 2.1 Reptiles: Type study - Calotes: Classification, External characters, Digestive system, Respiration, Structure of Heart, Arterial system, Venous system, Nervous system (Brain), Urinogenital system and development 2.2 Difference between venomous & non-venomous snakes 2.3 Poison apparatus and Biting mechanism in snakes 2.4 Snake bite, Anti-Venom, Preventive measures and First aid Treatment	12
Unit 3	Histology 3.1 Microtomy: Introduction to microtomy, Types of microtomes and their application 3.2 Techniques in Histology: Tissue fixation, single and double staining techniques 3.3 Types of fixative and stains 3.4 Histological structure: Mammalian tongue, Spleen, Skin and Eye	10
Unit 4	Physiology and Ecology 4.1 Cardiovascular system: Structure of heart, Origin of heart, Double circulation, Conduction system, Regulation of heart beat, Cardiac cycle and Cardiac output and electrocardiogram (ECG) 4.2 Blood Pressure: Types of blood pressure, Abnormalities related to blood pressure. 4.3 (i) Ecological Pyramids (ii) Energy flow in ecosystem (iii) Ecological succession: Definition, Causes of succession, Types and process of succession, Hydrosere, Lithosere and Climax.	11

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SEMESTER-III & IV

REFERENCE BOOKS:

1. Modern textbook of Zoology Vertebrates.....R. L. Kotpal
2. Chordate Zoology.....E. L. Jordan & Dr. P. S. Verma
3. Practical Zoology Vertebrate.....S. S. Lal
4. A Text Book of Chordates..... N. Arumugam, A. Thangamani, S. P. Kumar, LM. Narayana
5. Chordate zoology..... P.S. Dhami & J.K. Dhami
6. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology.....PS Varma & VK Agrawal
7. Physiology of anatomy and physiology.....Tortora & Tortora
8. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology.....P. S. Varma & V. K. Agrawal
9. Animal physiology.....Eckert
10. Essential of animal physiology.....S. C. Rastogi
11. Element of animal physiology.....R. Nagabhushanam
12. Human physiology.....C. C. Chatterjee
13. Principal of animal physiology.....Wood D. W.
14. Physiology of anatomy and physiology.....Tortora & Tortora
15. Text book of Baley's Histology.....Copenharver bunga & burge
16. A text-book of the principles of animal histology..... Ulrie Dahlgren
17. Animal Behaviour.....Agarwal V.K.
18. An Introduction to Animal Behaviour.....Aubrey Manning, Marian Stamp Dawkins
19. Concepts of Animal Behaviour.....Reena Mathur
20. Fundamentals of Ecology..... Eugene Odum
21. Environment & EcologyR Rajagopalan

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Course Level	5.0		Internal Marks	--
Programme	Zoology		External Marks	--
Semester	III		Practical Internal	50
Category of Course	Discipline Specific Core Courses (Major-7)		Practical External	50
Course Credit	04		Prac. External Exam Duration	3 hrs
Teaching Hours	120		Total	100
Course Code			Exam Duration	4 hrs
Course Title	Non-Chordates-II, Cell Biology, Wildlife, Chordates – II, Histology, Physiology and Ecology			

COURSE OBJECTIVES:

- The course would provide practical learning of animal systematics, life cycle of mosquito, cell division, spotting of Biogeographic zones and protected areas of India in map of India, behaviour and adaptations of few chordate animals, practical knowledge for the identification and study differences between venomous and non-venomous snakes, operating microtome and other histological techniques.

COURSE OUTCOMES:

- Upon completion of the course, students should be able to:
- Learn the use of various laboratory instruments, techniques, lab etiquettes and good lab practices.
- Develop skills for identification and classification of invertebrate animal, venomous and non-venomous snakes.
- Learn about biogeographic zones and protected areas of India, behaviour and adaptations of few chordate animals, operating microtome and other histological techniques.
- Enhance collaborative learning and communication skills through practical sessions, team work, group discussions, assignments and projects.

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SEMESTER-III & IV

Course Contents: (Practical)

No.	Syllabi	Teaching hours
Practical 1	Identification and classification of Invertebrate animals (i) Phylum: Platyhelminthes : - Planaria, Bipalium, Liverfluke, Schistosoma, Tape worm, <i>Moniezia Expansa</i> (ii) Phylum: Nematoda: Ascaris, Hookworm, <i>Enterobius vermicularis</i> , Filarial worm, Guinea worm	60
Practical 2	Identification and classification of Invertebrate animals (i) Phylum Annelida: Aphrodite, Nereis, Pheretima, Lumbricus, Leech Pontobdella (ii) Phylum Arthropoda: Peripatus, Lobster, Prawn, Grasshopper, Dragonfly, Centipede, Millipede, Spider, Scorpion, Limulus	
Practical 3	To Study Systems of Leech (Through chart or Multimedia or Slide): (i) External Characters (ii) Digestive System (iii) Nervous System (iv) Reproductive System	
Practical 4	To Study Mounting of Leech (Through chart or Multimedia or Slide): (i) Jaws (ii) Salivary Gland (iii) Nephridia (iv) Ovary	
Practical 5	To study Life cycle of Anopheles and Culex Mosquito through permanent slide/chart	
Practical 6	To study Mouth Parts of Culex and Anopheles Mosquito through permanent slide/chart	
Practical 7	To study mitotic cell division through temporary mount of onion root tip	
Practical 8	Biogeographic classification of India spotting in map of India	
Practical 9	Protected Areas representing each biogeographic zone spotting in map of India- Hemis National Park, Dachigam National Park, Desert National Park, Velavadar Blackbuck National	

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	Park, Bandipur National Park, Bandhavgarh Tiger Reserve, Valmiki Tiger Reserve, Sunderbans Tiger Reserve, Kaziranga Tiger Reserve, Galathea National Park.	
Practical 10	Protected Areas representing each category (as per theory syllabus) spotting in map of India- Corbett Tiger Reserve, Singhbhum Elephant Reserve, Nanda Devi Biosphere Reserve, Chharidhandh Conservation Reserve, Siswan Community Reserve.	
Practical 11	Study of Parental Care Behaviour: (i) Arius (ii) Hippocampus (ii) Ichthyophis (ii) Alytes	
Practical 12	To study different types of beaks and claws in aves.	
Practical 13	To study systems of Calotes (Through chart or Multimedia) : (i) External characters, (ii) Digestive system, (iii) Arterial system, (iv) Venous system, (v) Urinogenital system, (vi) Brain	
Practical 14	To study Mountings of Calotes : (i) Pecten (ii) Blood (iii) Striated Muscle	
Practical 15	To identify and study differences between venomous and non-venomous snakes. 1. Rat Snake, 2. Python, 3. Sand Boa, 4. Hydrophis, 5. King Cobra, 6. Cobra, 7. Krait, 8. Russel's Viper, 9. Echis carinata	
Practical 16	To study manual rotary microtome	
Practical 17	To study histological structure of mammalian Tongue, Spleen, Skin and Eye through permanent slide/multimedia/chart	
Practical 18	To study different types of fixatives and stains	
Practical 19	Counting of pulse rate at rest and after exercise	
Practical 20	To check blood pressure using sphygmomanometer	

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REFERENCE BOOKS:

1. A textbook of Practical Zoology Invertebrates.....S. S. Lal
2. A textbook of Practical Zoology Vertebrates.....S. S. Lal
3. A Manual of Practical Zoology, Invertebrates.....P. S. Verma
4. Wild Life of Gujarat.....H. S. Singh
5. Indian National Parks and Sanctuaries.....Khatri & Annand S
6. A Guide to Planning Wildlife Management in Protected Areas and Managed Landscapes. V.B. Savarkar
7. Text book of Bailey's Histology.....Copenhagen bunga & burge
8. A text-book of the principles of animal histology..... Ulrie Dahlgren

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Course Level	5.0	Internal Marks	25
Programme	Zoology	External Marks	50
Semester	III	Practical Internal	--
Category of Course	Multidisciplinary Course	Practical External	25
Course Credit	04 (3T+1P)	Prac. External Exam Duration	2.0 hrs.
Teaching Hours	45T + 30P	Total	100
Course Code		Exam Duration	2.0 hrs
Course Title	Fundamentals of Zoology-III		

COURSE OBJECTIVES:

- The course would provide an insight to the basics of structural organisation of cell organelles and their functions, cell division and cell signalling.
- The students will be introduced to the principles and techniques of microtomy and histology. Course also provides knowledge of human cardio-vascular physiology and the concepts of ecology.
- The course will also make the students aware about wild and domestic animals; difference between national parks and sanctuaries; knowledge of some important national parks and sanctuaries of Gujarat state and will create interest among them to explore the animal diversity in nature.

COURSE OUTCOMES:

- Upon completion of the course, students should be able to:
- Learn about the cell organelles, cell division, cell cycle and transport of nutrients, ions and macromolecules across cell membrane.
- Students will understand the principles and techniques of microtomy and histology, human cardio-vascular physiology and the concepts of ecology.
- Able to differentiate between wild life and domesticated animals with understanding of importance of wildlife. Familiarize with sanctuaries and national parks.

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COURSE CONTENT		
Units	Syllabi	Teaching hours
Unit 1	Cell Biology 1.1 Cell organelles: (i) Endoplasmic reticulum (ii) Mitochondria and Peroxisomes (iii) Cytoskeleton (iv) Nucleus (v) Ribosomes 1.2 Cell Division: Mitosis, Meiosis, Cell cycle and its regulation 1.3 Transport of nutrients, ions and macromolecules across cell membrane.	11
Unit 2	Histology 2.1 Microtomy: Introduction to microtomy, Types of microtomes and their application 2.2 Techniques in Histology: Tissue fixation, single and double staining techniques 2.3 Types of fixative and stains 2.4 Histological structure: Mammalian tongue, Spleen, Skin and Eye	12
Unit 3	Physiology and Ecology 3.1 Cardiovascular system: Structure of heart, Origin of heart, Double circulation, Conduction system, Regulation of heart beat, Cardiac cycle and Cardiac output and electrocardiogram (ECG) 3.2 Blood Pressure: Types of blood pressure, Abnormalities related to blood pressure. 3.3 (i) Ecological Pyramids (ii) Energy flow in ecosystem	12
Unit 4	Wildlife 4.1 Introduction & Importance of Wildlife 4.2 Difference between National Parks & Sanctuaries 4.3 Wildlife in Gujarat: National Parks: (i) Gir Forest National Park (ii) Marine National Park in Gulf of Kutch Sanctuaries: (i) Kutch desert wildlife sanctuary, (ii) Barda wildlife sanctuary (iii) Nalsarovar bird sanctuary (iv) Khijadia bird sanctuary	10

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Course Contents: (Practical)

No.	Syllabi	Teaching hours
Practical 1	To study mitotic cell division through temporary mount of onion root tip	30
Practical 2	To study cell organelles with the help of permanent slides/charts/models (i) Endoplasmic reticulum (ii) Mitochondria and Peroxisomes (iii) Cytoskeleton (iv) Nucleus (v) Ribosomes	
Practical 3	To study manual rotary microtome	
Practical 4	To study histological structure of mammalian Tongue, Spleen, Skin and Eye through permanent slide/multimedia/chart	
Practical 5	To study different types of fixatives and stains	
Practical 6	Counting of pulse rate at rest and after exercise	
Practical 7	To check blood pressure using sphygmomanometer	
Practical 8	National Park & Sanctuary (as per theory syllabus) spotting in map of Gujarat.	
Practical 9	Study of following wild animals-1. Asiatic Lion, Leopard, Hyena, Chinkara, Spotted deer, Wild Ass by photograph, Chart, stuffed animals or multimedia	
Practical 10	Study of following wild animals-2. Caracal, Dugong, Dolphin, Greater flamingo, Painted stork, Uromastyx by photograph, Chart, stuffed animals or multimedia	
Practical 11	To study IUCN Red data list categories with example [Extinct-Pink Headed Duck, Critically Endangered-Great Indian Bustard, Endangered-Tiger, Vulnerable-Snow Leopard, Least concerned-Indian Peafowl]	
Practical 12	To submit any chart/model/histological slides according to syllabus.	

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Subject: Zoology

SEMESTER-III & IV

REFERENCE BOOKS:

1. Cell Biology.....Dr. Satyeshchandra Roy
2. Cytology & Genetics.....P. K. Gupta
3. Cell & Molecular Biology.....De Robertis
4. Biotechnological Cell Biology.....V. B. Rastogi
5. Molecular Biology.....V. B. Rastogi
6. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology.....
.....P. S. Varma & V. K. Agrawal
7. Cytology, Genetics & Evolution.....P. K. Gupta
8. Wild Life of Gujarat.....H. S. Singh
9. Wildlife Conservation and management.....R. Mathur
10. Biodiversity and wildlife of India and its conservation, Ecology and
Environment.....P. D. Sharma
11. Animal physiology.....Eckert
12. Essential of animal physiology.....S. C. Rastogi
13. Element of animal physiology.....R. Nagabhushanam
14. Human physiology.....C. C. Chatterjee
15. Principal of animal physiology.....Wood D. W.
16. Physiology of anatomy and physiology.....Tortora & Tortora
17. Text book of Baley's Histology.....Copenharver bunga & burge
18. A text-book of the principles of animal histology..... Ulrie Dahlgren
19. Fundamentals of Ecology..... Eugene Odum
20. Environment & EcologyR Rajagopalan

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Course Level	5.0		Internal Marks	50
Programme	Zoology		External Marks	50
Semester	IV		Practical Internal	--
Category of Course	Discipline Specific Core Courses (Major-8)		Practical External	--
Course Credit	04		Prac. External Exam Duration	--
Teaching Hours	60		Total	100
Course Code			Exam Duration	2.0 hrs
Course Title	Non-Chordates-III, Genetics, Developmental Biology and Applied Zoology			

COURSE OBJECTIVES:

- The course would provide an insight to the learner about the existence of different lifeforms on the Earth, and appreciate the diversity of animal life. It will help the student to understand the features of Kingdom Animalia and systematic organization of the animals based on their evolutionary relationships, structural and functional affinities.
- The course will help in building sound fundamental knowledge of the principles of genetics, Human Chromosome and Karyotyping and Giant Chromosome to be useful for higher studies and research in this field.
- Developmental biology aims to understand the concepts and major developmental phenomenon like Parthenogenesis and Regeneration while applied zoology provides understanding of various household insects.

COURSE OUTCOMES:

- Upon completion of the course, students should be able to:
- Learn about the importance of systematics, taxonomy and structural organization of animals with detailed study of *Pila globosa* as a model organism.
- Learn about the principles of mendelian genetics, Human Chromosome and Karyotyping and Giant Chromosome which will be useful them for higher studies and research in this field.
- Learn about the concepts of developmental biology and major developmental phenomenon like Parthenogenesis and Regeneration while applied zoology provides understanding of various household insects.

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COURSE CONTENT		
Units	Syllabi	Teaching hours
Unit 1	Mollusca 1.1 General characteristic and classification up to class 1.2 Torsion and detorsion in Gastropoda 1.3 Economic importance of Mollusca 1.4 Study of <i>Pila globosa</i> : Systematic Position, Habit and Habitat, External Features, Digestive System, Circulatory System, Reproductive System, Nervous System and Sense Organs.	12
Unit 2	Echinodermata and Hemichordata 2.1 General characteristics and classification up to class 2.2 Larval forms of Echinodermata 2.3 Water vascular system with reference to all classes of Echinodermata 2.4 Affinities of Balanoglossus	10
Unit 3	Genetics 3.1 Extension of Mendelian Genetics: Pleiotropy, Lethal genes, Epistasis: dominant and recessive, Sex linked and sex influenced genes, Extra chromosomal inheritance: Kappa Particles in Paramecium, 4 O'clock Mirabilis Jalapa 3.2 Structure of Chromosome and types of Chromosome according to Centromere 3.3 Human Chromosome and Karyotyping 3.4 Giant Chromosome: 1. Polytene Chromosome 2. Lampbrush Chromosome	12
Unit-4	Developmental Biology and Applied Zoology 4.1 Concept of Developmental Biology: Coelom, Segmentation, Somites, Germinal layers, Protostomes and Deuterostomes 4.2 Parthenogenesis : Definition, types and significance 4.3 Regeneration: Definition, types of regeneration, Regeneration in Hydra and Salamander 4.3 Household Insects: (i) Insects affecting Human health: 1. House Fly 2. Mosquito (ii) Insects damaging Food Products: 1. Rice Weevil 2. Wheat Weevil (iii) Insects damaging Household Goods: 1. Termite, 2. Silver Fish (iv) Insects damaging Storage grains: 1. Tribolium, 2. Pulse beetle 4.4 Insect Pest Management: (i) Cultural Control (ii) Biological Control (iii) Chemical Control	11

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Subject: Zoology
SEMESTER-III & IV

REFERENCE BOOKS:

1. Invertebrate Zoology.....E. L. Jordan & Dr. P. S. Verma
2. Invertebrate Zoology.....P. S. Dhami & J. K. Dhami
3. A modern textbook of Zoology Invertebrate Zoology.....R. L. Kotpal
4. A textbook of Practical Zoology Invertebrates.....S. S. Lal
5. A Manual of Practical Zoology, Invertebrates.....P. S. Verma
6. Cytology & Genetics.....P. K. Gupta
7. Cell & Molecular Biology.....De Robertis
8. Biotechnological Cell Biology.....V. B. Rastogi
9. Molecular Biology.....V. B. Rastogi
10. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology.....
.....P. S. Varma & V. K. Agrawal
11. Cytology, Genetics & Evolution.....P. K. Gupta
12. Developmental Biology, 6th edition.....Scott F Gilbert
13. Developmental Biology.....M Subramanian
14. Text Book Of Applied Zoology..... P.V. Jabde

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Course Level	5.0		Internal Marks	50
Programme	Zoology		External Marks	50
Semester	IV		Practical Internal	--
Category of Course	Discipline Specific Core Courses (Major-9)		Practical External	--
Course Credit	04		Prac. External Exam Duration	--
Teaching Hours	60		Total	100
Course Code			Exam Duration	2.0 hrs
Course Title	Fisheries, Animal husbandry, Biotechnology and Toxicology			

Course Objectives:

- The course is designed with an aim to provide knowledge of fishery biology including aquaculture, culture practices, induced breeding, various fish diseases, and fish by product, and post harvesting techniques.
- The course will create a deep understanding of major animal husbandry techniques like Apiculture, pearl culture and sericulture which helps in entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises.
- The students will be introduced to the principles and techniques of Biotechnology and Toxicology.

Course Learning Outcome:

Upon completion of the course, students should be able to:

- Learn about the importance of Animal husbandry with the help of study Apiculture, pearl culture and sericulture. Acquire sound knowledge on different components of apiculture, pearl culture and sericulture industry, Gain skill with hands on training on cultivation and carry forward to field, which helps in entrepreneurship abilities, innovative thinking, planning, and setting up small-scale enterprises.
- This course provides a platform for a student to shape her/his career in Industry or at Advanced Biological Research Institutes by giving the student a comprehensive understanding of the working principles in Molecular Analytical tools, such as Recombinant DNA technology, Next generation sequencing etc., which are now the need of the hour in a developing country.
- Learn the science of toxicology, including hazard identification, exposure assessment, dose-response assessment, and an understanding of the mechanisms of action and effects of toxic chemicals at multiple levels of biological organization.

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COURSE CONTENT		
Units	Syllabi	Teaching hours
Unit 1	FISHERIES BIOLOGY 1.1 Basics of aquaculture, definition and scope. History of aquaculture: Present global and national scenario. 1.2 Culture practices: Indian major carps and exotic carps; Shrimps and prawns. 1.3 Induced Breeding: Hormonal regulation of gonadal development, Activity of Gonadotropin releasing hormone, application of hormones in aquaculture. 1.4 Nutrition in fish: Nutrition, Feed formulation, Feed additives, Alternative feed ingredients. 1.5 Fish Diseases (Dropsy, Fungus infection, Gill rot, White spot, Costiasis, Argulus diseases) 1.6 Fish By product 1.7 Post harvesting Techniques in fisheries	12
Unit 2	ANIMAL HUSBANDRY 2.1 Apiculture: History, Classification and Life Cycle of Honey Bees; Social Organization of Bee Colony; Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth; Methods of Extraction of Honey (Indigenous and Modern); Products of Apiculture Industry and its Uses – Honey, Bees Wax, Propolis, Pollen etc. 2.2 Pearl culture: Important Pearl-Producing Oysters; Distribution in Indian Waters; Biology of Pearl Oyster; Formation of Pearl; Artificial Pearl Culture; Large-Scale Pearl Culture 2.3 Sericulture: Definition, history and present status; Silk route, Types of silkworms, Mulberry and non-mulberry Sericulture; Life cycle of <i>Bombyx-mori</i> ; Silkworm rearing technology: Early age and Late age rearing, Types of mountages, Spinning, harvesting and storage of cocoons.	12
Unit 3	BIOTECHNOLOGY 3.1 Isolation of DNA, RNA and Plasmid; 3.2 Polymerase chain reaction and its general applications; 3.3 Dye and Probe based detection in Real Time PCR; 3.4 Gene expression study and data analysis in qPCR; DNA fingerprinting; DNA foot-printing; 3.5 Enzymes used in r-DNA technology – Restriction Enzymes: Type I, Type II and Type III RE, nucleases, Polymerases, Ligase, kinases and phosphatases; 3.6 Vectors – Plasmids, Phages, Cosmids, Artificial chromosomes, Shuttle vectors, Expression vectors; Applications of Recombinant DNA Technology.	10

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Unit 4	TOXICOLOGY 4.1 Definition and scope of toxicology: Eco-toxicology and its environmental significance. 4.2 Toxic effects: Basic for general classification & nature. Dose-Response relationship: Synergism and Antagonism, Determination of ED50 & LD50. Acute and Chronic exposures. 4.3 Factors influencing Toxicity. Pharmacodynamics & Chemodynamics, dose conversion between animals and human 4.4 Diagnosis of toxic changes in liver and kidneys: Metabolism of drugs: paracetamol and aspirin with their toxic effects on tissues, 4.5 Metal toxicity: Toxicology of Arsenic, mercury, lead and cadmium. 4.6 Pesticide toxicity: Insecticides – Organophosphates and Carbamates. Mode of action of pesticides and metals 4.7 Application of toxicology	11
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Reference Book:

1. Fish & Fisheries of India..... V.G.Jhingram
2. Aquaculture – Principles and Practices..... Pillay, T., V., R., Kutty, M., N. 2nd Edn.
3. Fishes an introduction to Ichthyology..... Paper and Moyle
4. Marine fisheries..... D.V.Bal, K.V.Rao
5. Ichthyology..... S.Chand
6. Text book of applied entomology..... Srivastava
7. Economic zoology..... Shukla & Upadhyaya
8. Pest management & Pesticides Indian scenario..... Nyar B.V.
9. Poultry science..... Mihir Suthar
10. Elements of Bio-technology..... P.K.Gupta
11. Molecular Biology & Biotechnology..... R.A.Meyers
12. Biotechnology..... Keshav Trehan
13. Genetic engineering..... Rastogi & Pathak, Oxford
14. Biotechnology..... U. Satyanarayana
15. Principles and Methods of Toxicology..... A. Wallace Hayes. Taylor and Francis.
16. Principles of biochemical toxicology..... John A. Timbrell (4th Edn)

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Course Level	5.0	Internal Marks	--
Programme	Zoology	External Marks	--
Semester	IV	Practical Internal	50
Category of Course	Discipline Specific Core Courses (Major-10)	Practical External	50
Course Credit	04	Prac. External Exam Duration	2 hrs
Teaching Hours	120	Total	100
Course Code		Exam Duration	2 hrs
Course Title	Non-Chordates-III, Genetics, Developmental Biology, Applied Zoology, Fisheries, Animal husbandry, Biotechnology and Toxicology		

COURSE OBJECTIVES:

- The course would provide practical learning of animal systematics, genetics problem, identification of various of household Insects, Important edible fishes of Saurashtra coast, determination of fish age by scales, various fish by-products, post harvesting technique in fisheries, Apiculture, Pearl culture, Sericulture, preparation of culture of E.coli, Calculation of LC50, behavioural response to some toxicants (in fishes/insects/artemia/ any other animal) and visit to any one fish processing plant or fishing area or any educational institute which is relevant to the subject.

COURSE OUTCOMES:

- Upon completion of the course, students should be able to:
- Learn the use of various laboratory instruments, techniques, lab etiquettes and good lab practices.
- Develop skills for identification and classification of invertebrate animals and household insects.
- Learn about Important edible fishes of Saurashtra coast, determination of fish age by scales, various fish by-products, post harvesting technique in fisheries, Apiculture, Pearl culture, Sericulture, preparation of culture of E.coli, Calculation of LC50, behavioural response to some toxicants (in fishes/insects/artemia/ any other animal).
- Enhance collaborative learning and communication skills through practical sessions, team work, group discussions, assignments and projects.

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Course Contents: (Practical)

No.	Syllabi	Teaching hours
Practical 1	Identification and classification of Invertebrate animals: Phylum: Mollusca: Chiton, Chaetoderma, Pila, Aplysia, Unio, Mytilus, Dentalium, Octopus, Loligo	60
Practical 2	Identification and classification of Invertebrate animals: (i) Phylum: Echinodermata : Star fish, Brittle Star, Sea Urchin, Sea Cucumber, Feather Star (ii) Phylum : Hemichordata : Balanoglossus, Rhabdopleura	
Practical 3	To study external features, digestive system, nervous system, blood vascular system and reproductive system of Pila.	
Practical 4	To study mounting of Osphradium, Radulla, and Statocyst of Pila.	
Practical 5	To study various Larval forms of Echinodermata	
Practical 6	Solve genetic problem: Pleiotropy and Lethal genes	
Practical 7	Solve genetic problem: Epistasis, sex linked and sex influenced genes and extra chromosomal inheritance	
Practical 8	To study Giant Chromosome by preparing temporary mount of salivary gland of Chironomus larvae	
Practical 9	To study regeneration in hydra through permanent slide	
Practical 10	Identification of Household Insects: (i) Insects affecting Human health: 1. House Fly 2. Mosquito (ii) Insects damaging Food Products: 1. Rice Weevil 2. Wheat Weevil (iii) Insects damaging Household Goods: 1. Termite, 2. Silver Fish (iv) Insects damaging Storage grains: 1. Tribolium, 2. Pulse beetle	
Practical 11	To study apparatus for insect collection:	

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	(i) Insect Net (iii) Killing Jar (ii) Aspirator	
Practical 12	Important edible fishes and some invertebrate of Saurashtra sea-coast. [(1) Prawn (2) Lobster (3) Loligo (4) Oyster (5) Pomfret (6) Bombay Duck (7) Ghol fish (8) Dara fish (9) Koth (10) Shark (11) Catla (12) Mrigal]	60
Practical 13	To determine age of fish by scales.	
Practical 14	To study various fish by-products.	
Practical 15	To study post harvesting technique in fisheries.	
Practical 16	To study Apiculture.	
Practical 17	To study Pearl culture.	
Practical 18	To study Sericulture.	
Practical 19	To study preparation of culture of <i>E.coli</i> and prepare slide and observed the structure of microorganism under microscope.	
Practical 20	Calculation of LC ₅₀ .	
Practical 21	To Study behavioural response to some toxicants (in fishes/insects/artemia/ any other animal).	
Practical 22	Visit to any one fish processing plant or fishing area or any educational institute which is relevant to the subject.	

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Subject: Zoology
SEMESTER-III & IV

REFERENCE BOOKS:

1. A textbook of Practical Zoology Invertebrates.....S. S. Lal
2. A textbook of Practical Zoology Vertebrates.....S. S. Lal
3. A Manual of Practical Zoology, Invertebrates.....P. S. Verma
4. Fish & Fisheries of India.....V.G.Jhingram
5. Aquaculture – Principles and Practices.....Pillay, T.,V., R., Kutty, M., N. 2nd Edn.
6. Fishes an introduction to Ichthyology.....Paper and Moyle
7. Marine fisheries.....D.V.Bal, K.V.Rao
8. Ichthyology.....S.Chand
9. Text book of applied entomology.....Srivastava
10. Economic zoology.....Shukla & Upadhyaya
11. Pest management & Pesticides Indian scenario.....Nyar B.V.
12. Poultry science.....Mihir Suthar
13. Elements of Bio-technology.....P.K.Gupta
14. Molecular Biology & Biotechnology.....R.A.Meyers
15. Biotechnology.....Keshav Trehan
16. Genetic engineering.....Rastogi & Pathak, Oxford
17. Biotechnology.....U. Satyanarayana
18. Principles and Methods of Toxicology.....A. Wallace Hayes. Taylor and Francis.
19. Principles of biochemical toxicology.....John A. Timbrell (4th Edn)

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Course Level	5.0		Internal Marks	25
Programme	Zoology		External Marks	50
Semester	IV		Practical Internal	--
Category of Course	Discipline Specific Minor Courses (Minor-3)		Practical External	25
Course Credit	04 (01T + 03P)		Prac. External Exam Duration	2 hrs.
Teaching Hours	75 (45T + 30P)		Total	100
Course Code			Exam Duration	2 hrs
Course Title	NON-CHORDATES-II, CYTOLOGY AND WILDLIFE MANAGEMENT			

COURSE OBJECTIVES:

- The course would provide an insight to the learner about the existence of different lifeforms on the Earth, and appreciate the diversity of animal life. It will help the student to understand the features of Kingdom Animalia and systematic organization of the animals based on their evolutionary relationships, structural and functional affinities.
- The course will provide basics of sutural organisation of cell organelles and their functions and cell division,
- The course will also make the students aware about Biogeographic classification of India, Categories and functioning of Protected Areas other than National Parks and Sanctuaries in India and will create interest among them to explore the animal diversity in nature.

COURSE OUTCOMES:

- Upon completion of the course, students should be able to:
- Learn about the importance of systematics, taxonomy and structural organization of animals. Appreciate the diversity of invertebrates living in varied habit and habitats. Critically analyze the organization, life cycle and pathogenicity of *Ascaris lumbricoides* and *Wuchereria bancrofti* making them familiarize with diseases spread by them.
- Learn major study types in zoology: Mosquito.
- Learn about the cell organelles, cell division and cell cycle
- Will able to get basic knowledge of Biogeographic classification of India and Categories and functioning of Protected Areas other than National Parks and Sanctuaries in India and will create interest among them to explore the animal diversity in nature.

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COURSE CONTENT		
Units	Syllabi	Teaching hours
Unit 1	Platyhelminthes and Nematoda 1.1 General characteristic and classification up to class 1.2 Parasitic adaptations of flatworms 1.3 Life cycle and pathogenicity of <i>Ascaris lumbricoides</i> and <i>Wuchereria bancrofti</i>	11
Unit 2	Annelida and Arthropoda 2.1 General characteristics and classification up to class 2.2 Peripatus: the connecting link between Annelida and Arthropoda 2.3 Type Study: Mosquito (i) Life cycle of <i>Culex</i> & <i>Anopheles</i> Mosquito (ii) Mouth parts of <i>Culex</i> & <i>Anopheles</i> mosquito	12
Unit 3	Cell Biology 1.1 Cell organelles: (i) Endoplasmic reticulum (ii) Mitochondria and Peroxisomes (iii) Cytoskeleton (iv) Nucleus (v) Ribosomes 1.2 Cell Division: Mitosis, Meiosis, Cell cycle and its regulation 1.3 Transport of nutrients, ions and macromolecules across cell membrane.	12
Unit-4	Wildlife 4.1 Biogeographic classification of India 4.2 Categories and functioning of Protected Areas other than National Parks and Sanctuaries- Tiger Reserves, Elephant Reserves, Biosphere Reserves, Conservation Reserves, Community Reserves.	10

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Course Contents: (Practical)

No.	Syllabi	Teaching hours
Practical 1	Identification and classification of Invertebrate animals (i) Phylum: Platyhelminthes : - Planaria, Bipalium, Liverfluke, Schistosoma, Tape worm, <i>Moniezia expansa</i>	30
Practical 2	Identification and classification of Invertebrate animals: (ii) Phylum: Nematoda: Ascaris, Hookworm, <i>Enterobius vermicularis</i> , Filarial worm, Guinea worm	
Practical 3	Identification and classification of Invertebrate animals: (i) Phylum Annelida: Aphrodite, Nereis, Pheretima, Lumbricus, Leech Pontobdella	
Practical 4	Identification and classification of Invertebrate animals: (ii) Phylum Arthropoda: Peripatus, Lobster, Prawn, Grasshopper, Dragonfly, Centipede, Millipede, Spider, Scorpion, Limulus	
Practical 5	To study Life cycle of Anopheles and Culex Mosquito through permanent slide/chart	
Practical 6	To study Mouth Parts of Culex and Anopheles Mosquito through permanent slide/chart	
Practical 7	To study Cell organelles: through permanent slide/multimedia/chart (i) Endoplasmic reticulum (ii) Mitochondria and Peroxisomes (iii) Cytoskeleton (iv) Nucleus (v) Ribosomes	
Practical 8	To study mitotic cell division through temporary mount of onion root tip	
Practical 9	Biogeographic classification of India spotting in map of India	
Practical 10	Protected Areas representing each category (as per theory syllabus) spotting in map of India- Corbett Tiger Reserve, Singhbhum Elephant Reserve, Nanda Devi Biosphere Reserve, Chharidhandh Conservation Reserve, Siswan Community Reserve.	

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REFERENCE BOOKS:

1. Invertebrate Zoology.....E. L. Jordan & Dr. P. S. Verma
2. Invertebrate Zoology.....P. S. Dhami & J. K. Dhami
3. A modern textbook of Zoology Invertebrate Zoology.....R. L. Kotpal
4. A textbook of Practical Zoology Invertebrates.....S. S. Lal
5. A Manual of Practical Zoology, Invertebrates.....P. S. Verma
6. Cell Biology.....Dr. Satyeshchandra Roy
7. Cytology & Genetics.....P. K. Gupta
8. Cell & Molecular Biology.....De Robertis
9. Biotechnological Cell Biology.....V. B. Rastogi
10. Molecular Biology.....V. B. Rastogi
11. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology.....
.....P. S. Varma & V. K. Agrawal
12. Cytology, Genetics & Evolution.....P. K. Gupta
13. Wild Life of Gujarat.....H. S. Singh
14. Wildlife Conservation and management.....R.Mathur
15. Biodiversity and wildlife of India and its conservation, Ecology and
Environment.....P.D.Sharma
16. A Guide to Planning Wildlife Management in Protected Areas and Managed
Landscapes.. V.B. Savarkar
17. Textbook of wildlife management..... Singh, S.K.
18. Wildlife management and conservation..... Krasuman, P.R. & Cain, J.W.
19. Wildlife Ecology, Conservation, and Management.....J.M.Fryxell, A.R.E. Sinclair,
G. Caughley

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1. Illustrate your answer with neat and labelled diagrams.
2. Figure to the right side indicates full marks of questions.

EXTERNAL ASSESSMENT BY UNIVERSITY			
Que. No.	Particulars	Unit	Marks
Que. 1	(1)	Unit 1	05
	(2)		05
	Or		
	(1)		05
	(2)		05
Que. 2	(1)	Unit 2	05
	(2)		05
	Or		
	(1)		05
	(2)		05
Que. 3	(1)	Unit 3	05
	(2)		05
	Or		
	(1)		05
	(2)		05
Que. 4	(1)	Unit 4	05
	(2)		05
	Or		
	(1)		05
	(2)		05
Que. 5	(1)	Unit 1 & 2	05
	(2)		05
	Or		
	(1)	Unit 3 & 4	05
	(2)		05
Total			50

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Physiology and Ecology****Time: 4 Hours****Total Marks: 50**

Part-A (Practical 1-10)		
Que. No.	Particulars	Marks
Que-1	Sketch and label _____ system of Leech. (Practical-3)	04
Que-2	Sketch and label _____ mounting of Leech. (Practical-4)	02
Que-4	Prepare temporary slide as per instruction and show it to examiner. (Practical-7)	03
Que-5	Do as per instruction and show it to examiner. (Practical-8/9/10)	03
Que-6	Write as per instruction. A. Identify and classify giving reasons (Practical-1) B. Identify and classify giving reasons (Practical-2) C. Identify and Describe (Practical-5) D. Identify and Describe (Practical-6)	08
Que-7	Certified Journal.	2
Que-8	Viva-voice.	3
Part-B (Practical 11-20)		
Que. No.	Particulars	Marks
Que-1	Sketch and label _____ system of Calotes. (Practical-13)	04
Que-2	Sketch and label _____ mounting of Calotes. (Practical-14)	02
Que-3	Do as per instruction and show it to examiner. (Practical-16/18)	03
Que-4	Do as per instruction and show it to examiner. (Practical-19/20)	03
Que-5	Write as per instruction. A. Identify and describe (Practical-11) B. Identify and describe (Practical-12) C. Identify and describe (Practical-15) D. Identify and describe (Practical-17)	08
Que-6	Certified Journal.	02
Que-7	Viva-voice.	03

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Fisheries, Animal husbandry, Biotechnology and Toxicology****Time: 4 Hours****Total Marks: 50**

Part-A (Practical 1-11)		
Que. No.	Particulars	Marks
Que-1	Sketch and label _____ system of Pila. (Practical-3)	04
Que-2	Sketch and label _____ mounting of Pila. (Practical-4)	02
Que-4	Do as per instruction and show it to examiner. (Practical-6/7)	03
Que-5	Prepare temporary slide as per instruction and show it to examiner. (Practical-8)	03
Que-6	Write as per instruction. A. Identify and classify giving reasons (Practical-1) B. Identify and classify giving reasons (Practical-2) C. Identify and Describe (Practical-5/9) D. Identify and Describe (Practical-10/11)	08
Que-7	Certified Journal.	02
Que-8	Viva-voice.	03
Part-B (Practical 12-22)		
Que. No.	Particulars	Marks
Que-1	Identify and describe fishery of given animal (Practical-12)	03
Que-2	Determine the age of fish by scales. (Practical-13)	03
Que-3	Do as per instruction and show it to examiner. (Practical-19)	03
Que-4	Do as per instruction and show it to examiner. (Practical-20/21)	03
Que-5	Write as per instruction. A. Identify and describe (Practical-14) B. Identify and describe (Practical-15) C. Identify and describe (Practical-16/17/18)	06
Que-6	Report of the farm/industry visit. (Practical-22)	02
Que-7	Certified Journal.	02
Que-8	Viva-voice.	03

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SEMESTER – III

Practical Examination Paper Style NEP 2020
Multidisciplinary: Fundamentals of Zoology-III

Time: 2.0 Hours

Total Marks: 25

Que. No.	Particulars	Marks
Que-1	Prepare temporary slide as per instruction and show it to examiner. (Practical-1)	04
Que-2	Do as per instruction and show it to examiner. (Practical-6/7)	03
Que-3	Do as per instruction and show it to examiner. (Practical-8)	03
Que-4	Do as per instruction. A. Identify and Describe (Practical-2) B. Identify and Describe (Practical-3/4/5) C. Identify and Describe (Practical-6) D. Identify and Describe (Practical-9/10) E. Identify and Describe (Practical-11)	10
Que-5	Certified Journal.	2
Que-6	Viva-voice.	3

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SEMESTER – IV

Practical Examination Paper Style NEP 2020

Minor-3: Non-Chordates-II, Cytology and Wildlife Management

Time: 2.0 Hours

Total Marks: 25

Que. No.	Particulars	Marks
Que-1	Prepare temporary slide as per instruction and show it to examiner. (Practical-8)	04
Que-2	Describe lifecycle of _____. (Practical-5)	03
Que-3	Do as per instruction and show it to examiner. (Practical-9)	03
	Do as per instruction and show it to examiner. (Practical-10)	02
Que-4	Do as per instruction. A. Identify and classify giving reasons (Practical-1/2) B. Identify and classify giving reasons (Practical-3/4) C. Identify and Describe (Practical-6) D. Identify and Describe (Practical-7)	08
Que-5	Certified Journal.	2
Que-6	Viva-voice.	3

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