R.E. Society's

R. P. GOGATE COLLEGE OF ARTS & SCIENCE AND R.V. JOGALEKAR COLLEGE OF COMMERCE, RATNAGIRI (AUTONOMOUS)

NAAC accredited 'A' Grade (3rd Cycle)

Ratnagiri-415 612 (Maharashtra-India)

SYLLABUS FOR
F. Y. B. Sc. (ZOOLOGY)
Major Courses

Department of Zoology Under NEP 2020

Framed According to the National Education Policy (NEP 2020)

To be implemented from Academic Year: 2023-2024

PREAMBLE

In sharing this curriculum with the instructors and students of Semester I and Semester II (F.Y.B.Sc.) Zoology, I am delighted to announce that, for the very first time, we have made concerted efforts to gather feedback from all those involved in the learning process. This collaborative approach has allowed us to enhance its relevance and effectiveness.

Welcome to the beginning of your Bachelor of Science (B.Sc.) journey! We're excited to share how our education is changing for the better, following the National Education Policy (NEP) of 2020. This introduction will give you a clear idea of what's ahead in your first year.

The NEP 2020 has brought big changes to how we learn. It focuses on making you, the learner, the center of your education. It encourages you to be curious, creative, and a lifelong learner. Let's see how this new approach affects your first year in the B.Sc. program.

In your first year, we'll make sure you get a taste of different areas of science. Instead of studying each subject in isolation, we'll show you how they connect and overlap. This helps you see the bigger picture and understand how science works in the real world.

We believe in learning by doing. So, expect lots of hands-on experiments, fieldwork, and research projects. This way, you won't just memorize facts; you'll learn how to solve problems, which is super important in science.

We also want to make sure that everyone, no matter their background or abilities, feels welcome and supported. We understand that each student is unique, and our teaching methods will adapt to your needs. We're here to help you succeed.

To add more excitement, we offer a range of subjects and pathways for you to explore. You can choose what interests you most and even mix different subjects. This means you have more control over what you learn and can follow your passions.

In a nutshell, your first year in the B.Sc. program, following NEP 2020, is a journey of discovery and learning. We want you to be curious, embrace the diversity of ideas, and be ready for exciting opportunities ahead. Together, we'll explore the world of science and create a brighter future through knowledge, exploration, and innovation.

OBJECTIVES

- Introduce students to ecosystem concepts, biodiversity, wildlife conservation, and management using various teaching tools.
- Provide field experiences to deepen their understanding of ecological concepts.
- Equip students with knowledge in wildlife, opening up career opportunities in Wildlife Tourism.
- Enable students to identify socio-economic animals and understand their significance to humans.
- Foster an appreciation for the importance of biodiversity conservation and coexistence.
- Empower students to recognize potential risk factors affecting human health.
- Explain the role and impact of environmental conservation programs.
- Develop fundamental scientific skills, including observation, biological techniques, and experimental skills.

STRUCTURE OF THE COURSE:

SEMESTER – I

MAJOR COURSES

MAJOR COURSE CODE	COURSE TITLE	UNIT	TOPICS	CREDITS	NO. OF LECTU RES
USZOO101	**Wonders of Animal World, Biodiversity and its Conservation**	1	Wonders of Animal World	**2**	**30**
		2	Biodiversity and its Conservation		
		3	Footsteps to follow		
USZOO102	**Instrumentation and Animal Biotechnology**	1	Laboratory safety, Units and Measurement	**2**	**30**
		2	Instrumentation		
		3	Animal Biotechnology		
USZOOP1	**Zoology Major Practical I**	Practical based on USZOO101 and USZOO102		**2**	**60**

SEMESTER – II

MAJOR COURSES

MAJOR COURSE CODE	COURSE TITLE	UNIT	TOPICS	CREDITS	NO. OF LECTU RES
USZOO201	**Ecology and Ecosystem**	1	Population ecology	**2**	**30**
		2	Ecology and Ecosystem		
		2	National parks and Sanctuaries of India		
USZOO202	**Nutrition and Common Human Diseases**	1	Nutrition	**2**	**30**
		2	Public Health and Hygiene		
		3	Common Human Diseases and Disorders		
USZOOP2	**Zoology Major Practical II**	Practical based on USZOO201 and USZOO202		**2**	**60**

Syllabus for (F.Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Wonders of Animal World, Biodiversity and its Conservation**
Course Code (refer to student handbook)	USZO101
Class	F.Y.B.Sc.
Semester	01
No of Credits	02
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core Major
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: Wonders of Animal World, Biodiversity and its Conservation

Curriculum:

CO1- Curiosity will be ignited in the mind of learners, to know more about the fascinating world of animals which would enhance their interest and love for the subject of Zoology.

CO2- Learners would appreciate treasure of Biodiversity, its importance and hence would contribute their best for its conservation.

CO3-Minds of learners would be impulse to think differently and would be encouraged ipso facto to their original crude ideas from the field of biological sciences.

Unit	Title	Learning Points	No of Lectures
I	**Wonders of Animal World**	1.1 Echolocation in Bats and Cetaceans - Dolphins and Whales 1.2: Mechanism of Pearl formation in Mollusca 1.3: Bioluminescence in Animals: Noctiluca, Glow worm, Firefly, Angler Fish (Mechanism and use for the animal) 1.4: Regeneration in Animals - Earthworm (Annelida) and Lizard (Reptile) 1.5: Mimicry in Butterflies and its significance: Great Egg fly and Common Crow, Common Palm fly and Plain Tiger. 1.6: Mechanism of Coral formation and types of Coral reefs 1.7: Bird migration: Definition, types and factors inducing bird migration 1.8: Adaptive features of desert animals: Reptiles (Phrynosoma) and Mammals (Camel) 1.9: Breeding and Parental care in: 1.9.1: Pisces - Ovo-viviparous (Black Molly/Guppy), Mouth brooders (Tilapia), Brood pouches (Sea horse) 1.9.2: Amphibia - Mouth brooders (Darwin's Frog), Egg carriers (Midwife Toad) 1.9.3: Mammals - Egg-laying (Duck-billed Platypus), Marsupials (Kangaroo) 1.10: Aves: Brood Parasitism (Cuckoo)	**10**
II	**Biodiversity and its Conservation**	2.1 Introduction to Biodiversity - Definition, Concepts, Scope and Significance 2.2: Levels of Biodiversity - Introduction to Genetic, Species and Ecosystem Biodiversity 2.3: Introduction of Biodiversity Hotspots- (Western Ghats and Indo- Burma Border) 2.4: Values of biodiversity - Direct and Indirect use value 2.5: Threats to Biodiversity - Habitat loss and Man-	**10**

		Wildlife conflict 2.6: Biodiversity conservation and management 2.6.1: Conservation strategies: in situ, ex-situ, National parks, Sanctuaries and Biosphere reserves. 2.6.2: Introduction to International efforts: Convention on Biological Diversity (CBD), International Union for Conservation of Nature and Natural Resources (IUCN), United Nations Environment Program - World Conservation Monitoring Centre (UNEP-WCMC) 2.6.3: National Biodiversity Action Plan, 2002 2.6.4: Introduction to Indian Wildlife (Protection) Act, 1972 and Convention for International Trade of endangered species	
III	**Footsteps to follow**	3.1: Dr. Hargobind Khorana (Genetic code) 3.2: Dr. Varghese Kurien (Amul –White revolution) 3.3: Dr. Salim Ali (Ornithologist) 3.4: Anna Hazare (Water Conservation-Ralegan Siddhi) 3.5: Baba Amte (Anandvan) 3.6: Kiran Mazumdar Shaw (Biocon) 3.7: Gadre Fisheries (Surimi) 3.8 : Rajendra Singh	**10**

	PRACTICALS USZOOP1 (Based on USZOO101)	**1 Credit**
1.	Mounting of foraminiferan shells from sand (any 3)	
2.	Study of types of Corals - Brain, Organ pipe, Stag Horn, Mushroom coral	
3.	Study of the following; a. Symbiosis (Termite and Trychonympha, hermit crab and sea anemone) b. Camouflage (leaf insect, chameleon) c. Cannibalistic mate-eating animals (Spider and Praying Mantis) d. Animal architects: Termites, Harvester ant and Baya weaver bird e. Study of bioluminescent organisms – Noctiluca, glow worm, fire fly, angler fish	
4.	Breeding and parental care in Amphibia- Rhacophorus, Midwife toad, Darwin's frog, Caecilian.	
5.	Mounting of scales of fish (placoid, cycloid and ctenoid)	
6.	Study of fossils.	
7.	a) Study of Adaptive radiation in Reptiles - Turtle, Tortoise, Phrynosoma, Draco) b) Identification and differentiation of venomous and non-venomous snakes (Scales, Fangs, Bite marks, etc.)	

8.	Study of Types of feathers (contour, filoplume, down), beaks (Nectar feeding , Insect catching, Fruit eating, Scavenging, Filter feeding), claws (perching, wading, swimming, hopping) in birds	
9.	The Culture of Paramecium.	
10.	a) Identification of birds - Coppersmith Barbet, Bulbul, Rose ringed Parakeet, Magpie Robin, two local birds. b) Field Report – To be done in a group of ten students (submission of written / typed report preferably along with photographs/ tables/ graphs. **Other Suggested topics for field observation/survey:** - Butterflies / Fishes / Migratory birds of local area. - Variations in Human like Attached vs. Free Earlobes, Blood Groups, Eye colour, etc. using statistical method.	

Note – 1. Practical sessions may be conducted using specimens authorized by wildlife and other regulating authorities. However, it is strongly recommended that teaching methods utilize photographs, audio-visual aids, simulations, models, etc., as recommended by the UGC and as envisaged in the regulations of the relevant monitoring bodies. No new specimens shall be procured for the purpose of conducting the practicals mentioned above.
2.There shall be at least one excursion/field trip.

REFERENCES AND ADDITIONAL READING

1. Vertebrate Zoology Volume I- Jordan and Verma, S. Chand and Co.
2. Invertebrate Zoology Volume II- Jordan and Verma, S. Chand and Co.
3. Invertebrate Zoology- T. C. Majupuria, S. Nagin and Co.
4. Chordate Zoology- P. S. Dhami and J. K. Dhami, R. Chand and Co.
5. Invertebrate Zoology- P. S. Dhami and J. K. Dhami, R. Chand and Co.
6. Introduction to Vertebrates- Moore Cambridge University- Low Priced Edition
7. Zoology- S. A. Miller and J. B. Harley, Tata McGraw Hill
8. Modern Textbook of Zoology, Invertebrates, R. L. Kotpal
9. Fundamentals of Ecology- E. P. Odum, Sunders Publication
10. Fundamentals of Ecology- M.C. Dash-2nd edition, Tata McGraw Hill
11. Essentials of Ecology and Environmental Science - S.V.S Rana
12. Biodiversity- S.V.S Rana- Prentice Hall Publications
13. Modern Biology- V. B. Rastogi
14. Biology of Mollusca- D. R. Khanna
15. A Textbook of Zoology, Vol. II- T. Jeffery Parker and William. A. Haswell-Low Price Publications
16. Ecology and Environment- P. D. Sharma, R. K. Rastogi Publications
17. Introduction to Ecology- R. Dajoz
18. Wildlife Laws and its Impact on Tribes- Mona Purohit, Deep and Deep Publications
19. Biodiversity- K.C. Agarwal- Agro Botanica Publications
20. Butterflies of India – Isaac Kehimkar- BNHS Publication0

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	Marks
Class Test	20
Assignment	10
Classroom performance	05
Attendance	05
Total	**40**

B. External Evaluation – 60 %

Semester End Evaluation (Paper Pattern)- 60 Marks

Question No.	Options	Unit	Marks
1.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	1	15
2.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	2	15
3.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	3	15
4.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3	15

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	**05**
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	**30**
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (F.Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Instrumentation and Animal Biotechnology**
Course Code (refer to student handbook)	USZOO102
Class	F.Y.B.Sc.
Semester	01
No of Credits	02
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core Major
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: Instrumentation and Animal Biotechnology

Curriculum:

CO1- Learners would work safely in the laboratory and avoid occurrence of accidents (mishaps) which will boost their scholastic performance and economy in use of materials/chemicals during practical sessions.

CO2- Learners would understand recent advances in the subject and their applications for the betterment of mankind; and that the young minds would be tuned to think out of the box.

CO-3 Students will be skilled to select and operate suitable instruments for the studies of different components of Zoology of this course and also of higher classes including research.

Unit	Title	Learning Points	No of Lectures
I	**Laboratory safety, Units and Measurement**	1.1: Introduction to good laboratory practices 1.2: Use of safety symbols: meaning, types of hazards and precautions 1.3: Units of measurement: 1.3.1: Calculations and related conversions of each: Metric system- length (meter to micrometer); weight (gram to microgram), Volumetric (Cubic measures) 1.3.2: Temperature: Celsius, Fahrenheit, Kelvin 1.3.3: Concentrations: Percent solutions, ppt, ppm, ppb dilutions, Normality, Molarity and Molality. 1.3.4: Biostatistics: Introduction and scope, Sampling and its types, Central Tendencies (mean, median, mode) Tabulation, Graphical representations (Histograms, bar diagrams, pie diagrams).	**10**
II	**Instrumentation**	Microscopy 2.1.1: Construction, principle and applications of Light microscopy, fluorescence microscopy, Electron microscopy and flow cytometry. 2.2: Colorimetry and Spectroscopy - Principle and applications. 2.3: pH - Sorenson's pH scale, pH meter - principle and applications. 2.4: Centrifuge - Principle and applications, types of centrifuges, types of rotors, differential and density gradient centrifugation, Sonication and Freeze drying 2.5: Chromatography - Principle and applications (Paper, Adsorption, Column, Thin layer, Affinity, Gas chromatography and HPLC) 2.6: Electrophoresis - Principle and applications (AGE	**10**

		and PAGE)	
III	**Animal Biotechnology**	3.1 Biotechnology: Scope and achievements of Biotechnology (Fishery, Animal Husbandry, Medical, Industrial) 3.2: Transgenesis: Retro viral method, nuclear transplantation method, DNA microinjection method and Embryonic stem cell method 3.3: Cloning (Dolly) 3.4: Ethical issues of transgenic and cloned animals 3.5: Applications of Biotechnology: 3.5.1: DNA fingerprinting: Technique in brief and its application in forensic science (Crime Investigation) 3.5.2: Recombinant DNA in medicines (recombinant insulin) 3.5.3: Gene therapy: Ex-vivo and In vivo, Severe Combined Immunodeficiency (SCID), Cystic Fibrosis 3.5.4: Green genes: Green Fluorescent Protein (GFP) from Jelly fish- valuable as reporter genes used to detect food poisoning 3.5.5 Genetically Modified organisms: Bt cotton, Land-mine detecting plants, Salmon fish, Human milk producing Cows, Featherless chickens	**10**

	PRACTICALS USZOOP1(Based on USZOO102)	**1 Credit**
1.	Calculation of pH of three different samples (one each acidic, alkaline and neutral) using pH paper/Universal Indicator and confirming the result with pH meter.	
2.	a) Study of parts of microscope and their functions. b) Technique of focusing a permanent slide under 10x and 45x (objectives).	
3.	a) Dilution of given sample and estimation of OD by using colorimeter. b) Calculation of concentration from the given OD using formula.	
4.	a) Separation of amino acids from the mixture by paper chromatography. b) Calculation of Rf value of separated pigments/amino acids from given chromatogram and their identification from standard chart.	
5.	Separation of pigments by adsorption chromatography using chalk.	
6.	Separation of lipids by TLC,	
7.	Separation of egg albumin by electrophoresis.	
8.	Identification of transgenic fish (Trout and Salmon) / cloned animals (Dolly sheep, cc cat and Snuppy dog) from photograph.	
9.	Extraction of fruit juice with pectinase from apple/guava/or any other suitable fruit	
10.	Application of DNA Fingerprinting in criminology (photograph of electrophoretic pattern to be given for interpretation by the students)	

Note – 1. Practical sessions may be conducted using specimens authorized by wildlife and other regulating authorities. However, it is strongly recommended that teaching methods utilize photographs, audio-visual aids, simulations, models, etc., as recommended by the UGC and as envisaged in the regulations of the relevant monitoring bodies. No new specimens shall be procured for the purpose of conducting the practicals mentioned above.
2.There shall be at least one excursion/field trip.

REFERENCES AND ADDITIONAL READINGS

1. Introduction to Practical Biochemistry – David T. Plummer (Tata McGraw Hill Publishing Co. Ltd.)
2. Introductory Practical Biochemistry – S.K. Sawhney and Randhir Singh (Narosa Publishing House)
3. Methods in Biostatistics – B. K. Mahajan, (Jaypee Publications)
4. Microscopy and Cell Biology - V. K. Sharma, (Tata McGraw Hill Publishing Co. Ltd.)
5. Bioinstrumentation – L. Veera Kumari, (M.J.P. Publishers)
6. Principles and Techniques of Practical Biochemistry – Keith Wilson and John Walker, (Cambridge University Press)
7. Understanding biotechnology- Aluizio Borem, David Bowe-Low price edition–Pearson Publication
8. A Textbook of Biotechnology – R. C. Dubey, S. Chand Publication.
9. A Manual of Medical Laboratory Technology -A. H. Patel, Navneet Prakashan Ltd.
10. Biological instruments and methodology – Dr. P. K. Bajpai, S. Chand company Ltd.
11. Calculations in Molecular biology and Biotechnology - Frank H. Stephenson, Academic Press.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class Test	20
Assignment	10
Classroom performance	05
Attendance	05
Total	**40**

B. External Evaluation – 60 %

Semester End Evaluation (Paper Pattern)- 60 Marks

Question No.	**Options**	**Unit**	**Marks**
1.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	1	15
2.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	2	15
3.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	3	15
4.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3	15

Practical Examination Pattern:

(A) Internal Examination

Heading	**Practical**
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	**05**
Total	**20**

(B) External (Semester end practical examination)

Particulars	**Practical**
Lab work	**30**
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (F.Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Ecology and Ecosystem**
Course Code (refer to student handbook)	USZOO201
Class	F.Y.B.Sc.
Semester	02
No of Credits	02
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core Major
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: Ecology and Ecosystem

Curriculum:

CO1- This unit would allow learners to study about nature of animal population, specific factors affecting its growth and its impact on the population of other life form.

CO2- Learners will grasp the concept of interdependence and interaction of physical, chemical and biological factors in the environment and will lead to better understanding about implications of loss of fauna specifically on human being, erupting spur of desire for conservation of all flora and fauna.

CO3- Learners would be inspired to choose career options in the field of wild life conservation, research, photography and ecotourism.

Unit	Title	Learning Points	No of Lectures
I	**Population ecology**	1.1: Population dynamics 1.1.1: Population density 1.1.2: Natality 1.1.3: Mortality 1.1.4: Fecundity 1.1.5: Age structure 1.1.6: Sex ratio 1.1.7: Life tables 1.1.8: Survivorship curves 1.1.9: Population dispersal and distribution patterns 1.1.10 Niche concept 1.2: Population growth regulation 1.2.1: Intrinsic mechanism – Density dependent fluctuations and oscillations 1.2.2: Extrinsic mechanism- Density independent, environmental and climate factors, population interactions 1.3: Population growth pattern 1.3.1: Sigmoid 1.3.2: J Shaped 1.4: Human census (India) – Concept, mechanism and significance	**10**
II	**Ecosystem**	2.1: Concept of Ecosystems 2.1.1: Ecosystem - Definition and components 2.1.2: Impact of temperature on biota 2.1.3: Biogeochemical cycles (Water, Oxygen, Nitrogen, Sulphur) 2.1.4: Fresh water ecosystem – Lentic and Lotic 2.1.5: Food chain and food web in ecosystem (Fresh water and Grass land). 2.1.6: Ecological pyramids - energy, biomass and number. 2.1.7: Animal interactions (commensalism, mutualism,	**10**

		predation, antibiosis, parasitism)	
III	**National parks and Sanctuaries of India**	3.1: Concept of Endangered and Critically Endangered species using examples of Indian Wildlife with respect to National Parks and Wildlife Sanctuaries of India (Sanjay Gandhi National Park, Tadoba Tiger Reserve, Corbett National Park, Kaziranga National Park, Gir National Park, Silent Valley, Pirotan Island Marine Park, Keoladeo Ghana National Park, Bandipur Sanctuary) 3.2: Management strategies with special reference to Tiger and Rhinoceros in India 3.3: Ecotourism 3.4: Biopiracy	**10**

	PRACTICALS USZOOP2 (Based on USZOO201)	**1 Credit**
1.	Interpretation of the given graphs/ tables and comment on pattern of population nature: i. Survivorship curve ii. Life tables iii. Fecundity tables iv. Age structure v. Sex ratio	
2.	a) Calculation of Natality, Mortality, Population density from given data b) Estimation of population density by capture recapture method	
3.	Interpretation of Growth curves (Sigmoid and J shaped)	
4.	Estimation of hardness from given water sample (tap water v/s well water)	
5.	Estimation of Free carbon dioxide (Free CO2) from two different samples- aerated drinks(diluted) v/s tap water	
6.	Identification and interpretation of aquatic and terrestrial (Grassland) food chains and food webs	
7.	Construction of food chain/food web using given information/data.	
8.	a) Identification and interpretation of ecological pyramids of energy, biomass and number b) Construction of different types of pyramids from given data.	
9.	Study of the following: a) Endangered (Great Indian Bustard, Asiatic lion, Blackbuck, Olive Ridley Sea turtle) and critically endangered species (Slender-billed vulture, Gharial, Malabar civet) of Indian wildlife and state reasons for their decline b) Study Biodiversity hotspots using world map (Western Ghats and Indo-Burma) Study of sanctuaries, national parks, biosphere reserves in India with respect to its brand fauna)	

Note – 1. Practical sessions may be conducted using specimens authorized by wildlife and other regulating authorities. However, it is strongly recommended that teaching methods utilize

photographs, audio-visual aids, simulations, models, etc., as recommended by the UGC and as envisaged in the regulations of the relevant monitoring bodies. No new specimens shall be procured for the purpose of conducting the practicals mentioned above.
2.There shall be at least one excursion/field trip.

REFERENCES AND ADDITIONAL READING

1. Fundamentals of Ecology - Eugene P. Odum and Grey W. Barrett, Brook Cole/ Cengage learning
2. Fundamentals of Ecology - M. C. Dash, Tata McGraw Hill company Ltd. New Delhi
3. Ecology - Mohan P. Arora, Himalaya Publishing House
4. Field Biology and Ecology -- Alen H. Benton and William E. Werner, Tata McGraw Hill ltd, New Delhi
5. Ecology and Environment - Sharma P. D, Rastogi Publication, Mumbai
6. Ecology: Principles and Applications - Chapman J.L, Cambridge University trust
7. Ecology - Subramaniam and Others, Narosa Publishing House
8. Wildlife laws and its impact on tribes - Mona Purohit, Deep and deep Publication
9. Biology - Eldra Solomon, Linda R. Berg and Diana W. Martin, Thomson/ Brooks/ Cole
10. Economic Zoology, Biostats and Animal Behaviour - Shukla, Mathur, Upadhyay, Prasad. Rastogi Publications.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class Test	20
Assignment	10
Classroom performance	05
Attendance	05
Total	**40**

B. External Evaluation – 60 %

Semester End Evaluation (Paper Pattern)- 60 Marks

Question No.	**Options**	**Unit**	**Marks**
1.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	1	15
2.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	2	15
3.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	3	15
4.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3	15

Practical Examination Pattern:

(A) Internal Examination

Heading	**Practical**
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	**05**
Total	**20**

(B) External (Semester end practical examination)

Particulars	**Practical**
Lab work	**30**
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (F.Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Nutrition and Common Human diseases**
Course Code (refer to student handbook)	USZOO202
Class	F.Y.B.Sc.
Semester	02
No of Credits	02
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core Major
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: Nutrition and Common Human diseases

Curriculum:

CO1- Healthy dietary habits would be inculcated in the life style of learners in order to prevent risk of developing health hazards in younger generation due to faulty eating habits.

CO2-Promoting optimum conservation of water, encouragement for maintaining adequate personal hygiene, optimum use of electronic gadgets, avoiding addiction, thus facilitating achievement of the goal of healthy young India in true sense.

CO3- Learners will be able to promptly recognize stress related problems at initial stages and would be able to adopt relevant solutions which would lead to psychologically strong mind set promoting positive attitude important for academics and would be able to acquire knowledge of cause, symptoms and precautions of infectious diseases.

Unit	Title	Learning Points	No of Lectures
I	**Nutrition**	1.1 Concept and definition of terms - Nutrition, Malnutrition and Health 1.2 Nutrients: Micronutrients and macronutrients 1.3: Importance of Dietary Fibres in food –Dietary fibre Classification, sources, composition, properties & nutritional significance 1.4: Minerals & Trace Elements, Bio-Chemical and Physiological Role, bio-availability & requirements, sources, deficiency & excess (Calcium, Sodium, Potassium Phosphorus, Iron, Fluoride, Zinc, Selenium, Iodine, Chromium) 1.5 Vitamins - Bio-Chemical and Physiological Role, bio-availability and requirements, sources, deficiency & excess. 1.6 Water - Functions, daily requirements, Water balance. 1.7: Concept of balanced diet, dietary recommendations to a normal adult, infant, pregnant woman and aged. 1.8: Malnutrition disorders – Anemia (B12 and Iron deficiency), Rickets, Beriberi, Marasmus, Goiter, Kwashiorkor (cause, symptoms, precaution and remedy). 1.9: Constipation, piles, starvation, acidity, flatulence, peptic ulcers (cause, symptoms, precaution and remedy). 1.10: Obesity (Definition and consequences). 1.11: BMI calculation and its significance.	**10**
II	**Public Health and Hygiene**	2.1: Health 2.1.1: Definition of Health, the need for health education and health goal.	**10**

		2.1.2: Physical, psychological and Social health issues. 2.1.3: WHO and its programmes - Polio, Small pox, Malaria and Leprosy (concept, brief accounts and outcome with respect to India). 2.1.4: Ill effects of self-medication. 2.2: Water and water supply 2.2.1: Sources and properties of water. 2.2.2: Purification of water, small scale, medium scale and large scale (rapid sand filters) 2.2.3: Water footprint (concept, brief accounts and significance). 2.3: Hygiene: 2.3.1: Hygiene and health factors at home, personal hygiene, oral hygiene and sex hygiene. 2.4: Radiation risk: 2.4.1: Mobile Cell tower and electronic gadgets (data of recommended level, effects and precaution). 2.5: Blood bank – Concept and significance	
III	**Common Human Diseases and Disorders**	3.0 Human diseases: Introduction and Types - Bacterial, Viral, Protozoan, Helminthic, infectious, non-infectious etc. 3.1 Viral Diseases: Common Cold, Flu, Polio, Rabies 3.2 Stress related disorders 3.2.1: Hypertension, Diabetes type II, anxiety, insomnia, migraine, depression (cause, symptoms, precaution and remedy) 3.3: Communicable and non-communicable diseases 3.3.1: Tuberculosis, Typhoid, Pneumonia, Malaria and Dengue 3.3.2 Swine flu (cause, symptoms, precaution and remedy). 3.3.3: Hepatitis (A and B), AIDS, Gonorrhea and Syphilis 3.3.4: Diseases of respiratory system- Asthma, Bronchitis. 3.3.5: Oral Cancer (Discuss cause/causative agents, symptoms, diagnostics, precaution /prevention and remedy) Allergies**:** hypersensitivity to foreign substances, e.g., pollen, dust, mites, etc. 3.5 Drugs and Alcohol Abuse, causes and effects	**10**

	PRACTICALS USZOOP2 (Based on USZOO202)	**1 Credit**
1.	Qualitative estimation of Vitamin C by Iodometric method.	
2.	Study of microscopic structure of starch granules of different cereals (wheat, maize and jowar).	

3.	a) Estimation of maltose from brown/white bread. b) Moisture content from biscuits or other suitable food products.	
4.	Food adulteration Test: a) Milk adulterants (starch and glucose), methylene blue reduction Test (MBRT). b) Adulterants in Cheese, Butter, Jaggery, Ghee, Honey, Iodized Salt.	
5.	a) Estimation of protein content of two egg varieties. b) Study of efficacy of different antacids (any two antacids).	
6.	Study of Human Parasites Endoparasites - Protozoans (Entamoeba, Plasmodium), Helminthes (Ascaris, Wuchereria), Ectoparasites (Head louse, tick) and Exoparasites (Bed bug, Mosquito).	
7.	Screening of anaemic /non-anaemic persons using CuSO4 method.	
8.	First Aid – Demonstration Practical Training for teachers and students to be conducted by the experts from red cross, Civil defense, Civic authorities by individual institute or cluster colleges in rotation.	
9.	BMI analysis - Measurement of Height/ Weight and calculation of BMI using formula, preparation and submission of report. (10 students/ group-50 readings/group)	

Note – 1. Practical sessions may be conducted using specimens authorized by wildlife and other regulating authorities. However, it is strongly recommended that teaching methods utilize photographs, audio-visual aids, simulations, models, etc., as recommended by the UGC and as envisaged in the regulations of the relevant monitoring bodies. No new specimens shall be procured for the purpose of conducting the practicals mentioned above.
2.There shall be at least one excursion/field trip.

REFERENCES AND ADDITIONAL READING

1. Common Medical Symptoms edited - P. J. Mehta National Implicants and Distributions
2. Parks Textbook of Preventive and Social Medicine K. Park M/S Banarasidas Bhanot Jabalpar.
3. Human Physiology – Volume I – II C. C. Chatterjee, Medical Allied agency, Kolkatta.
4. Parasitology (Protozoology and Helminthology) - K. D. Chatterjee, Chatterjee Medial Publishers.
5. Essentials of Public Health and Sanitation- Part I and Part II. All India Institute of Local Self Government.
6. Textbook of Medical Parasitology- C. K. Jayaram Panikkar. Jaypee Brothers.
7. A Treatise on Hygiene and Public Health. -B. N. Ghosh. Calcutta Scientific Publishing Company.
8. Clinical Dietetics and Nutrition - F. P. Antia and Philip, Oxford University Press.
9. Nutrition: Principles and Application in Health Promotion - J. B. Lippincott Company. Philadelphia.
10. Are You Healing Yourself Mr. Executive - Dr. R. H. Dastur. IBH Publishing Company.
11. Food Nutrition and Health- Dr. Shashi Goyal, Pooja Gupta, S. Chand Publications.
12. Textbook of Human Nutrition - Mahtab Bamji, Prahlad Rao.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	Marks
Class Test	20
Assignment	10
Classroom performance	05
Attendance	05
Total	**40**

B. External Evaluation – 60 %

Semester End Evaluation (Paper Pattern)- 60 Marks

Question No.	Options	Unit	Marks
1.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	1	15
2.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	2	15
3.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	3	15
4.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3	15

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	**05**
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	**30**
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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R.E. Society's

R. P. GOGATE COLLEGE OF ARTS & SCIENCE AND R.V. JOGALEKAR COLLEGE OF COMMERCE, RATNAGIRI (AUTONOMOUS)

NAAC accredited 'A' Grade (3rd Cycle)

Ratnagiri-415612 (Maharashtra-India)

F. Y. B. Sc. SYLLABUS FOR VOCATIONAL SKILL COURSES (VSC) IN ZOOLOGY

Department of Zoology Under NEP 2020

Framed According to the National Education Policy (NEP 2020)

To be implemented from Academic Year: 2023-2024

PREAMBLE:

In alignment with the progressive vision outlined in the National Education Policy (NEP) of 2020, we are pleased to introduce a Vocational Skill Course in Laboratory Practices in Biological Sciences, incorporating Biostatistics, for the first-year Bachelor of Science (B.Sc.) students. This vocational course represents a vital step in realizing the transformative ideals of NEP 2020, which prioritize the development of practical skills, holistic education, and a dynamic, learner-centric approach.

The NEP 2020 envisions an educational landscape that not only imparts theoretical knowledge but also equips students with the practical skills necessary to excel in their chosen fields. This vocational skill course is designed to bridge the gap between academic learning and real-world application, aligning with NEP 2020's emphasis on experiential learning and skill development.

In launching this course, we place a strong emphasis on chemical preparation, recognizing its pivotal role in various scientific disciplines. Chemical preparation forms the backbone of experiments, analyses, and research in fields such as chemistry, biology, and environmental science. Through this course, students will gain practical knowledge and skills in chemical preparation, empowering them to conduct experiments, analyze substances, and contribute to scientific advancements. This emphasis on chemical preparation aligns with our commitment to providing a comprehensive and hands-on education that equips students with the tools they need to excel in their chosen fields.

The Vocational Skill Course in Laboratory Practices in Biological Sciences, with a focus on Biostatistics, under NEP 2020, is a testament to our commitment to providing students with a dynamic and relevant education. It empowers them with the practical skills and knowledge required for success in the ever-evolving field of biological sciences while aligning seamlessly with the visionary principles of NEP 2020. Through this course, we aim to cultivate a generation of biology professionals who are well-prepared, adaptable, and ready to contribute meaningfully to the world of science and research**.**

OBJECTIVES:

1. Provide hands-on experience in biological laboratory practices.
2. Develop skills in biostatistics for data analysis in biology.
3. Foster a holistic approach to learning, emphasizing practical skills.
4. Encourage active participation and experiential learning.
5. Prepare students for careers in research, industry, or healthcare by equipping them with practical skills.
6. Enhance understanding of biological concepts through real-world application.
7. Promote critical thinking and problem-solving in biological contexts.
8. Cultivate teamwork and collaboration through laboratory projects.
9. Align with the National Education Policy (NEP) 2020's vision for practical skill development and holistic education.

STRUCTURE OF THE COURSE:

SEMESTER I

ZOOLOGY-VOCATIONAL SKILL COURSE 1 (USZOVSC104)

VOCATIONAL SKILL COURSE CODE	COURSE TITLE	Unit	Title	CREDITS	NO. OF LECTURES
USZOVSC104	**Laboratory Practices in Biological Sciences**	Practical -I	Biological Material and Chemical Preparation, Dilutions, and Safety Handling.	**1**	**30**
		Practical -II	Exploring Various Analytical Methods.	**1**	**30**

Syllabus for (F.Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Laboratory Practices in Biological Sciences**
Course Code (refer to student handbook)	USZOVSC104
Class	F.Y.B.Sc.
Semester	01
No of Credits	02
Nature	Practical
Type (applicable to NEP only)	Vocational Skilled Course
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: Laboratory Practices in Biological Sciences

Course Outcomes:

CO1: Students will follow a protocol independently, including locating materials and equipment, practicing good lab procedures and accurately performing all experimental procedures.

CO2: To demonstrate proficiency in maintaining a safe workplace, including observation of lab safety procedures, use of personal protective equipment, identification hazards and proper disposal of commonly used chemicals and biohazardous materials.

CO3: To understand the underlying principles as well as practical guidelines of "how to do it" and "how to interpret it" statistical data particularly for bio system.

CO4: Students will be acquainted with the concept of biostatistics.

Curriculum:

	PRACTICAL - I **(Biological Material and Chemical Preparation, Dilutions, and Safety Handling.)**	**1 Credits**
1.	Interpretation of safety symbols (toxic, corrosive, explosive, flammable, skin irritant, oxidizing, compressed gases, aspiration hazards and Biohazardous infectious material)	
2.	Preparing a solution of known concentration from a known amount of solid material.	
3.	Preparing a solution of known concentration by dilution.	
4.	Preparing a solution of given molarity and volume.	
5.	Preparation of a solution of given normality.	
6.	Preparation of a solution of a given molality.	
7.	Preparation of a solution of given percentage.	
8.	Preparation of ppm and ppb solutions.	
9.	Preparing dilute solutions from concentrated ones.	
10.	a) Preparation of exact 1 N HCL b) Preparation of exact 1 N NaOH	

Evaluation pattern:

Practical Examination:

(A) Internal Examination

Heading	**Practical**
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	**Practical**
Lab work	**30**
Total	**30**

	PRACTICAL- II (Exploring Various Analytical Methods)	1 Credits
1.	Construction of a discrete frequency distribution.	
2.	Construction of a continuous grouped frequency distribution.	
3.	Construction of the bar diagram.	
4.	Construction of a histogram.	
5.	Construction of a pie diagram.	
6.	Construction of frequency polygon and frequency curve from the frequency table.	
7.	Calculation of the arithmetic mean, mode and median.	
8.	Calculation of median, quartiles, deciles and percentiles.	
9.	Calculation of range, quartile deviation, means deviation and standard deviation.	
10.	Calculation of coefficient of variation.	

Evaluation pattern:

Practical Examination:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	**05**
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	**30**
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

Learning Resources recommended:

1. A Manual of Laboratory and Diagnostic Tests" by Frances Talaska Fischbach and Marshall Barnett Dunning III
2. Laboratory Techniques in Biochemistry and Molecular Biology" by Ralph Rapley

3. Laboratory Safety for Chemistry Students" by Robert H. Hill Jr. and David C. Finster
4. Biostatistics: A Foundation for Analysis in the Health Sciences" by Wayne W. Daniel and Chad L. Cross
5. Biostatistics: The Bare Essentials" by Geoffrey R. Norman and David L. Streiter
6. Principles of Biochemistry" by Albert L. Leininger, David L. Nelson, and Michael M. Cox.
7. Laboratory Techniques in Biochemistry and Molecular Biology" by M. S. Swaminathan and M. V. Krishnarao
8. "Biostatistics: Basic Concepts and Applications" by Madan M. Gupta
9. "Laboratory Techniques in Zoology" by J.P. Sharma
10. "Biostatistics: Principles and Practices" by M.N. Satyanarayana
11. "Experimental Techniques in Plant Disease Epidemiology" by S. Nagarajan and D. S. Rathore.
12. Biostatistics: A Foundation for Analysis in the Health Sciences" by B. K. Mahajan
13. "Biostatistics: Textbook and Practical Approach" by M. Swaminathan and S. Ravichandran
14. "Practical Manual of Experimental and Clinical Pharmacology" by S. R. Yadav and A. S. Yadav
15. "Biostatistics for Medical, Nursing and Pharmacy Students" by A. Subha Rani
16. "Laboratory Techniques in Botany" by H. S. Chauhan and G. M. M. Shah
17. "Research Methodology and Biostatistics" by Dr. R. R. Mehta

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NAAC accredited 'A' Grade (3rd Cycle)

Ratnagiri-415612 (Maharashtra-India)

F.Y. B. Sc. SYLLABUS FOR
Skill Enhancement Course (SEC) IN ZOOLOGY

Aquarium Fish keeping

Department of Zoology Under NEP 2020

Framed According to the National Education Policy (NEP 2020)

To be implemented from Academic Year: 2023-2024

PREAMBLE:

Welcome to the exciting Skill Enhancement Course on Aquarium Fish Keeping, specially designed for First Year Bachelor of Science (B. Sc.) students under the National Education Policy 2020 (NEP 2020). This course introduces you to the captivating world of aquarium fish and provides hands-on experience in the care and management of aquatic life.

In alignment with the NEP 2020's emphasis on holistic education and skill development, this course aims to go beyond traditional classroom learning. It is designed to offer practical skills that can be applied both personally and professionally, fostering a deeper connection with the natural world and promoting sustainability.

Aquarium fish keeping is a rewarding hobby and a valuable skill, combining elements of biology, ecology, and responsible pet ownership. This course will not only teach you the art and science of creating and maintaining beautiful aquatic environments but will also instil a sense of responsibility and ethical consideration for the welfare of the fish and their habitats.

Throughout this course, you will learn about the principles of water quality, the various types of aquarium systems, the different species of fish suitable for captivity, and the art of creating aesthetically pleasing aquascapes. You will gain practical knowledge in setting up, maintaining, and troubleshooting aquariums, ensuring the health and well-being of your aquatic companions.

Beyond personal enrichment, this course equips you with valuable skills relevant to careers in the fields of aquaculture, aquatic ecology, and environmental conservation. The ability to understand and care for aquatic life is increasingly important in a world where preserving biodiversity and sustainable resource management are top priorities.

We encourage you to approach this skill enhancement course with enthusiasm and curiosity, as it not only enriches your academic experience but also enhances your practical abilities and fosters a deeper appreciation for aquatic ecosystems.

As you embark on this journey of Aquarium Fish Keeping, may you develop a lifelong passion for the underwater world, promoting responsible pet ownership and contributing to the broader goals of environmental conservation.

Best wishes for your Skill Enhancement Course on Aquarium Fish Keeping under NEP 2020.

OBJECTIVES:

- Introduce students to the fundamental principles of aquarium fish keeping.
- Provide hands-on experience in setting up and maintaining aquariums.
- Familiarize students with various species of aquarium fish suitable for captivity.
- Teach the importance of water quality and its impact on aquatic life.
- Develop practical skills in designing aesthetically pleasing aquascapes.
- Offer insights into potential career paths related to aquaculture, aquatic ecology, and conservation.
- Foster a deeper appreciation for aquatic ecosystems and biodiversity.
- Encourage responsible and sustainable practices in the management of aquatic environments.
- Align with the skill development goals of the National Education Policy 2020 (NEP 2020) to enhance students' practical abilities.

STRUCTURE OF THE COURSE:

SEMESTER II

ZOOLOGY- SKILL ENHANCEMENT COURSE 1 (USZOSEC204)

COURSE CODE	COURSE TITLE	Unit	Title	CREDITS	NO. OF LECTURES
USZOSEC204	**Aquarium Fish keeping**	1	Introduction to Aquarium fish keeping	**1**	**15**
		2	Fish Nutrition and aquarium maintenance		
		3	Fish Breeding		
			Practical based on three units	**1**	**30**

Syllabus for (F.Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Aquarium Fish keeping**
Course Code (refer to student handbook)	USZOSEC204
Class	F.Y.B.Sc.
Semester	01
No of Credits	02
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core Minor
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: Aquarium fish keeping

Curriculum:

CO1-Students will be able to understand the basic principles aquarium fish keeping

CO2- Students will set up and maintain a healthy aquarium ecosystem, including filtration, lighting and water quality control.

CO3- Identify common diseases in aquarium fish and implement preventive measures.

CO4- Apply appropriate treatment methods to address fish health issues.

CO5- Create a visually appealing aquarium with appropriate aqua scaping techniques.

Unit	Title	Learning Points	No of Lectures
I	**Introduction to Aquarium fish keeping**	1.1 Introduction to aquarium fish biology, Types of aquariums and setup requirements, Freshwater Vs. saltwater aquariums 1.2 Understanding the equipment needed for aquarium setup. 1.3 Selecting fish species, Identifying different fish species and their requirements 1.4 Choosing compatible fish species for a community aquarium 1.5 Understanding the role of filtration in maintaining water quality, Types of filtration systems and their pros and cons	**5**
II	**Fish Nutrition and aquarium maintenance**	2.1 Understanding the nutritional requirements of different fish species 2.2 Types of fish food and feeding techniques, preventing overfeeding and managing feeding schedules 2.3 Disease prevention and treatment, Common diseases in aquarium fish. Recognizing signs of illness and stress, Implementing quarantine procedures 2.4 Aquarium maintenance, Water changes and testing, cleaning techniques for aquarium glass, decorations and substrate 2.5 Maintenance of equipment (Filters, heaters, lights)	**5**
III	**Fish Breeding**	3.1 Fish Reproductive Biology- Understanding fish reproductive anatomy and physiology, Differentiating between male and female fish. 3.2 Selecting Breeding Candidates- Identifying healthy, sexually mature fish for breeding, Recognizing signs of readiness for breeding. 3.3 Breeding Setups- Setting up breeding tanks and their specifications, Choice of breeding media (e.g., spawning mops, caves, or plants). 3.4 Spawning Techniques- Introduction to different spawning methods, Inducing breeding through environmental cues.	**5**

		3.5 Egg Care and Hatching- Care and protection of fish eggs, Monitoring egg development and maintaining water quality, Feeding fry with appropriate food sources.	

Sr. No.	PRACTICAL	1 Credit
1.	Assess the compatibility of different fish varieties in a community tank.	
2.	Study the behavior and preferences of different fish varieties.	
3.	Estimation of Nitrite and nitrate levels from water sample.	
4.	Investigate the impact of different water change frequencies on ammonia, nitrite, and nitrate levels.	
5.	Explore the correlation between nitrite and nitrate levels.	
6.	Determine the stability of pH levels in your aquarium.	
7.	Compare the effectiveness of natural materials (e.g., crushed coral) and chemical buffers in stabilizing pH.	
8.	Preparation of artificial fish feed (e.g., flakes, granules, pellets etc.)	
9.	Culture of live feed for fishes.	
10.	Investigate the impact of different feeding frequencies on fish health and water quality.	
11.	Observe the impact of overfeeding or other factors on ammonia levels.	
12.	Evaluate the effectiveness of your aquarium filter.	

REFERENCES AND ADDITIONAL READING

1. The Complete Idiot's Guide to Freshwater Aquariums" by Mike Wickham
2. The Simple Guide to Freshwater Aquariums" by David E. Boruchowitz
3. Fish Nutrition and Aquarium Maintenance:
4. Aquarium Care of Goldfish" by David E. Boruchowitz
5. Aquarium Plants: Their Identification, Cultivation, and Ecology" by Karel Rataj and Thomas J. Horeman
6. The 101 Best Tropical Fishes: How to Choose and Keep Hardy, Brilliant, Fascinating Species That Will Thrive in Your Home Aquarium" by Kathleen Wood
7. Breeding Aquarium Fishes: A Complete Introduction" by Herbert R. Axelrod and Warren E. Burgess,

Evaluation Pattern:

A. Internal Evaluation- 40 % 20 Marks

Method	Marks
Class Test	10
Assignment	10
Total	**20**

B. External Evaluation – 60 %

Semester End Evaluation (Paper Pattern)- 30 Marks

MCQ based semester end examination (30 marks):

Question Paper Pattern

1. There shall be 45 MCQs in a test paper, (15 MCQs/unit).
2. Out of these 45 MCQs, any 30 MCQs to be attempted.
3. Each MCQ carries 1 mark.
4. First 30 attempted MCQs will be considered while checking the answers.
5. There will be no negative marking for wrong answers.
6. Test duration will be one hour.

Distribution of marks for MCQ based external examination (30 marks)

Time: 1.0 hours **Total marks: 30**

Total MCQs	To be attempted	Marks per MCQ	MCQs/Unit
45	30	30	15

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	**05**
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	**30**
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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NAAC accredited 'A' Grade (3rd Cycle)

Ratnagiri-415612 (Maharashtra-India)

F. Y. B. Sc. SYLLABUS FOR OPEN ELECTIVES (OE) IN ZOOLOGY

Health and Hygiene

Department of Zoology Under NEP 2020

Framed According to the National Education Policy (NEP 2020)

To be implemented from Academic Year: 2023-2024

PREAMBLE:

The National Education Policy 2020 represents a significant milestone as it marks the first education policy of the 21st century in our country. The primary goal is to transform pedagogy to render education more holistic, integrated, discovery-driven, learner-centric, flexible, and enjoyable. Simultaneously, it aims to make education more relevant and fulfilling for learners while equipping them for gainful and satisfying employment opportunities. Environmental education has gained increasing importance, prompting educational institutions to engage more actively in conservation initiatives.

One of the most significant aspects of this policy is its emphasis on subject flexibility, allowing learners to align their educational paths with their individual talents and interests. It advocates reducing the curriculum content to prioritize essential learning and encourage critical thinking, creativity, multidisciplinary, and the assimilation of new knowledge in rapidly evolving fields. The syllabus not only provides pedagogical guidance but also outlines clear objectives and desired outcomes for each topic, benefiting both teachers and students.

In keeping with the visionary principles outlined in the National Education Policy (NEP) of 2020, we are delighted to introduce an open elective focused on Health and Hygiene for first-year students pursuing a Bachelor of Science (B.Sc.). This open elective is thoughtfully designed to provide students with a dynamic and inclusive learning experience that aligns seamlessly with the transformative ethos of NEP 2020.

NEP 2020 is all about putting students at the center of their education. It means you get to choose what you're interested in and what matches your skills and future career goals. Our Health and Hygiene elective is a great example of this freedom and creativity. It's here to help you learn about health in a comprehensive way, and it will encourage you to think critically, explore science, and see how different subjects connect.

The success of this revamped syllabus hinges on the dedication and enthusiasm of educators, which has been consistently high throughout the process. To further support teachers, textbooks aligned with the new National Education Policy 2020 are being published for the first time. This course is designed to be dynamic and interactive, aiming to cultivate skilled professionals equipped with both knowledge and practical expertise.

OBJECTIVES:

1. Promote awareness of holistic health encompassing physical, mental, and social well-being.
2. Educate students about preventive health practices, including hygiene, nutrition, and lifestyle choices.
3. Develop critical thinking skills in evaluating health-related information and decision-making.
4. Encourage scientific inquiry and research within the context of health and hygiene.
5. Foster interdisciplinary connections by exploring the intersections of health with biology, psychology, sociology, and environmental science.
6. Emphasize the importance of community health and well-being, including public health initiatives and healthcare systems.
7. Provide a foundational understanding for students considering careers in healthcare, public health, nutrition, or related fields.

STRUCTURE OF THE COURSE:

SEMESTER I

OPEN ELECTIVE COURSES

OPEN ELECTIVE COURSE CODE	COURSE TITLE	UNIT	TOPICS	CREDITS	NO. OF LECTURES
USZOOOE104	**Health and Hygiene - I**	1	Introduction to personal health and Hygiene	**2**	**30**
		2	Nutrition and health		
		3	Mental Health and well-being		

SEMESTER II

OPEN ELECTIVE COURSES

OPEN ELECTIVE COURSE CODE	COURSE TITLE	UNIT	TOPICS	CREDITS	NO. OF LECTURES
USZOOOE204	**Health and Hygiene - II**	1	Reproductive Physiology	**2**	**30**
		2	Reproductive health and wellness		
		3	Reproductive hygiene		

Syllabus for (F.Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Health and Hygiene - I**
Course Code (refer to student handbook)	USZOOOE104
Class	F.Y.B.Sc.
Semester	01
No of Credits	02
Nature	Theory
Type (applicable to NEP only)	Open Elective
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: Health and Hygiene-I

Course Outcomes:

CO1: Students will acquire comprehensive understanding of the principles and practices related to personal health and hygiene

CO2: Students will learn practical strategies to promote healthy lifestyle and develop habits that contribute to over-all wellbeing.

CO3: Students will understand the fundamental principles of mental health and its critical role in overall well-being.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Introduction to personal health and Hygiene**	Introduction to health 1.1 Definition of health, Health Education the need for health education and health goal. 1.1.2 Physical, psychological and social health issues 1.1.3 Definition and importance of personal health and hygiene 1.1.4 Factors influencing personal health 1.1.5 Health promotion and disease prevention 1.2 Personal Hygiene practices 1.2.1 Hand hygiene and proper handwashing Techniques 1.2.2 Oral hygiene, brushing, flossing and Mouthwash 1.2.3 Body hygiene, bathing, skin and grooming	10
II	**Nutrition and health**	2.1 Nutrition and Healthy Eating Habits 2.1.1 Importance of nutrition for overall health and well-being 2.1.2 Macronutrients- Carbohydrates, proteins and fats: function, sources and recommended intake 2.1.3 Micronutrients – Vitamins and minerals: functions. Sources, and deficiency risks, role in supporting various physiological processes 2.1.4 Dietary guidelines: Recommended daily allowances (RDAs), Food pyramid/plate and balanced diet concept. 2.1.5 Caloric needs and expenditure, Basal metabolic rate (BMR) and factors affecting it 2.2 Special dietary needs 2.2.1 Nutrition during different life Stages (Pregnancy, infancy, aging) 2.2.2 Dietary considerations for athletes and physically active individuals 2.2.3. Health effects of poor nutrition 2.2.4 Diet and disease prevention 2.2.5 Nutritional assessments	10

III	**Mental Health and well-being**	2.1 Mental Health 2.1.1Understanding mental health and its impact on overall well-being 2.1.2 Common mental health disorders (anxiety, depression, bipolar disorder) 2.1.3 Factors influencing mental health 2.1.4. Stress management techniques 2.1.5 Building resilience and positive coping Strategies 2.2 Sleep and Rest 2.2.1 Importance of sleep for health 2.2.2 Sleep hygiene practices 2.2.3 Strategies for improving sleep quality Benefits of physical activity 2.2.4 Digital devices and sleep: Impact of screen time on sleep quality, establishing technology free zones before sleep 2.2.5 Sleep and physical health: impact of sleep on immune function, metabolism and cardiovascular health	10

Learning resources recommended:

1. An Introduction to Community Health" by James F. McKenzie and Robert R. Pinger
2. Nutrition: Concepts and Controversies" by Frances Sizer and Ellie Whitney
3. Nutrition for Health, Fitness, and Sport" by Melvin H. Williams and Eric Rawson
4. Mental Health: A Person-Centred Approach" by Nicholas Procter and Helen P. Hamer
5. Introduction to Psychology" by James W. Kalat
6. Community and Public Health Nursing: Evidence for Practice" by Gail A. Harkness and Rosanna DeMarco
7. Health Promotion in Nursing Practice" by Nola J. Pender, Carolyn L. Murdaugh, and Mary Ann Parsons
8. Health and Wellness" by Gordon Edlin and Eric Galanty
9. The Human Body Book: An Illustrated Guide to its Structure, Function, and Disorders" by Richard Walker
10. Nutrition Science" by B. Srilakshmi
11. Public Health and Community Medicine" by K. Park
12. Mental Health: The Indian Perspective" by D. Nagaraja Rao
13. Health Education and Community Pharmacy" by Parveen Kumar
14. Nutrition and Dietetics" by Shubhangini A. Joshi
15. Hygiene and Sanitation" by R.K. Bansal
16. Mental Health Care in India: Current Issues and Emerging Perspectives" by S. K. Chaturvedi and Ajit Avasthi
17, Practical Community Medicine" by R. H. Sinha

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	Marks
Class Test	20
Assignment	10
Classroom performance	05
Attendance	05
Total	**40**

B. External Evaluation – 60 %

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 15 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (40 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	1	15
2.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	2	15
3.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	3	15
4.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3	15

Syllabus for (F.Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Health and Hygiene - II**
Course Code (refer to student handbook)	USZOOE204
Class	F.Y.B.Sc.
Semester	02
No of Credits	02
Nature	Theory
Type (applicable to NEP only)	Open Elective
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: Health and Hygiene-II

Course Outcomes:

CO1: Understand the anatomy and physiology of the reproductive system

CO2: Identify common sexually transmitted infections, their causes, symptoms and preventive measures

CO3: Understand the psychological and social aspects of reproductive health.

CO4: Knowledge of reproductive hygiene practices and their significance

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Reproductive Physiology**	**1.1 Introduction to reproductive health and hygiene** 1.1.1 Definition and importance of reproductive health 1.1.2 Key concepts in reproductive hygiene **1.2 Reproductive Anatomy and Physiology** 1.2.1 Male reproductive system, structure and Function 1.2.2 Regulation of male reproductive system 1.2.3 Female reproductive system, structure and Function 1.2.4 Menstrual cycle and hormonal regulation 1.2.5 Pregnancy and Hormonal changes 1.2.6 Menopause and aging 1.2.7 Assisted Reproductive technologies (ART)	10
II	**Reproductive health and wellness**	**1.3 Contraception and family planning** 1.3.1 Barrier methods (e.g. condoms diaphragms) 1.3.2 Hormonal methods (e.g. birth control pills, patches, injections) 1.3.3 Long-acting reversible contraceptives (e.g. intrauterine devices, implants) 1.3.4 Emergency contraception **1.4. Infertility and reproductive disorders:** 1.4.1 causes of male and female infertility, 1.4.2 diagnosis, treatment options and emotional aspects **1.5 Sexually transmitted infections (STIs)** 1.5.1Common STIs, causes, symptoms and complications 1.5.2 Prevention, testing and treatment of STIs 1.5.3 Sexual health education and safe practices	10
III	**Reproductive hygiene**	**2.1. Reproductive hygiene and self-care** 2.1.1 Menstrual health management 2.1.2 Personal hygiene practices 2.1.3 Maintaining a healthy reproductive system 2.1.4 Emotional wellbeing and self-care	10

		2.2 Social and Psychological aspects of Reproductive Health 2.2.1 Gender roles and reproductive health 2.2.2 Relationships and communication 2.2.3 Sexual consents and rights 2.2.4 Reproductive health disparities	

Learning resources recommended:

1. Guyton and Hall Textbook of Medical Physiology by John E. Hall
2. Reproductive Health and Wellness by K. D. Chavan
3. Reproductive Health: Global Issues, Challenges, and Strategies edited by Justin C. Konje and Omrana Pasha
4. Reproductive Hygiene by M. V. Thambi
5. Essentials of Reproductive Health by P. S. Bhatia and T. K. Dutta
6. Textbook of Reproductive Medicine edited by Sudha Salhan and Manju Puri
7. Women's Reproductive Health edited by P. Sinha and S. C. Shukla
8. Textbook of Human Reproductive Genetics by Aruna M. Raichur and Latha N. Shenoy
9. Textbook of Assisted Reproductive Techniques by Gita Khanna
10. Reproductive Endocrinology and Infertility: Integrating Modern Clinical and Laboratory Practice by Bharti Kalra and Shashank Joshi
11. Textbook of Gynaecology by Richa Saxena
12. Community Medicine: A Students Manual by Parikshit Sanyal
13. Women's Health and Reproductive Medicine edited by Duru Shah and Rishma Dhillon Pai.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class Test	20
Assignment	10
Classroom performance	05
Attendance	05
Total	**40**

B. External Evaluation – 60 %

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 15 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (40 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	1	15
2.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	2	15
3.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	3	15
4.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3	15

R.E. Society's

R. P. GOGATE COLLEGE OF ARTS & SCIENCE AND R.V. JOGALEKAR COLLEGE OF COMMERCE, RATNAGIRI (AUTONOMOUS)

NAAC accredited 'A' Grade (3rd Cycle)

Ratnagiri-415612 (Maharashtra-India)

Bachelor of Science (B. Sc.) Programme

Program: S.Y.B. Sc.
Course: Zoology

Syllabus for Semester III & IV

Under Choice Based Credit System (CBCS)

To be implemented from Academic Year 2023-2024

PREAMBLE:

Welcome to the next level of your academic journey in the field of Zoology! As you enter the Second Year of your Bachelor of Science (B. Sc.), this syllabus is designed to build upon the foundational knowledge and insights gained in your first year, delving deeper into the captivating world of zoological science.

Zoology continues to be an awe-inspiring exploration of the diverse life forms that inhabit our planet. It encompasses the scientific study of animals in all their glory, from their molecular and cellular makeup to their complex behaviors, ecological roles, and evolutionary histories. In this year, we aim to further refine your understanding of the intricate relationships and processes that define the animal kingdom.

Throughout this course, you will embark on a more in-depth journey into various branches of zoological science. You will study advanced topics in animal physiology, morphology, taxonomy, and ecology. You will explore the remarkable adaptations that have allowed different species to thrive in their respective environments, and you will delve into the fascinating world of animal behavior and evolution.

The Second Year of your B. Sc. in Zoology is designed to challenge your analytical and critical thinking abilities. It will encourage you to apply your knowledge to real-world scenarios, fostering a deeper understanding of the role of animals in ecosystems and the importance of conservation efforts in preserving our planet's biodiversity.

As you progress through this year, we encourage you to actively engage with the subject matter, participate in practical work, and explore research opportunities that may arise. Zoology is not just a field of study; it's a gateway to discovering the wonders of life on Earth, and it equips you with valuable skills and insights that are relevant in various scientific and conservation-related careers.

We hope that this year of your B. Sc. in Zoology will inspire you to delve even deeper into the intricacies of the animal kingdom, and that you will continue to approach your studies with curiosity, dedication, and a passion for scientific exploration.

May your journey in the Second Year of Bachelor of Science in Zoology be filled with exciting discoveries, intellectual growth, and a profound appreciation for the remarkable world of animals.

Best wishes for your continued academic and scientific pursuits.

Chairperson
BOS in Zoology
Gogate Jogalekar College,
Ratnagiri.

Syllabus for S. Y. B. Sc. Course: ZOOLOGY
Credit Based Semester and Grading System
(To be implemented from the Academic Year 2023-2024)

SEMESTER – III

COURSE CODE	UNIT	TOPIC	CREDITS	LECTURES /WEEK
USZO301	I	Fundamentals of Genetics	2	1
	II	Chromosomes and Heredity		1
	III	Nucleic acids		1
USZO302	I	Nutrition and Excretion	2	1
	II	Respiration and Circulation		1
	III	Control and Coordination of Life Processes, Locomotion and Reproduction		1
USZO303	I	Ethology	2	1
	II	Parasitology		1
	III	Economic Zoology		1
USZOP3		Practicals based on all three courses	03	9

SEMESTER – IV

COURSE CODE	UNIT	TOPIC	CREDITS	LECTURES /WEEK
USZO401	I	Origin and Evolution of Life	2	1
	II	Population Genetics and Evolution		1
	III	Scientific Attitude Methodology Scientific Writing and Ethics in Scientific Research		1
USZO402	I	Cell Biology	2	1
	II	Endomembrane System		1
	III	Biomolecules		1
USZO403	I	Comparative Embryology	2	1
	II	Aspects of Human Reproduction		1
	III	Pollution and its Effect on Organisms		1
USZOP3		Practicals based on all three courses	03	9

Syllabus for (S.Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Fundamentals of Genetics, Chromosomes, Heredity and Nucleic acids**
Course Code (refer to student handbook)	USZO301(Course-V)
Class	S. Y. B. Sc.
Semester	03
No of Credits	03
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 word	

Nomenclature: Fundamentals of Genetics, Chromosomes, Heredity and Nucleic acids

Course Outcomes:

CO1- Learner would comprehend and apply the principles of inheritance to study heredity.
CO2 - Learner will understand the concept of multiple alleles, linkage and crossing over.
CO3 - Learner will comprehend the structure of chromosomes and its types.
CO4 - Learner will understand the mechanisms of sex determination.
CO5- Learner would be able to correlate the disorders linked to a particular sex chromosome.
CO6 - Learner will understand the importance of nucleic acids as genetic material.
CO7 - Learner would comprehend and appreciate the regulation of gene expressions.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Fundamentals of Genetics**	**1.1 Introduction to Genetics** • Definition, Scope and Importance of Genetics. • Classical and Modern concept of Gene (Cistron, Muton, Recon). • Brief explanation of the following terms: Allele, Wild type and Mutant alleles, Locus, Dominant and Recessive traits, Homozygous and Heterozygous, Genotype and Phenotype, Genome. **1.2 Mendelian Genetics** • Mendelian Genetics: Monohybrid & Dihybrid Cross, Test Cross, Back Cross, Mendel's Laws of Inheritance, Mendelian Traits in Man. • Exceptions to Mendelian inheritance: Incomplete dominance, Co- dominance, Lethal Genes, Epistasis - Recessive, Double recessive, Dominant and Double dominant. • Chromosome theory of inheritance. • Pedigree Analysis-Autosomal dominant and recessive, X- linked dominant, and recessive. **1.3 Multiple Alleles and Multiple Genes** • Concept of Multiple Alleles, Coat colour in rabbit, ABO and Rh blood group system • Polygenic inheritance with reference to skin colour and eye colour in humans. • Concept of Pleiotropy. **1.4 Linkage and Crossing Over** Linkage and crossing over, Types of crossing over, Cytological basis of crossing over.	**15**
II	**Chromosomes and Heredity**	**2.1 Chromosomes** • Types of Chromosomes–Autosomes and Sex chromosomes • Chromosome structure - Heterochromatin, Euchromatin • Classification based on the position of	**15**

		centromere • Endomitosis, Giant chromosomes- Polytene and Lampbrush chromosomes and Significance of Balbiani rings **2.2 Sex-determination** • Chromosomal Mechanisms: XX-XO, XX-XY, ZZ-ZW • Sex determination in Honey bees: Haplo-diploidy • Sex determination in *Drosophila*- Genic balance theory, Intersex, Gynandromorphs • Parthenogenesis • Hormonal influence on sex determination- Freemartin and Sex reversal. • Role of environmental factors-*Bonelia* and Crocodile • Barr bodies and Lyon hypothesis **2.3 Sex linked, sex influenced and sex-limited Inheritance.** • X-linked: Colour-blindness, Haemophilia • Y-linked: Hypertrichosis • Sex-influenced genes • Sex-limited genes	
III	**Nucleic acids**	**3.1 Genetic material** • Griffith's transformation experiment, Avery-Macleod & McCarty experiment and Hershey Chase experiment of Bacteriophage infection. • Chemical composition and structure of nucleic acids • Double helix nature of DNA, Solenoid model of DNA • Types of DNA– A, B, Z & H forms • DNA in Prokaryotes- Chromosomal and Plasmid • Extranuclear DNA-Mitochondria and Chloroplast • RNA as a genetic material in virus • Types of RNA: Structure and function **of genetic information in a Eukaryotic Cell** • DNA Replication • Transcription of mRNA • Translation • Genetic code **3. 3 Gene expression and regulation** • One gene-one enzyme hypothesis/one polypeptide hypothesis • Concept of Operon • Lac Operon	**15**

	Practical USZOP3 (Course-V)	
1.	Extraction and detection of DNA.	**1 Credit**
2.	Extraction and detection of RNA.	
3.	Mounting of Barr bodies.	
4.	Study of polytene chromosome.	
5.	Study of mitosis-temporary squash preparation of Onion root tip.	
6.	Detection of blood groups and Rh factor.	
7.	Problems in Genetics a) Monohybrid/Dihybrid Cross: b) X- linked inheritance: c) Multiple Alleles	
8.	Chromosome morphology: (photographs to be provided).	
9.	Pedigree analysis.	
10.	Problems based on molecular biology.	
11.	Maintenance of Drosophila culture, identify male and female flies, and identifying different larval stages.	

N. B:

I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

II) Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority/Body from time to time, every college should constitute the following Committees:

1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and
2) A Dissection Monitoring Committee (DMC)

Composition of DMC shall be as follows:

i) Head of the Concerned Department (Convener/Chairperson)
ii) Two Senior Faculty Members of the concerned Department
iii) One Faculty of related department from the same College.
One or two members of related department from neighboring colleges

USE OF ANIMALS FOR ANY EXPERIMENT/DISSECTION/MOUNTING IS BANNED. SIMULATIONS, AUTHORISED PERMANENT SPECIMENS/SLIDES, CHARTS, MODELS AND OTHER INNOVATIVE METHODS ARE ENCOURAGED.

Learning Resources recommended:

1. Principles of Genetics. Gardner, E. J., Simmons, M.J and Snustad, D.P. John Wiley and Sons Concepts of Genetics. Klug, W. S., Cummings M.R., Spencer, C.A. Benjamin Cummings.
2. Genetics-A Molecular Approach. Russell, P.J. Benjamin Cummings.
3. Genetics: Analysis of Genes and Genomes. Daniel L., Hartl, Elizabeth W. Jones & Bartlett Publishers.
4. Introduction to Genetic Analysis. Griffiths, A. J. F., Wessler. S.R., Lewontin, R.C. and Carroll, S. B. W. H. Freeman and Co.
5. Cell Biology Genetics, Molecular Biology Evolution and Ecology Verma P.S. and Agrawal 9th Edition, Chand Publications, New Delhi.
6. Principles of Genetics – Eight edition- Eldon john Gardner, Michael J. Simmons, D. Peter Snustad.
7. Genetics-Weaver, Hedrick, third edition, McGraw Hill Education.
8. Genetics A Mendelian approach Peter J. Russel, Pearson Benjamin Cummings.
9. Genetics A conceptual approach, Benjamin A. Pierce, Southwestern University, W.H. Freeman and company, New York.
11. Genetics, Third Edition, Monroe W. Strickberger.
12. Genetics from gene to genome, third edition, Leela and H. Hartwell, Leeroy Hood, Michael7. L. Goldberg, Ann E. Reynolds, Lee M. Silver, McGraw Hill Education.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class Test	20
Assignment	10
Classroom performance	05
Attendance	05
Total	**40**

B. External Evaluation – 60 %

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 15 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (40 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	1	15
2.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	2	15
3.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	3	15
4.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3	15

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	**05**
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	**30**
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (S.Y.B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Life Processes**
Course Code (refer to student handbook)	USZO302 (COURSE-VI)
Class	S.Y.B. Sc.
Semester	III
No of Credits	03
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: Life processes

CO1- Learner would understand the increasing complexity of nutritional, excretory and osmoregulatory physiology in evolutionary hierarchy.

CO2- Learner would be able to correlate the habit and habitat with nutritional, excretory and osmoregulatory structures.

CO3- Learner would understand the increasing complexity of respiratory and circulatory physiology in evolutionary hierarchy.

CO4- Learner will be able to correlate the habit and habitat of animals with respiratory and Circulatory organs.

CO5- Learner would understand the process of control and coordination by nervous and endocrine regulation.

CO6- Learner would be amazed by various locomotory structures found in the animal kingdom.

CO7- Learner would be acquainted with various reproductive strategies present in animals.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Nutrition and Excretion**	**1.1Comparative study of nutritional apparatus** (structure and function): Amoeba, Hydra, Cockroach, Amphioxus, Pigeon, Ruminants **1.2 Physiology of digestion in man.** **1.3** Comparative study of excretory and osmoregulatory structures and functions. a) Amoeba-Contractile vacuole b) Planaria-Flame cells **1.4 Cockroach**-Malpighian tubules Categorization of animals based on principle nitrogenous excretory Products **1.5** Structure of kidney, uriniferous tubule and physiology of urine Formation in man	**15**
II	**Respiration and Circulation**	**2.1Comparative study of respiratory organs** (structure and function) Earthworm, Spider, Any bony fish (Rohu */ Anabas /Clarius),* Frog and Pigeon. **2.2 Structure of lungs and physiology of respiration in man** **2.3 Comparative study of circulation** (a) Open and Closed type, (b) Single and Double type. **2.4 Types of circulating fluids** - Water, Coelomic fluid, Haemolymph, Lymph and Composition of blood **2.5 Comparative study of hearts** (structure and function) Earthworm, Cockroach, Shark, Frog, Crocodile and Pigeon. **2.6 Structure and mechanism of working of heart**	**15**

		in man.	
III	**Control and Coordination, Locomotion and Reproduction**	**3.1 Control and co-ordination** • Irritability in *Paramoecium*, nerve net in *Hydra*, nerve ring and nerve cord in earthworm. • Types of neurons based on the structure and function. • Conduction of nerve impulse: Resting potential, Action potential and Refractory period • Synaptic transmission **3.2 Movement and Locomotion** Locomotory organs-structure and functions; *a.* Pseudopodia in Amoeba (Sol-Gel theory), Cilia in *Paramoecium* *b.* Wings and legs in cockroach c. Tube feet in starfish d. Fins of fish **3.3** Structure of striated muscle fibre in human and sliding filament theory **3.4 Reproduction** **a. Asexual Reproduction**- Fission, Fragmentation, Gemmule formation and Budding **b. Sexual reproduction** i. Gametogenesis ii. Structure of male and female gametes in human iii. Types of fertilization iv. Oviparity, Viviparity, Ovo-viviparity	**15**

	Practical USZOP3 (Course-VI)	
1.	Urine analysis—Normal and Abnormal constituents.	**1Credit**
2.	Detection of ammonia excreted by fish from aquarium water.	
3.	Detection of uric acid from excreta of birds.	
4.	Study of striated and non-striated muscle fibres.	
5.	Study of nutritional apparatus (Amoeba, Hydra, Earthworm, Pigeon, Ruminant stomach).	
6.	Study of respiratory structures: a. Gills of bony fish and cartilaginous fish b. Lungs of frog c. Lungs of mammal *d.* Accessory respiratory structure in *Anabas*/ *Clarius* e. Air sacs of Pigeon	
7.	Study of locomotory organs (Amoeba, Bivalve, Cockroach, Starfish, Fish, and Bird).	
8.	Study of different types of hearts (Cockroach, Shark, Frog, Garden lizard, Crocodile and Mammal).	

9.	Study of permanent slides on Reproduction: (a)Sponge gemmules, (b) Hydra budding, (c) T.S. of mammalian testis, (d)T.S. of mammalian ovary.	

N. B:

I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

II) Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority/Body from time to time, every college should constitute the following Committees:

2) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and

2) A Dissection Monitoring Committee (DMC)

Composition of DMC shall be as follows:

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ii) Two Senior Faculty Members of the concerned Department
iii) One Faculty of related department from the same College.
One or two members of related department from neighboring colleges

USE OF ANIMALS FOR ANY EXPERIMENT/DISSECTION/MOUNTING IS BANNED. SIMULATIONS, AUTHORISED PERMANENT SPECIMENS/SLIDES, CHARTS, MODELS AND OTHER INNOVATIVE METHODS ARE ENCOURAGED.

Learning Resources recommended:

1. Vertebrate Zoology Volume I- Jordan and Verm, S. Chand and Co.
2. Invertebrate Zoology Volume II- Jordan and Verma, S. Chand and Co.
3. Invertebrate Zoology-Majupuria T.C., Nagin S. and Co.
4. Chordate Zoology- Dhami P. S. and Dhami J. K., R. Chand and Co.
5. Invertebrate Zoology-Dhami P. S. and Dhami J. K., R. Chand and Co.
6. Introduction to Vertebrates- Moore Cambridge University-Low Priced Edition.
7. Zoology-Miller S. A. and Harley J.B., Tata McGraw Hill.
8. Modern Textbook of Zoology, Invertebrates, Kotpal R.L
9. Biological Science, Taylor D.J., Stout G.W., Green N.P.O, Soper R., Cambridge University Press.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class Test	20
Assignment	10
Classroom performance	05
Attendance	05
Total	**40**

B. External Evaluation – 60 %

Semester End Evaluation (Paper Pattern)- 60 Marks

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3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (40 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	1	15
2.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	2	15
3.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	3	15
4.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3	15

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	**05**
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	**30**
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (S.Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Ethology, Parasitology, Economic Zoology**
Course Code (refer to student handbook)	USZOO303 (Course-VII)
Class	S.Y.B. Sc.
Semester	III
No of Credits	03
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: **Ethology, Parasitology, Economic Zoology**

CO1- Learner would gain insight into different types of animal behaviour and their role in biological adaptations.

CO2- Learner would be sensitized to the feelings which are instrumental in social behaviour.

CO3-Learner would understand the general epidemiological aspects of parasites that affect humans and take simple preventive measures for the same.

CO4- Learner would comprehend the life cycle of specific parasites, the symptoms of the disease and its treatment.

CO5- Learner would gain knowledge on animals useful to mankind and the means to make the most of it.

CO6- Learner would learn the modern techniques in animal husbandry and would pursue entrepreneurship as a career.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Ethology**	**1.1 Introduction to Ethology** • Definition, History and Scope of Ethology • Animal behaviour: Innate and Learned behaviour • Types of learning: Habituation, Imprinting and Types of imprinting – Filial and sexual, Classical conditioning. • Instrumental learning and insight learning. **1.2 Aspects of animal behaviour:** • Communication in bees and ants • Mimicry and colorations • Displacement activities, Ritualization • Migration in fish, schooling behavior • Habitat selection, territorial behaviour. **1.3 Social behaviour:** • Social behavior in primates –Hanuman langur • Elements of socio-biology: Altruism and Kinship	**15**
II	**Parasitology**	**2.1 Introduction to Parasitology and Types of Parasites** • Definitions: Parasitism, Host, Parasite, Vector-biological and mechanical • Types of parasites- Ectoparasite, Endoparasite and their subtypes • Parasitic adaptations in Ectoparasites and Endoparasites • Types of hosts: Intermediate and definitive, reservoir **2.2 Host-parasite relationship and host specificity** • Different types of hosts- parasite relationship, structural specificity, physiological specificity and ecological specificity **2.3 Lifecycle, pathogenicity, control measures and treatment** • *Entamoeba histolytica, Fasciola hepatica, Taenia solium, Wuchereria bancrofti* **2.4 Morphology, life cycle, pathogenicity, control**	**15**

		measures and treatment • Head louse (*Pediculus humanus capittis*), Mite (*Sarcoptes scabei)*, Bedbug (*Cimex lectularis)* **2.5 Parasitological significance** • Zoonosis-Bird flu, Anthrax, Rabies and Toxoplasmosis	
III	**Economic Zoology**	**3.1 APICULTURE** **3.1.1 Methods of bee keeping and management** • Introduction to different species of honey bees used in apiculture. • Selection of flora and bees for apiculture. • Advantages and disadvantages of traditional and modern methods of apiculture. • Pests and Bee Enemies-Wax moth, wasp, black ants, bee-eaters, king crow and disease control **3.1.2 Economic importance** • Honey-Production, chemical composition and economic importance • Bee wax- Composition and economic importance. • Role of honey bee in pollination. **3.2 VERMICULTURE** **3.2.1 Rearing methods, management and economic importance** • Introduction to different species of earthworms used in vermiculture. • Methods of vermiculture. • Maintenance and harvesting • Economic importance: Advantages of vermiculture, demand for earthworms; market for vermicompost and scope for entrepreneurship. **3.3 DAIRY SCIENCE** **3.3.1 Dairy development in India** • Role of dairy development in rural economy, employment opportunities **3.3.2 Dairy Processing** • Filtration, cooling, chilling, clarification, pasteurization, freezing **3.3.3 Milk and milk products** • Composition of milk • Types of milk: a) Buffalo milk b) Cow milk (A1&A2) • Whole milk and toned milk, Milk products	**15**

	Practical USZOP3 (Course-VII)	**1 Credit**
1.	Extraction of casein from milk and its qualitative estimation.	
2.	Preparation of paneer from given milk sample.	
3.	Measurement of density of milk using different samples by Lactometer.	

4.	Study of Honey Bee: a) Lifecycle of Honey Bee and Bee Hive b) Mouthparts of Honey Bee c) Legs of Honey Bee d) Sting Apparatus of Honey Bee	
5.	Study of ethological aspects: a) Warning colouration. b) Animal instinct c) Imprinting d) Communication in animals: Chemical signals and Sound signals e) Displacement activities in animals: Courtship and mating behavior in animals and Ritualization.	
6.	Study of Protozoan parasites: *a. Trypanosoma gambiense* *b. Giardia intestinalis*	
7.	Study of Helminth parasites: *a. Ancylostoma duodenale* *b. Dracunculus medinensis*	
8.	Parasitic adaptations: Scolex and mature proglottid of Tapeworm	
9.	Study of Ectoparasites: a) Leech b) Tick c) Mite	
10.	Project- Suggested topics on economic zoology (e.g. Apiculture / Sericulture/Lac culture/ Vermicompost technique / Construction Of artificial beehives/Animal husbandry/ Aquaculture /any other)	

N. B:

I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

II) Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority/Body from time to time, every college should constitute the following Committees:

3) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and

2) A Dissection Monitoring Committee (DMC)

Composition of DMC shall be as follows:

k) Head of the Concerned Department (Convener/Chairperson)

ii) Two Senior Faculty Members of the concerned Department

iii) One Faculty of related department from the same College.

One or two members of related department from neighboring colleges

USE OF ANIMALS FOR ANY EXPERIMENT/DISSECTION/MOUNTING IS BANNED. SIMULATIONS, AUTHORISED PERMANENT SPECIMENS/SLIDES, CHARTS, MODELS AND OTHER INNOVATIVE METHODS ARE ENCOURAGED.

Learning Resources recommended:

1. Animal Behaviour-David McFarland
2. Animal Behaviour-Mohan Arora
3. Animal Behaviour- Reena Mathur
4. An introduction to Animal Behaviour-Dawkins
5. Animal Behaviour-Agarwal
6. Animal Behaviour-Tinbergen
7. Biology of Insects- 1992 Saxena S. C. Oxford and IBH Publishing Co New Delhi. Bombay. Calcutta
8. Bee and Bee Keeping- Roger A. Morse, Cornell University Press London
9. Vermiculture Technology- Clive A. Edwards, Norman Q. Arancon and Rhonda Sherman
10. Parasitology-Chatterjee K.D., Chatterjee Medical Publishers.
11. Medical Parasitology- Arora
12. Textbook of Medical Parasitology- C. K Jayaram Paniker, Jaypee Brothers.
13. A textbook of Parasitology- Kochhar S.K. Dominant Pub. &Dis, New Delhi.
14. Essentials of Parasitology-Gerald D. Schmidt: Universal Bookstall, New Delhi.
15. Introduction to Parasitology- Sharma P. N. and Ratnu L.S., Chand S & Co. Pvt. Ltd.
16. Introduction to Parasitology-Chandler and Read John Wiley& Sons
17. Economic Zoology Biostatistics and Animal behaviour –S. Mathur, Rastogi Publicatons.
18. Economic Zoology-Shukla G.S. & Upadhyay V. B., Rastogi Publications.
19. A handbook on Economic Zoology, S. Chand& Co.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class test	20
Assignment	10
Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 15 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (40 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	1	15
2.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	2	15
3.	Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	3	15
4.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3	15

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (S.Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Population Genetics, Evolution and Research Methodology**
Course Code (refer to student handbook)	USZO401 (Course-VIII)
Class	S.Y.B. Sc.
Semester	IV
No of Credits	03
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: **Population Genetics, Evolution and Research Methodology**

CO1-Learner will gain insights into the origin of life.
CO2-Learner will analyses and critically view the different theories of evolution.
CO3-Learner would understand the forces that cause evolutionary changes in natural populations
CO4- Learner would comprehend the mechanisms of speciation
CO5- Learner will be able to distinguish between microevolution, macroevolution and Mega evolution
CO6- The learner would develop qualities such as critical thinking and analysis,
CO7-The learner will imbibe the skills of scientific communication and he/she will understand the ethical aspects of research

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Origin and Evolution of Life**	**1.1 Introduction** • Origin of the Universe • Chemical evolution - Miller-Urey experiment, Haldane and Oparin theory • Origin of life • Origin of eukaryotic cell **1.2 Evidences in favour of organic evolution** Evidences from geographical distribution, paleontology, anatomy, embryology, physiology and genetics **1.3 Theories of organic evolution** • Theory of Lamarck • Theory of Darwin and Neo- Darwinism • Mutation Theory • Modern synthetic theory, Weismann's Germplasm theory	**15**
II	**Population Genetics and Evolution**	**2.1 Introduction to Population genetics** • Definition Brief explanation of the following terms: Population, Gene pool, Allele frequency, Genotype frequency, Phenotype frequency, Microevolution **2.2 Population genetics** • Hardy-Weinberg Law • Factors that disrupt Hardy Weinberg equilibrium: Mutation, Migration (gene flow), Non-random mating (inbreeding, inbreeding depression, assortative mating (positive and negative), disassortative mating, Genetic drift (sampling error, fixation, bottleneck effect and founder effect) • Natural Selection: Patterns of Natural Selection- Stabilizing selection, Directional selection (examples: pepper red moth, antibiotic resistance in bacteria, pesticide resistance) and Disruptive selection **2.3 Evolutionary genetics**	**15**

		• Genetic variation: Genetic basis of variation- mutations and recombination (crossing over during meiosis, independent assortment of chromosomes during meiosis and random union of gametes during fertilization) • Nature of genetic variations: Genetic polymorphism, Balanced polymorphism, Mechanisms that preserve balanced polymorphism- Heterozygote advantage and frequency dependent selection, • Neutral variations • Geographic variation (Cline) • Species concept: Biological species concept and evolutionary species Concept • Speciation and Isolating mechanisms**:** Definition and modes of speciation (allopatric, sympatric, parapatric and peripatric) • Geographical isolation • Reproductive isolation and its isolating mechanisms (prezygotic and postzygotic) **2.4 Macroevolution and megaevolution**: Concept and Patterns of macroevolution (stasis, preadaptation/exaptation, mass extinctions, Adaptive radiation and coevolution), Mega evolution	
III	**Scientific Attitude Methodology Scientific Writing and Ethics in Scientific Research**	**3.1 Process of science:** • A dynamic approach to investigation: The Scientific method, Deductive reasoning and inductive reasoning, Critical thinking, Role of chance in scientific discovery (serendipity) • Scientific research: Definition, difference between method and methodology, characteristics, types • Steps in the Scientific method: Identification of research problem, formulation of research hypothesis, testing the hypothesis using Experiments or surveys, preparing research/study Design including methodology and execution (appropriate controls, sample size, technically sound, free from bias, repeat experiments for consistency), documentation of data, data analysis and interpretation, results and conclusions. • Dissemination of data: Reporting results to scientific community (publication in peer- reviewed journals, thesis, dissertation, reports, oral presentation, poster presentation) • Application of knowledge: Basic research, Applied research and Translational research **3. 2 Scientific writing:**	**15**

		• Structure and components of a research paper: preparation of manuscript for publication of research paper- title, authors and their affiliations, abstract, keywords and abbreviations, introduction, material and methods, results, discussion, conclusions, acknowledgement, bibliography; figures, tables and their legends **3. 3 Writing a review paper** • Structure and components of review • Report writing and types of report • Computer application: Plotting of graphs, Statistical analysis of data. Internet and its application in research-Literature survey, Online submission of manuscript for publication. **3.4 Ethics** • Ethics in animal research: The ethical and sensitive care and use of animals in research, teaching and testing, approval from Dissection Monitoring Committee (DMC) • Ethics in clinical research: Approval from clinical research ethics Committee or/and informed consent **3.5 Plagiarism**	

	Practical USZOP4 (Course-VIII)	
1.	Study of population density by line transect method & Quadrant method and calculate different diversity indices. • Index of Dominance • Index of frequency • Rarity Index • Shannon Index • Index of species diversity	**1 Credit**
2.	Study of prokaryotic cells (bacteria)by Crystal violet staining technique.	
3.	Study of eukaryotic cells (WBCs)from blood smear by Leishman‘s stain	
4.	Identification and study of fossils: • Arthropods: Trilobite • Mollusca: Ammonite • Aves: Archaeopteryx	
5.	Identification of: • Allopatric speciation (Cyprinodont species) • Sympatric speciation (Hawthorn fly and Apple maggot fly) • Parapatric speciation (Snail)	
6.	Bibliography/Abstract writing	
7.	Preparation of PowerPoint Presentation based on a research paper.	
8.	Report submission on ‘Current issues in Biological sciences’	

N. B:

I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

II) Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority/Body from time to time, every college should constitute the following Committees:

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2) A Dissection Monitoring Committee (DMC)

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Learning Resources recommended:

1. Theory of Evolution-Smith, Cambridge Press, and Low-price Ed.
2. Evolution-Strickberger, CBS publication
3. Evolution-P.S. Verma and Agarwal
4. Introduction to Evolution by Moody
5. Biology. E. P. Solomon, L.R. Berg, D. W. Martin, Thompson Brooks/Cole
6. Biology -The Unity and Diversity of Life**.** C. Starr, R. Taggart, C. Evers, L. Starr, Brooks/Cole Cengage learning International Edition
7. Research Methodology, Methods and Techniques-by C. R. Kothari, Wiley Eastern Ltd. Mumbai
8. Practical research planning and design 2nd edition-Paul D Leedy, Macmilan Publication

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class test	20
Assignment	10
Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 15 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (40 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	1	15
2.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	2	15
3.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	3	15
4.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3	15

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

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Syllabus for (S. Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Ultrastructure of cell organelles and Biomolecules**
Course Code (refer to student handbook)	USZO402 (Course - IX)
Class	S.Y.B. Sc.
Semester	IV
No of Credits	03
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: **Ultrastructure of cell organelles and Biomolecules**

CO1- Learner would acquire insight into the composition of the transport mechanisms adopted by the cell and its organelles for its maintenance and composition of cell.

CO2- Learner would appreciate the intricacy of endomembrane system.

CO3-Learner would understand the interlinking of endomembrane system for functioning of cell

CO4- The learner will realize the importance of biomolecules and their clinical significance.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Cell Biology**	**1.1 Introduction to cell biology** • Definition and scope • Cell theory • Generalized prokaryotic, eukaryotic cell: size, shape and structure **1.2 Nucleus** • Size, shape, number and position • Structure and functions of interphase nucleus • Ultrastructure of nuclear membrane and pore complex • Nucleolus: general organization, chemical composition & functions • Nuclear sap/ nuclear matrix • Nucleocytoplasmic interactions **1.3 Plasma membrane** • Fluid Mosaic Model • Junctional complexes • Membrane receptors • Modifications: Microvilli and Desmosomes **1.4 Transport across membrane** • Diffusion and Osmosis • Transport: Passive and Active • Endocytosis and Exocytosis **1.5 Cytoskeletal structures** • Microtubules: Composition and functions • Microfilaments: Composition and functions	**15**
II	**Endomembrane System**	**2.1 Endoplasmic reticulum** (ER): General morphology of endomembrane system, ultrastructure, types of ER and biogenesis of ER •Functions of Rough Endoplasmic Reticulum (RER) and Smooth Endoplasmic Reticulum (SER) **2.2 Golgi complex**: Ultrastructure of Golgi complex, functions of Golgi complex (protein glycosylation, lipid and polysaccharide metabolism, protein sorting and secretion, Golgi Anti-Apoptotic Protein -GAAP) **2.3 Lysosomes**: Origin, occurrence, polymorphism and functions;	**15**

		Peroxisomes: Origin, morphology & functions **2.4Mitochondria**: Ultrastructure, chemical composition, functions of mitochondria and bioenergetics (Chemical energy & ATP, Kreb's cycle, respiratory chain and oxidative phosphorylation)4	
III	**Biomolecules**	**3.1 Biomolecules: Concept of micromolecules and macromolecules** **3.2 Carbohydrates:** • Definition classification, properties and isomerism, glycosidic bond • Structure of Monosaccharides (glucose and fructose); Oligosaccharides (lactose and sucrose); Polysaccharides (cellulose, starch, glycogen and chitin) • Biological role and clinical significance. **3.3 Amino Acids and Proteins:** • Basic structure, classification of amino acids, • Essential and Non-essential amino acids, Peptide bond, • Protein conformation: Primary, Secondary, Tertiary, Quaternary • Types of proteins–Structural (collagen)and functional proteins (hemoglobin) • Biological role and clinical significance. **3.4 Lipids:** • Definition, classification of lipids with examples, ester linkage • Physical and chemical properties of lipids. • Saturated and unsaturated fatty acids • Essential fatty acids; Triacylglycerols; Phospholipids (lecithin and cephalin); Steroids (cholesterol) **3.5 Biological role and clinical significance** Vitamins: • Water soluble vitamins (e.g., Vit. C, Vit. B12) • Lipid soluble vitamins (e.g., Vit A, Vit D) • Biological role and clinical significance	**15**

	Practical USZOP4(Course-IX)	**1 Credit**
1.	Study of permeability of cell through plasma membrane (osmosis in blood cells).	
2.	Measurement of cell diameter by occulometer (by using permanent slide)	
3.	Qualitative tests for carbohydrates (Molisch's test, Benedicts test, Barfoed's test, Anthrone test)	
4.	Qualitative tests for protein (Ninhydrin test, Biuret test, Millon's test, Xanthoproteic test)	

5.	Qualitative test for lipids (Solubility test, Sudan III test)	
6.	Study of rancidity of lipids by titrimetric method.	
7.	Ultrastructure of cell organelles (Electron micrographs) of: • Nucleus • Endoplasmic reticulum (Smooth and Rough) • Mitochondria. • Golgi apparatus • Lysosomes	
8.	Study of clinical disorders due to carbohydrates, proteins and lipid imbalance (Photograph to be provided / symptoms to be given and disorder to be identified): • Hyperglycemia • Hypoglycemia • Anemia • Kwashiorkor • Marasmus • Fatty Liver	

N. B:

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II) Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority/Body from time to time, every college should constitute the following Committees:

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Learning Resources recommended:

1. Cell Biology, Singh and Tomar, Rastogi Publication.
2. Cell and Molecular Biology, E.D.P De Robertis and E.M.R Robertis, CBS Publishers and Distributors.
3. The cell, A molecular approach, Goeffrey M. Coper ASM Press Washington D.C.
4. A textbook of cytology M. Suruchi Tyagi Dominant Publishers and Distributors New Delhi.
5. Cell and molecular biology, Gupta P. K., Rastogi Publication, India.
6. Cell Biology, Pawar C.B. Himalaya publication
7. Molecular Biology of the cell, (6^{th}ed) by the Insertus
8. Principles of Biochemistry, 2005, 2^{nd} and 3^{rd} edn. Lehninger A.L. Nelson D.L. and Cox M.M.
9. Biochemistry, Dushyant Kumar Sharma, 2010, Narosa Publishing house PVT.Ltd.
10. A Textbook of Biochemistry, 9thedition, Dr. Rama Rao A.V.S.S and Dr A Suryalakshmi.
11. Biochemistry- G Zubay, Addison Wesley, 1983
12. Biochemistry, L Stryer, 3rd/4th/5th ed, 1989, Freeman and Co. NY

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class test	20
Assignment	10
Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 15 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (40 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	**Options**	**Unit**	**Marks**
1.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	1	15
2.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	2	15
3.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	3	15
4.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3	15

Practical Examination Pattern:

(A) Internal Examination

Heading	**Practical**
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	**Practical**
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

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Syllabus for (S. Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Comparative Embryology, Aspects of Human Reproduction, Pollution and its effect on organisms**
Course Code (refer to student handbook)	USZO403 (Course -X)
Class	S.Y.B. Sc.
Semester	IV
No of Credits	03
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: **Comparative Embryology, Aspects of Human Reproduction, Pollution and its effect on organisms**

CO1- Learner will be able to understand and compare the different types of eggs and sperms.
CO2- Learner will be able to understand and compare the different pre- embryonic stages.
CO3- Learners will able to understand human reproductive physiology.
CO4- Learners will become familiar with advances in ART and related ethical issues.
CO5-The learners will be sensitized about the adverse effects of pollution and measures to control

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Comparative Embryology**	**1.1** Types of Eggs- Based on amount and distribution of yolk **1.2** Structure and Types of Sperm **1.3** Types of Cleavages **1.4** Types of Blastulae **1.5** Types of Gastrulae **1.6** Coelom -Formation and types	**15**
II	**Aspects of Human Reproduction**	**2.1 Human reproductive system and hormonal regulation** • Anatomy of human male and female reproductive system • Hormonal regulation of reproduction and impact of age on reproduction - menopause and andropause **2.2Contraception & birth control** • Difference between contraception and birth control • Natural Methods: Abstinence, rhythm method, temperature method, cervical mucus or Billings method, coitus interruptus, lactation amenorrhea • Artificial methods: Barrier methods, hormonal methods, intrauterine contraceptives, sterilization, termination, Abortion **2.3 Infertility** **Female infertility**: **Causes** - Failure to ovulate; production of infertile eggs; damage to oviducts (oviduct scarring and Pelvic inflammatory disease -PID, TB of oviduct), Uterus (TB of uterus and cervix) **Infertility associated disorders** - Endometriosis, Polycystic Ovarian Syndrome (PCOS), Primary ovarian failure (POF), Sexually Transmitted Infections (STIs) - gonorrhoea, chlamydia, syphilis and genital herpes; Antibodies to sperm; Genetic causes- recurrent abortions • **Role of endocrine disruptors** **2.4 Treatment of infertility** • Removal /reduction of causative environmental factors	**15**

		• Surgical treatment • Hormonal treatment- fertility drugs • Assisted Reproductive Technology (ART) - In vitro fertilization (IVF); Embryo transfer (ET); Intra-Fallopian transfer (IFT), Gamete Intra-Fallopian Transfer (GIFT) &Intra-Zygote Transfer (ZIFT); Intra-cytoplasmic Sperm Injection (ICSI) with ejaculated sperm and sperm retrieved from testicular biopsies; Testicular sperm extraction (TESE). • Sperm bank, cryopreservation of gametes and embryos • Surrogacy	
III	**Pollution and its effect on organisms**	**3.1 Air Pollution** • Types and sources of air pollutant • Effects of air pollution on organisms, its control and abatement measures **3.2 Water Pollution** • Types and sources of water pollutant • Effects of water pollution on organisms, its control and abatement measures **3.3 Soil Pollution** • Types and sources of soil pollutant • Effects of soil pollution on organisms, its control and abatement measures **3.4 Sound pollution** • Different sources of sound pollution • Effects of sound pollution on organisms, its control and abatement measures **3.5 Pollution by radioactive substances** **3.6 Pollution by solid wastes** • Types and sources, • Effects of solid waste pollution, its control and abatement measures **3.6 Pollution – Climate Change and Global Warming**	**15**

	Practical USZOP4 (Course-XA)	**1 credit**
1.	Study of air microflora.	
2.	Estimation of dissolved oxygen from the given water sample.	
3.	Estimation of salinity by refractometer from the given water sample.	
4.	Estimation of conductivity by conductometer from the given water sample.	
5.	Study of physical properties of soil: temperature, moisture and texture.	
6.	Study of chemical properties of soil-pH, organic matter.	
7.	Study of sound pollution monitoring device.	

8.	Detection of pregnancy from given sample of urine.	
9.	Study of birth control measures applicable to human–IUD, condom and hormonal pills.	
10.	Study of the following permanent slides, museum specimens and materials • Mammalian sperm and ovum • Types of Egg– fish, frog and hen • Cleavage, blastula and gastrula (Amphioxus, Frog and Bird)	
11.	Review writing on any topic of current developments in Biological sciences.	
12.	Study of natural ecosystem and field report of the visit.	

N. B:

I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

II) Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority/Body from time to time, every college should constitute the following Committees:

6) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and

2) A Dissection Monitoring Committee (DMC)

Composition of DMC shall be as follows:

n) Head of the Concerned Department (Convener/Chairperson)
ii) Two Senior Faculty Members of the concerned Department
iii) One Faculty of related department from the same College.
One or two members of related department from neighboring colleges

USE OF ANIMALS FOR ANY EXPERIMENT/DISSECTION/MOUNTING IS BANNED. SIMULATIONS, AUTHORISED PERMANENT SPECIMENS/SLIDES, CHARTS, MODELS AND OTHER INNOVATIVE METHODS ARE ENCOURAGED.

Learning Resources recommended:

1. Developmental Biology-5thEdition, Scot F. Gilbert, Sinauer Associates Inc.
2. Developmental Biology-Subramoniam T., Narosa Publishers.
3. Developmental Biology-Berril N. J., Tata McGraw–Hill Publication.
4. Essential Reproduction-Martin H. Johnson, Wiley-Blackwell Publication.
5. Chick Embryology-Bradley M. Pattern.
6. Embryology-Mohan P. Arora.
7. Chordate Embryology-Dalela, Verma and Tyagi.
8. Human Anatomy and Physiology. E. L. Marie, Pearson Education Low Price Edition.

9. Biological Science. Taylor, Green and Stout. Cambridge Publication.
10. Biology. E. P. Solomon, L.R. Berg, D. W. Martin, Thompson Brooks/Cole.
11. Human Biology-Daniel D. Chiras Jones and Bartlett.
12. The Physiology of Reproduction Vol I & II - E. K. Nobel and JU. D. Neil, Raven Press, New York.
13. Air Pollution, KudesiaV. P. Pragati Prakasa, Meerut.
14. Fundamentals of Air Pollution Daniel A. Vallero, Academic press5th Edition.
15. Principles and Practices of Air Pollution Control and Analysis J. R. Mudakani I K International Pub. House Pvt. Ltd.
16. Text Book of Air Pollution and its Control, S. C. Bhatia Atlantic.
17. Water Pollution, Kudesia V. P., Pragati Prakasan, Meerut.
18. A text book of Environmental Chemistry and Pollution Control, S. S. Dogra, Swastic Pub, New Delhi.
19. Practical Methods for water and Air Pollution Monitoring, S. K. Bhargava, New Age International.
20. Hand Book of Water and waste water Analysis, Kanwaljit Kaur, Atlantic.
21. Aquatic Pollution by Edward A. Laws.
22. Environmental Science and Technology, Stanely E. Manahan.
23. Environmental Chemistry, A.K. De, New Age International.
24. A Text Book of Environmental Studies, Gurdeep R. Chatwal, Harish Sharma, Madhu Arora.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class test	20
Assignment	10
Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 15 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (40 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	1	15
2.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	2	15
3.	A. Answer any one of the two (10 marks) B. Answer any one out of the two (5 marks)	3	15
4.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3	15

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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R.E. Society's

R. P. GOGATE COLLEGE OF ARTS & SCIENCE AND R.V. JOGALEKAR COLLEGE OF COMMERCE, RATNAGIRI (AUTONOMOUS)

NAAC accredited 'A' Grade (3rd Cycle)

Ratnagiri-415612 (Maharashtra-India)

Bachelor of Science (B. Sc.) Programme

Program: T.Y.B. Sc.
Course: Zoology

Syllabus for Semester V & VI

Under Choice Based Credit System (CBCS)

To be implemented from Academic Year 2023-2024

PERAMBLE:

Welcome to the final year of your Bachelor of Science (B. Sc.) program in Zoology! This syllabus is here to help you take your knowledge of animals and the natural world to the next level. You've learned a lot in the past two years, and now it's time to dive even deeper into the fascinating world of zoology.

Zoology is all about understanding animals, from their tiny cells to their complex behaviours, and how they fit into our world. In this year, we're going to explore some advanced topics and really get into the nitty-gritty of how animals work and how they impact our planet.

You'll study things like animal genetics (how animals inherit traits), evolution (how animals change over time), animal behaviour (why animals do what they do), and ecology (how animals interact with their environments). This year, you'll also have a chance to focus on your interests and maybe even do some research.

This final year is designed to help you become a better thinker and problem solver. It's all about preparing you for whatever comes next, whether it's more school, a job, or something else entirely. The skills and knowledge you gain this year will be super valuable, no matter where your journey takes you.

Don't be afraid to ask questions, work with your teachers and classmates, and take on new challenges. Zoology is a field where there's always more to discover, and we hope this year will inspire you to keep exploring and caring for the incredible animals that share our planet.
Best of luck in your final year of Bachelor of Science in Zoology!

Chairperson,
BOS in Zoology,
Gogate Jogalekar College,
Ratnagiri.

Syllabus for T. Y. B. Sc. Course: ZOOLOGY

Credit Based Semester and Grading System

(To be implemented from the Academic Year 2023-2024)

SEMESTER – V

COURSE CODE	UNIT	TOPIC	CREDITS	LECTURES /WEEK
USZO501	I	Principles of Taxonomy	2.5	1
	II	Kingdom Animalia I		1
	III	Kingdom Animalia II		1
	IV	Type study: Sepia		1
USZO502	I	Basic Haematology	2.5	1
	II	Applied Hematology		1
	III	Basic Immunology		1
	IV	Applied Immunology		1
USZO503	I	Mammalian Histology	2.5	1
	II	Toxicology		1
	III	General Pathology		1
	IV	Biostatistics		1
USZO504	I	Integumentary system and derivatives	2.5	1
	II	Human Osteology		1
	III	Muscles of long bones of Human limbs		1
	IV	Developmental biology of Chick		1
			10	**16**
USZOP05		Practicals based on all four courses	**06**	**16**
Total Number of Credits and Workload			**16**	**32**

Syllabus for T. Y. B. Sc. Course: ZOOLOGY

Credit Based Semester and Grading System

(To be implemented from the Academic Year 2023-2024)

SEMESTER – VI

COURSE CODE	UNIT	TOPIC	CREDITS	LECTURES /WEEK
USZO601	I	Phylum Chordata: Group Protochordata and Group Euchordata I	2.5	1
	II	Group Euchordata II		1
	III	Group Euchordata III		1
	IV	Type study: Shark		1
USZO602	I	Enzymology	2.5	1
	II	Homeostasis		1
	III	Endocrinology		1
	IV	Animal Tissue Culture		1
USZO603	I	Molecular Biology	2.5	1
	II	Genetic Engineering		1
	III	Human Genetics		1
	IV	Bioinformatics		1
USZO604	I	Environment management	2.5	1
	II	Wildlife Management		1
	III	Bioprospecting and Zoo pharmacognosy		1
	IV	Zoogeography		1
			10	16
USZOP06		Practicals based on all four courses	06	16
Total Number of Credits and Workload			**16**	**32**

Syllabus for (T. Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Taxonomy - Invertebrates and Type Study**
Course Code (refer to student handbook)	USZO501(Course-XI)
Class	T.Y.B. Sc.
Semester	V
No of Credits	4
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: **Taxonomy - Invertebrates and Type Study**

CO1- Learners will apprehend the basis of classification and modern classification up to class of the lower invertebrate animals.

CO2 - The learners will be familiarized with classification up to phylum Nematoda along with their examples**.**

CO3 – Learners will get an idea of higher groups of invertebrate animal life, their classification and their peculiar aspects.

CO4 – Learners will get an idea of general characteristics and details of invertebrate animal systems.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Principles of Taxonomy**	1.1 : Levels of Organization: 1.1.1 : Unicellularity, colonization of cells, multicellularity 1.1.2 : Levels of Organization: Acellular, Cellular, Tissue level, Organ level and 'Organ-system' level 1.2 : Symmetry 1.2.1 : Basic concept and definition 1.2.2 : Types: a. Asymmetry: e.g. Amoeba b. Radial symmetry: e.g. Starfish c. Bi-lateral symmetry: e.g. Invertebrate - Planaria Vertebrate - Man 1.2.3: Evolutionary significance of symmetry 1.3 : Coelom 1.3.1 : Basic concept and definition 1.3.2: Formation of coelom 1.3.3 : Types: a. Acoelomate: Platyhelminthes e.g. Liver fluke b. Pseudocoelomate: Nematoda e.g. Roundworm c. Coelomate: e.g. Frog 1.3.4 : Evolutionary significance of coelom 1.4 : Metamerism 1.4.1 : Basic concept and definition 1.4.2 : Types: a. Pseudo metamerism: e.g. Tapeworm b. True metamerism: i. Homonymous - Annelida e.g. Nereis ii. Heteronomous - Cephalization - Insecta e.g. Dragonfly Cephalothorax - Crustacean e.g. Lobster 1.4.3: Evolutionary significance of metamerism 1.5 : Taxonomy 1.5.1 : Basic concept, definition and objectives 1.5.2 : Linnaean Hierarchy, Binomial Nomenclature 1.5.3: Six Kingdom classification: General characters of each Kingdom with examples: Kingdom Archaebacteria, Kingdom Eubacteria,	**15**

		Kingdom Protista, Kingdom Fungi, Kingdom Plantae, Kingdom Animalia. 1.6 : Kingdom Protista: Animal like Protists: Protozoa 1.6.1 : General characters of Protozoa 1.6.2 : Classification of Protozoa with distinguishing features and suitable examples: Phylum Sarcomastigophora, Class Sarcodina e.g. Amoeba Class Mastigophora e.g. Trypanosoma Phylum Ciliophora, Class Ciliata e.g. Opalina Class Phyllopharyngea e.g. Dysteria Phylum Sporozoa, Class Aconoidasida e.g. Plasmodium, Class Conoidasida e.g. Toxoplasma	
II	**Kingdom Animalia I**	Phylum Porifera a. General characters b. Classification up to class with distinguishing features and suitable examples: Class Calcarea e.g. Leucosolenia (Branched sponge) Class Hexactinellida e.g. Hyalonema (Glass-rope sponge) Class Demospongia e.g. Euspongia (Bath sponge) 2.2 : Phylum Cnidaria a. General characters b. Classification up to class with distinguishing features and examples Class Hydrozoa e.g. Hydra Class Scyphozoa e.g. Aurelia (Jelly fish) Class Anthozoa e.g. Meandrina (Maze Coral) 2.3 : Phylum Platyhelminthes a. General characters b. Classification up to class with distinguishing features and examples Class Turbellaria e.g. Dugesia (Planaria) Class Trematoda e.g. Schistosoma (Blood-fluke) Class Cestoda e.g. Taenia (Tapeworm) c. Morphology, life cycle and pathogenicity of *Fasciola hepatica* 2.4 : Phylum Nematoda a. General characters b. Classification up to class with distinguishing features and examples Class: Aphasmida (Adenophorea) e.g. Trichinella (Trichina worm) Class: Phasmida (Secernentea) e.g. Ascaris (Roundworm)	**15**
III	**Kingdom Animalia II**	Phylum Annelida 3.1.1 : General characters 3.1.2 : Classification up to class with distinguishing features and examples Class Polychaeta e.g. Neries (Clamworm), Class Oligochaeta e.g. Pheretima (Earthworm) Class Hirudinea e.g. Hirudinaria (Leech) 3.2: Phylum Arthropoda	**15**

		3.2.1 : General characters 3.2.2 : Classification up to class with distinguishing features and examples Subphylum Chelicerata Class Arachnida e.g. Hottentotta (Scorpion) Class Merostomata e.g. Limulus (Horse-shoe crab) Class Pycnogonida e.g. Nymphon (Sea spider) Subphylum Crustacea Class Malacostraca e.g. Scylla (Crab) Class Maxillipoda e.g. Balanus (Barnacle) Subphylum Uniramia, Class Chilopoda e.g. Scolopendra (Centipede) Class Diplopoda e.g. Xenobolus (Millipede), Class Insecta e.g. Attacus (Moth) 3.3 : Phylum Mollusca 3.3.1 : General characters of the Phylum 3.3.2 : Classification up to class with distinguishing features and examples Class Aplacophora e.g. Chaetoderma (Glisten worm solenogaster) Class Polyplycophora e.g. Chiton (Coat-of-mail shell) Class Monoplacophora e.g. Neopilina Class Gastropoda e.g. Nerita (Nerit) Class Pelecypoda e.g. Solen (Razor clam) Class Scaphopoda e.g. Dentalium (Tusk shell) Class Cephalopoda e.g. Nautilus (Pearly nautilus) 3.4 : Phylum Echinodermata 3.4.1 General characters 3.4.2 Classification up to class with distinguishing features and examples Class Asteroidea e.g. Protoreaster (Starfish), Class Ophiuroidea e.g. Ophiothrix (Brittle star) Class Echinoidea e.g. Clypeaster (Sand dollar), Class Holothuroidea e.g. Cucumaria (Sea cucumber) Class Crinoidea e.g. Antedon (Sea lily) 3.5 Minor phyla 3.5.1 : General characters along with examples of Phylum Acanthocephala e.g. Moniliformis Phylum Onychophora e.g. Peripatus (Velvet worm) Phylum Chaetognatha e.g. Sagitta (Arrow worm) 3.5.2 : Peripatus, a connecting link - Affinities with Phylum Annelida, Arthropoda and Mollusca. 3.6 Phylum Hemichordata 3.6.1 : General characters, classification with distinguishing features and examples Class Enteropneusta e.g. Balanoglossus (Acorn worm) Class Pterobranchia e.g. Rhabdopleura Class Planctosphaeroidea e.g. Planctosphera 3.7 Basic concepts of phylogeny: Phylogenetic tree of invertebrates	
	Type study: Sepia	4.1: General characters and classification, Habit and habitat, External characters, mantle cavity, locomotion, economic	**15**

		importance 4.2: Digestive system, Respiratory system, Circulatory system, Excretory system, Nervous system and Sense organs, Reproductive system	

	PRACTICALS	**1.5 credits**
1.	Classification of phyla up to class and study of the general characters up to class. Kingdom Protista - Animal-like Protists: Protozoa A. Phylum: Sarcomastigophora Class Sarcodina e.g. Amoeba Class Mastigophora e.g. Euglena	
	B. Phylum: Ciliophora Class Ciliata e.g. Paramoecium Class Phyllopharyngea e.g. Dysteria	
	C. Phylum: Sporozoa, Class Aconoidasida e.g. Eimeria Class Conoidasida e.g. Sarcocystis Kingdom Animalia	
	D. Phylum: Porifera Class Calcarea e.g. Scypha (Little vase sponge) Class Hexactinellida e.g. Hyalonemma (Glass-rope sponge) Class Demospongia e.g. Spongilla (Freshwater sponge)	
	E. Phylum Cnidaria Class Hydrozoa e.g. Vellela (By-the-wind sailor) Class Scyphozoa e.g. Rhizostoma (Barrel jellyfish) Class Anthozoa e.g. Corallium (Coral)	
	F. Phylum Platyhelminthes Class Turbellaria e.g. Dugesia (Planaria) Class Trematoda e.g. Fasciola (Liverfluke) Class Cestoda e.g. Taenia (Tapeworm)	
	G. Phylum Nematoda Class Aphasmida (Adenophorea) e.g. Trichinella (Trichina worm) Class Phasmida (Secernentea) e.g. Ascaris (Roundworm)	
	H. Phylum Annelida Class Polychaeta e.g. Arenicola (Lugworm) Class Oligochaeta e.g. Tubifex (Sludge worm) Class Hirudinea e.g. Pontobdella (Marine leech)	
	I. Phylum Arthropoda Subphylum Chelicerata Class Arachnida e.g. Hotentotta (Scorpion) Class Merostomata e.g. Limulus (Horseshoe crab) Class Pycnogonida e.g. Nymphon (Sea spider) Subphylum Crustacea Class Malacostraca e.g. Panulirus (Lobster) Class Maxillipoda e.g. Cyclops (Copepods)	

	Subphylum Uniramia Class Chilopoda e.g. Scolopendra (Centipedes) Class Diplopoda e.g. Xenobolus (Millipedes) Class Insecta e.g. Attacus (Moth)	
	J. Phylum Mollusca Class Aplacophora e.g. Chaetoderma (Glisten worm solenogaster) Class Polyplacophora e.g. Tonicella (Lined Chiton) Class Monoplacophora e.g. Neopilina Class Gastropoda e.g. Turbo (Turban shell) Class Pelycypoda e.g. Donax (Wedge shell) Class Scaphopoda e.g. Dentalium (Tusk shell) Class Cephalopoda e.g. Octopus	
	K. Phylum Echinodermata Class Asteroidea e.g. Asterias (Starfish) Class Ophiuroidea e.g. Ophiothrix (Brittle star) Class Echinoidea e.g. Echinus (Sea urchin) Class Holothuroidea e.g. Cucumaria (Sea cucumber) Class Crinoidea e.g. Crinoid (Sea lily)	
	L. Phylum Hemichordata Class Enteropneusta e.g. Saccoglossus Class Pterobranchia e.g. Rhabdopleura Class Planctosphaeroidea e.g. Planctosphaera	
2.	Minor Phyla Acoelomate M. Phylum Acanthocephala e.g. Echinorhynchus Coelomate N. Phylum Chaetognatha e.g. Sagitta O. Phylum Onychophora e.g. Peripatus (Velvet worm)	
3.	Study of Sepia with the help of diagram / Photograph / Simulation whichever possible. No animal shall be dissected. a) Digestive system, b) Reproductive system c) Nervous system d) Jaws e) Radula f) Chromatophores g) Spermatophores h) Statocyst	
4.	Study tour - Visit to fish market / Aquarium / Local Gardens / Local available niche / National Parks / Sanctuaries / and such other places to observe invertebrates with special emphasis on Western Ghats and coast of Maharashtra and submit a report. College may conduct more than one field visit for wide exposure, if feasible. However, at least one field visit should be such that it is affordable to every student.	

Learning Resources recommended:

1. A manual of Zoology - Part I, Invertebrates; Ayyar, M. Ekambar Anath Invertebrate Zoology - Volumes of different Phyla; Hyman L.H. Instant Notes in Animal Biology by Richard D. Jurd.
2. Introduction to Zoology - Vol I: K. K. Chaki, G. Kundu and S. Sarkar, New Crystal Book
3. Agency.
4. Modern text book of Zoology - Invertebrates; Eleventh; Edition Professor R.L. Kotpal; Rastogi publication.
5. Invertebrate Zoology by E. L. Jordan & P. S. Verma Rev. edition,2009, Chand publications Invertebrate Zoology by P. S. Verma, edition, 2009, Chand publications.
6. Zoology for degree students, non-chordates by V.K. Agarwal 2011, S. Chand Publication Zoology for Degree Students, B.Sc. First Year, by V. K. Agarwal, Pub. S. Chand Coy.
7. B. Sc. Zoology, Invertebrate Zoology by V.K. Aggarwal2017, S. Chand publications Invertebrate Zoology by Fatik Baran 2012, PHI Learning.
8. A Textbook of Invertebrates by N.C. Nair et al. 2010 Saras publications Practical Zoology: Invertebrate, by S. S. Lal, 2016.
9. Invertebrate Zoology by Ruppert, Fox, Barnes, 7thedition,2003 publications Cengage Learning.
10. Invertebrate Zoology by D.T. Anderson 2nd edition 2002, publications Oxford Invertebrates by Richard C. Brusca *et. al*, 3rdedition2016, publications Oxford.
11. Biology of the invertebrates by Jan A. Pechenik, 7th edition,2014 publications McGraw Hill.
12. An introduction to the invertebrates by Janet Moore, 2ndedition2006, publications Cambridge.
13. Protozoology, by S. V. Nikam& S. T. Tanveer ed. 2011, Pub. Oxford Book Company (N.B.: This book includes Phylum Sarcomastigophora).

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class test	20
Assignment	10
Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 12 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (60 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	Answer any two out of the three (6 marks each)	1	12
2.	Answer any two out of the three (6 marks each)	2	12
3.	Answer any two out of the three (6 marks each)	3	12
4.	Answer any two out of the three (6 marks each)	4	12
5.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3,4	12

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (T. Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Hematology and Immunology**
Course Code (refer to student handbook)	USZO502 (Course-XII)
Class	T.Y.B. Sc.
Semester	V
No of Credits	4
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: **Haematology and Immunology**

CO1-The learner shall comprehend basic hematology.
CO2-Thelearnerwillbeabletoidentifyvariouscomponentsofhaemostaticsystems.
CO3-The learner will be familiar with the terminology used and diagnostic tests performed in a pathological laboratory.
CO4-The learner shall be acquainted with diagnostic approaches in haematological disorders.
CO5-The learner will be better equipped for further pathological course or working in a diagnostic laboratory.
CO6-The learner shall comprehend the types of immunity and the components of immune system.
CO7- The learner shall understand immune pathology and the principles and applications of vaccines.
CO8- The learner will develop basic understanding of immunology of organ transplantation.
CO9-The learner will realize the significant role of immune system in giving resistance against diseases

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Basic Haematology**	**1.1: Composition of plasma**: Water, respiratory gases, dissolved salts, plasma proteins, nutrients, enzymes, hormones, nitrogenous waste products **1.2: Hematopoiesis**: Erythropoiesis, leucopoiesis and thrombopoiesis **1.3: Erythrocytes**: Structure and functions, abnormalities in structure, total count, variation in number; ESR; types of anaemia **1.4: Hemoglobin**: Structure, formation and degradation; variants of hemoglobin (foetal, adult), abnormalities in hemoglobin (sickle cell and thalassemia) **1.5: Leucocytes**: Types and functions, total count and variation in number; leukemia and its types **1.6: Thrombocytes**: Structure, factors and mechanism of clotting, failure of clotting mechanism **1.7: Blood volume**: Total quantity and regulation; hemorrhage	**15**
II	**Applied Hematology**	**2.1: Introduction and scope of Applied Haematology** : Clinical, microbiological, oncological and forensic hematology 2**.2: Clinical significance of Diagnostic Techniques** 2.2.1 : Microscopic examination of blood: Blood cancer (lymphoma, myeloma), Infectious diseases (malaria, leishmaniasis), Haemoglobinopathies (sickle cell anaemia, thalassemia) 2.2.2 : Coagulopathies: Haemophilia and purpura 2.2.3: Biochemical examination of blood: Liver function tests: AST, ALT, LDH, Alkaline	**15**

		phosphatase, Total and direct bilirubin Kidney function test: Serum creatinine, Blood Urea Nitrogen (BUN) Carbohydrate metabolism tests: Blood sugar, Glucose tolerance test, Glycosylated hemoglobin test Other biochemical tests: Blood hormones - TSH, FSH, LH.	
III	**Basic Immunology**	**3.1 Overview of Immunology** 3.1.1 : Concept of immunity 3.1.2 : Innate immunity - Definition, factors affecting innate immunity, Mechanisms of innate immunity - First line of defense - physical and chemical barriers; Second line of defense - phagocytosis, inflammatory responses and fever 3.1.3 : Adaptive or Acquired immunity, Antibody mediated and cell mediated immunity; Active Acquired immunity - Natural and Artificial; Passive Acquired immunity - Natural and Artificial **3.2 : Cells and Organs of immune system** 3.2.1 : Cells of immune system - B cells, T cells and null cells, macrophages, dendritic cells and mast cells 3.2.2 : Organs of immune system Primary: Thymus and bone marrow Secondary: Lymph nodes and spleen **3.3 : Antigens**: Definition and properties; haptens **3.4 : Antibodies**: Definition, basic structure, classes of antibodies - IgG, IgA, IgM, IgD and IgE **3.5 : Antigen processing and presentation** 3.5.1: Endogenous antigens - cytosolic pathways 3.5.2: Exogenous antigens - endocytic pathways	**15**
IV	**Applied Immunology**	**4.1: Antigen-Antibody interaction** 4.1.1 : General features of antigen-antibody interaction 4.1.2 : Precipitation reaction - Definition, characteristics and mechanism. Precipitation in gels (slide test) Radial immunodiffusion (Mancini method) Double immunodiffusion (Ouchterlony method) 4.1.3 : Immunoelectrophoresis - Counter-current and Laurel's Rocket electrophoresis 4.1.4: Agglutination reaction definition, characteristics and mechanism. Haemagglutination (slide and micro-tray agglutination) Passive agglutination Coomb's test 4.1.5: Immunoassay - ELISA **4.2: Vaccines and Vaccination** 4.2.1 : Principles of vaccines - active and passive immunization, Routes of vaccine administration 4.2.2 : Classification of vaccines: Live attenuated Whole-Killed or inactivated	**15**

		Sub-unit vaccines: Toxoids, Protein vaccines, Viral-like particles, DNA vaccines 4.2.3 : Adjuvants used for human vaccines: Virosomes and Liposomes Saponins Water-in-oil emulsions 4.2.4 : Vaccines against human pathogens: Polio Hepatitis A and B Tuberculosis (BCG) **4.3: Transplantation Immunology**: Introduction to transplantation; Types of grafts; Immunologic basis of graft rejection: MHC compatibility in organ transplantation, Lymphocyte and Antibody mediated graft rejection; Precautionary measures against graft rejection.	

	PRACTICALS	
1.	Enumeration of Erythrocytes - Total Count.	
2.	Enumeration of Leucocytes - Total Count.	
3.	Differential count of Leucocytes.	
4.	Erythrocyte Sedimentation Rate by suitable method - Westergren or Wintrobe method.	
5.	Estimation of hemoglobin by Sahli's acid haematin method.	
6.	Determination of serum LDH by using colorimeter / spectrophotometer.	
7.	Estimation of total serum/ plasma proteins by Folin's method.	
8.	Estimation of serum/ plasma total triglycerides by Phosphovanillin method.	
9.	Latex agglutination test - Rheumatoid Arthritis.	
10.	Determination of bleeding and clotting time.	

Learning Resources recommended:

1. Human Physiology -Volume1; C.C. Chatterjee.
2. Essentials of Haematology; Shirish M. Kawthalkar; Jaypee Brothers.
3. Williams Hematology; Kenneth Kaushansky, Marshall A. Lichtman, E. Beutler, Thomas J. Kipps, Josef Prchal, Uri Seligsohn.
4. Essential Haematology; Victor Hoffbrand, Paul Moss, John Pettit. Rapid Review of Hematology; Ramadas Nayak; Jaypee Brothers.
5. Precise Haematology; Usha Rusia, Meera Sikka, Renu Saxena; Wiley India. Short Textbook of Haematology; Shah B.S.; C.B.S. Publisher and Distributor.
6. Mechanisms of Body Functions; Second Edition; Dexter M. Easton; Prentice-Hall of India Pvt. Ltd. New Delhi;1978.
7. A Text book of Practical Physiology; First Edition; V.G. Ranade; A.V.G. Prakashan, Pune;1968.
8. Principles of Anatomy & Physiology; Thirteenth Edition; Gerard J. Tortora & Bryan Derrickson; Biological Science Textbooks, Inc.;2012.
9. Biochemistry; Fourth Edition; U. Satyanarayana & U. Chakrapani; Elsevier; 2013.
10. Medical Biochemistry; Fourth Edition; John Baynes & Marek Dominiczak; Saunders (Elsevier);2014.
11. Harrison'sHematologyandOncology;3rd Edition (Harrison's Specialty); Dan Longo; McGraw-Hill.

12. Essentials of Haematology; Second Edition; Kawthalkar Shirish M.; Jaypee; 2013.Medical Biochemistry by C. Jaypee; 2012.
13. Essentials in Hematology and Clinical Pathology; Nayak, Ramadas. Clinical Pathology and Hematology; Maheshwari, Nanda; Jaypee.
14. Practical Hematology; Dacie J V; Churchill Livingstone;2006.
15. Lecture Notes: Haematology; Hatton, Chris S. R. Hughes-Jones, Nevin C. Hay, Deborah; Wiley-Blackwell. ABC series: ABC of Clinical Haematology; Provan; Drew Publisher: BMJ Books.
16. Principles of Anatomy& Physiology; Thirteenth Edition; Gerard J. Tortora & Bryan Derrickson; Biological Science Textbooks, Inc.;2012.
17. Immunology- Introductory Textbook; Shetty N.; New Age International; 2005.
18. Immunology-Essential and Fundamental; Pathak S., & Palan U.; Science Publishers;2005.
19. Immunology: A textbook; Rao C.V.; Alpha Science Int'l Ltd.; 2005.
20. Anantha Narayan and Paniker's textbook of Microbiology; C. J. Panike r(Ed.); Anantha Narayan R.; Orient Blackswan;2005.
21. Textbook of Immunology; Haleem Khan, Rajendra Sagar, Sadguna.
22. Prescott's Microbiology; Ninth Edition; Joanne M. Willey, Linda M. Sherwood & Christopher
23. Immunology; Third Edition; Janis Kuby; W.H. Freeman;1997.
24. Kuby Immunology; Sixth Edition; Thomas J. Kindt, Richard A. Goldsby, Barbara Osborne & Janis Kuby; W.H. Freeman;2007.
25. Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.;2006.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class test	20
Assignment	10
Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 12 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (60 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	Answer any two out of the three (6 marks each)	1	12
2.	Answer any two out of the three (6 marks each)	2	12
3.	Answer any two out of the three (6 marks each)	3	12
4.	Answer any two out of the three (6 marks each)	4	12
5.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3,4	12

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (T. Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Histology, Toxicology, Pathology and Biostatistics**
Course Code (refer to student handbook)	USZO503 (Course-XIII)
Class	T.Y.B. Sc.
Semester	V
No of Credits	4
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: **Histology, Toxicology, Pathology and Biostatistics**

CO1 - Learner would appreciate the well-planned organization of tissues and cells in the organ systems.

CO2 – The course will prepare learner to develop broad understanding of the different areas of toxicology.

CO3 - It will also develop critical thinking and assist students in preparation for employment in pharmaceutical industry and related areas.

CO4 - Learner will be familiar with various medical terminologies pertaining to pathological condition of the body caused due to diseases.

CO5 - The learner will be able to collect, organize and analyze data using parametric and non-parametric tests.

CO6 -will also be able to setup a hypothesis and verify the same using limits of significance.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Mammalian Histology**	**1.1 Vertical section** (V.S.) of skin: Layers and cells of epidermis; papillary and reticular layers of dermis; sweat glands, sebaceous glands and skin receptors **1.2 : Digestive System** 1.2.1 : Vertical section (V.S.) of tooth; hard tissue - dentine and enamel; soft tissue - dentinal pulp and periodontal ligaments 1.2.2 : Transverse section (T.S.) of tongue - mucosal papillae and taste buds 1.2.3 : Alimentary canal - Transverse section (T.S.) of stomach, small intestine, large intestine of mammal. 1.2.4 : Glands associated with digestive system - Transverse section (T.S.) of salivary glands, liver.	**15**
II	**Toxicology**	**2.1 Basic toxicology** 2.1.1 : Introduction to toxicology - brief history, different areas of toxicology, principles and scope of toxicology 2.1.2 : Toxins and Toxicants - Phytotoxins (caffeine, nicotine), Mycotoxins (aflatoxins), Zootoxins (cnidarian toxin, bee venom, scorpion venom, snake venom) 2.1.3 : Characteristics of Exposure - Duration of exposure, Frequency of exposure, Site of exposure and Routes of exposure 2.1.4 : Types of Toxicity - Acute toxicity, Sub-acute toxicity, Sub-chronic toxicity and Chronic toxicity 2.1.5 : Concept of LD50, LC50, ED50 2.1.6 : Dose Response relationship - Individual / Graded dose response, Quantal dose response, shape of dose response curves, Therapeutic index, Margin of safety	**15**

		2.1.7 : Dose translation from animals to human - Concept of extrapolation of dose, NOAEL (No Observed Adverse Effect Level), Safety factor, ADI (Acceptable Daily Intake) 2.1.8 : Target organ toxicity: Hepatotoxicity: susceptibility of the liver, types of liver injury, examples of hepatotoxicants; Neurotoxicity: vulnerability of nervous system, examples of neurotoxicants; Nephrotoxicity: susceptibility of kidney, examples of nephrotoxicants **2.2 Regulatory toxicology** 2.2.1 : OECD guidelines for testing of chemicals (an overview) 2.2.2 : CPCSEA guidelines for animal testing center, ethical issues in animal studies 2.2.3: Animal models used in regulatory toxicology studies 2.2.4: Alternative methods in toxicology (in vitro tests)	
III	**General Pathology**	**3.1 General Pathology**: Introduction and scope **3.2: Cell injury**: Mechanisms of cell injury: ischemic, hypoxic, free radical mediated and chemical **3.3: Retrogressive changes**: Definition, cloudy swelling, degeneration: fatty, mucoid and amyloid (causes and effects) **3.4: Disorders of pigmentation**: Endogenous: Brief ideas about normal process of pigmentation, melanosis, jaundice (causes and effects) **3.5: Necrosis**: Definition and causes; nuclear and cytoplasmic changes; types: coagulative, liquefactive, caseous, fat and fibroid **3.6: Gangrene**: Definition and types - dry, moist and gas gangrene	**15**
IV	**Biostatistics**	**4.1: Probability Distributions:** Normal, Binomial, Poisson distribution, Z-transformation, p- value, Probability - Addition and multiplication rules and their applications **4.2: Measures of Variation**: Variance, standard deviation, standard error **4.3: Testing of Hypothesis**: Basic concepts, types of hypothesis: Null hypothesis and Alternate hypothesis, Levels of significance and testing of hypothesis **4.4: Parametric and non-parametric test:** Parametric tests: two-tailed Z-test and t-test Non-parametric test: Chi-square test and its applications **4.5: Correlation**: Correlation coefficient and its significance	**15**

	PRACTICALS	1.5 credits
1.	Study of mammalian tissues: V.S. of Tooth, T.S. of Stomach, T.S. of small intestine, T.S. of Liver.	
2.	Microtomy: Tissue preservation and fixation, dehydration, infiltration, paraffin embedding and block preparation, sectioning, staining.	
3.	Identification of diseases or conditions (from slides or pictures): Vitiligo, Psoriasis, Bed sores, Necrosis, Oedema	
4.	To study the effect of CCl4 on the level of enzyme activity in liver on aspartate and alanine amino transferase, alkaline phosphatase (in vitro approach).	
5.	Study and interpretation of abnormal pathological reports: Blood (CBC), Urine (Routine) and Stool (Routine).	
6.	Following biostatistics practicals will be done using data analysis tool of Microsoft Excel (DEMONSTRATION in regular practicals) and manually:	
	a. Problems based on Z-test	
	b. Problems based on t-test	
	c. Problems based on Chi-square test	
	d. Correlation, regression analysis - demonstration only.	
	e. Problems based on ANOVA - demonstration only.	

Learning Resources recommended:

1. A Textbook of Histology; Deshmukh Shivaji; Dominant Pub. Colour Textbook of Histology; Gartner, Leslie P.; Saunders. A Textbook of Histology; Mathur Ramesh; Anmol Pub.
2. A Textbook of Histology and A Practical Guide; Gunasegaran J. P.; Elsevier A Textbook of Histology; Khanna D. R.; Sonali Pub.
3. Practical Zoology; Second Edition; Dr. K. C. Ghose &Dr. B. Manna; New Central Book
4. Agency Pvt. Ltd., Kolkata; 1999.
5. Casarett and Doulls Toxicology-The basic science of poisons; Edited by Curtis Klaassen; McGraw-Hill; 2001.
6. Toxicological testing handbook Principles, applications and data interpretation; David Jacobson – Kram and Kit Keller; CRC Press;2006.
7. Principles and methods of toxicology; A. Wallace Hayes; CRC Press; 2007.Toxicology-principles and methods; M.A. Subramanian; MJP Publishers, Chennai;2004.
8. Fundamentals of Toxicology; Kamleshwar Pandey and JP Shukla; New Central book Agency Ltd., Kolkata; 2011.
9. Elements of Toxicology; Kamleshwar Pandey and JP Shukla; Wisdom Press, New Delhi;2010.
10. Principles and Applications of Toxicology; Lahir Y.K.; Seekay Publications; 2013.
11. Essentials of Clinical Toxicology; Lall S.; Narosa Publishing House;1998.
12. A Textbook of Veterinary and General Pathology; Second edition; J. L. Vagad; IBDC Publishers.
13. Clinical Pathology; Guru G.; NCERT;1988.
14. Clinical Pathology; Batra Neelam; Vikas Publishing House Pvt. Ltd.; Nov.1982.
15. Essentials of General Pathology; Dr. Sudha Shivraj, Dr. Satish Kumar Amarnath, Dr. Sheela Devi; Exclusively distributed by CBS Publishers & Distributors.
16. Textbook of Pathology; Harsh Mohan; Jaypee Publishers.
17. Biostatistics-The Bare Essentials; Third Edition; Geoffrey R. Norman, David L. Streiner; B.C. Decker, Inc., Hamilton;2008.
18. Fundamentals of Biostatistics; Second Edition; Veer Bala Rastogi; Ane Books Pvt. Ltd., New

Delhi;2009(Reprint2010).
19. Fundamentals of Biostatistics; Second Revised Edition; Irfan Ali Khanand Atiya Khanum; Ukaaz Publications, Hyderabad;2004.
20. Instant Medical Biostatistics; Dr. Ranjan Das and Dr. Papri N. Das; Ane Books Pvt. Ltd., New Delhi;2009.
21. Primer of Biostatistics; Fifth Edition; Stanton A. Glantz; McGraw-Hill Companies, Inc.;2002.
22. Basic Biostatistics-Statistics for Public Health Practice; Second Edition; B. Burt Gerstman; Jones and Bartlett Learning Burlington;2015.
23. Biostatistics-A Guide to Design, Analysis, and Discovery; Second Edition; Ronald N. Forthofer, Eun SulLee and Mike Hernandez; Elsevier, Inc., (Academic Press), USA; 2007.
24. Statistics in Biology and Psychology; Sixth Edition; Debajyoti Das and Arati Das; Academic Publishers, Kolkata.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class test	20
Assignment	10
Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 12 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (60 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	**Options**	**Unit**	**Marks**
1.	Answer any two out of the three (6 marks each)	1	12
2.	Answer any two out of the three (6 marks each)	2	12
3.	Answer any two out of the three (6 marks each)	3	12
4.	Answer any two out of the three (6 marks each)	4	12
5.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3,4	12

Practical Examination Pattern:

(A) Internal Examination

Heading	**Practical**
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	**Practical**
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (T. Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Anatomy and Developmental Biology**
Course Code (refer to student handbook)	USZO504(COURSE-XIV)
Class	T.Y.B. Sc.
Semester	V
No of Credits	4
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: **Anatomy and Developmental Biology**

CO1- Learner will be able to understand the importance of various types of epidermal and dermal derivatives along with their functions.

CO2- Learner will be able to understand the structure, types and functions of human skeleton

CO3- Learners will identify various arrangement soft hind limb muscle sand will relate the arrangement with contraction and motion.

CO4 -Learner will be able to understand the processes involved in embryonic development and practical applications of studying the chick embryology.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Integumentary system and derivatives**	**1.1 Basic structure of integument: Epidermis and dermis** **1.2: Epidermal derivatives of Vertebrates** 1.2.1: Hair, hoof, horn, claw, teeth, beak and epidermal scales (small scales, large scales, modified scales - spine) 1.2.2: Glands - types (mucous, serous, ceruminous, poison, uropygial and salt gland) and functions 1.2.3: Type of feathers **1.3: Dermal derivatives of Vertebrates**: Scales in fish; scutes in reptiles and birds; dermal scales in mammals - Armadillo, Antler - Caribou **1.4: Special derivatives of integument**: Wart in toad, rattle in snake, whale bone in baleen whale, kneepads in camel.	**15**
II	**Human Osteology**	**2.1: Introduction**: Bone structure (Histology), physical properties, chemical composition and general functions of bones. Cartilage: General structure, functions **2.2: Axial skeleton** 2.2.1: Skull: General characteristics of skull bones - Cranial and facial bones 2.2.2 : Vertebral column: General characteristics of a vertebra, structure of different types of vertebrae (cervical, thoracic, lumbar, sacrum and coccyx) 2.2.3: Ribs and sternum: General skeleton of ribs and sternum 2.2.4: Hyoid bone: Structure and function. **2.3: Appendicular skeleton** 2.3.1: Pectoral girdle and bones of forelimbs 2.3.2: Pelvic girdle and bones of hind limbs	
III	**Muscles of long bones of Human limbs**	**3.1: Introduction and types of long limb muscles** 3.1.1: Flexors, Extensor, Rotator, Abductors, Adductors **3.2: Muscles of forelimbs** 3.2.1: Muscles that move the arm (Humerus) - Triceps brachii, Biceps brachii, brachialis and	**15**

		brachioradialis 3.2.2: Muscles that move the forearm (Radius-ulna) - Flexor carpi radialis, Flexor carpi ulnaris and Extensor carpi ulnaris 3.2.3: Muscles that move the wrist, hand and fingers - Flexor digitorium superficialis, Extensor carpi radialis and Extensor digitorum **3.3: Muscles of hindlimbs** 3.3.1: Muscles that move the thigh (Femur) - Sartorius, Adductor group, Quadriceps group (Rectus femoris, Vastus lateralis, Vastus medialis), Hamstring group (Biceps femoris, Semimembranosus, Semitendinosus) 3.3.2 : Muscles that move the lower leg (tibia-fibula) - Fibularis longus, Gastrocnemius, Tibialis anterior, Soleus, Extensor digitorum longus and Fibularis tertius 3.3.3 : Muscles that move the ankle, foot and toes - Tibialis anterior, Extensor digitorum, Longus and Fibularis muscles	
IV	**Developmental biology of Chick**	**4.1: Introduction to Developmental Biology**: Basic concept and principles of developmental biology - morphogenesis, organogenesis, fate maps, cell adhesion, cell affinity and cell differentiation. **4.2: Development of Chick embryo** 4.2.1: Structure of Hen's egg, physico-chemical nature and forms of yolk - granular, platelets and spheres; fertilization, cleavage, blastulation, gastrulation 4.2.2: Structure of chick embryo - 18hours, 24 hours, 33 hours, 48 hours and 72 hours 4.2.3: Extra embryonic membranes 4.2.4: Organizer: Introduction, Spemann Mangold experiment, Hensen's node as an organizer	**15**

	PRACTICALS	**1.5 credits**
1.	Study of integumentary systems - V. S. of Skin of Shark, Frog, Calotes, Pigeon and Human	
2.	Study of Human Axial Skeleton - Skull (whole) and Vertebral column (axis, atlas, typical cervical, typical thoracic, typical lumbar, sacrum, coccyx)	
3.	Study of Human Appendicular Skeleton - Pectoral and pelvic girdle with limb bones	
4	Study of muscles of forelimbs – Biceps brachii, Brachio radialis, Triceps brachii, flexor carpi, flexor ulnaris and Extersor carpi ulnaris	
5.	Study of muscles of hind limbs - Sartorius, Adductor group, Quadriceps group Rectus femoris, Vastus lateralis, Vastus medialis, Hamstring group (Biceps femoris, Semimembranosus, Semitendinosus), Fibularis longus, Gastrocnemius Tibialis anterior, Soleus, Extensor digitorum longus, Fibularis tertius	

6.	Study of ontogeny of chick embryo using permanent slides - 18 hours, 24 hours, 33 hours, 48 hours and 72 hours.	
7.	Preparation of temporary mounting of chick embryo up to 48 hours of incubation.	

N.B:

I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

II) Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority / Body from time to time, every college should constitute the following Committees:

1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and

2) A Dissection Monitoring Committee (DMC) to ensure that no dissections or mountings are done using animals.

Composition of DMC shall be as follows:

i) Head of the Concerned Department (Convener / Chairperson)
ii) Two Senior Faculty Members of the concerned Department
iii) One Faculty of related department from the same College
iv) One or two members of related department from neighbouring colleges.

USE OF ANIMALS FOR ANY EXPERIMENT /DISSECTION /MOUNTING IS BANNED. SIMULATIONS, AUTHORIZED PERMANENT SPECIMENS/SLIDES, CHARTS, MODELS AND OT OTHER INNOVATIVE METHODS ARE ENCOURAGED.

Learning Resources recommended:

1. Comparative Anatomy of the Vertebrates; Ninth Edition; Kent, G.C. and Carr R.K.; The McGraw-HillCompanies;2000.
2. Textbook of Chordates; Saras publication. Modern textbook of Zoology; Prof. R. L. Kotpal.
3. Integumentary system and its derivatives; Samuel D. Hodge.
4. Atlas of Human Anatomy – Vol. I; R.D. Sinelnikov; Mr. Publishers Moscow. A Guide of Osteology (for medical students); Prakash Kendra, Lucknow.
5. Human Osteology-Tim D White.
6. Text Book of Human Osteology- Singh Inderbir.
7. Mechanisms of Body Functions; Second Edition; Dexter M. Easton; Prentice-Hall of India Pvt. Ltd., New Delhi;1978.
8. Human Anatomy-John W. Hole, Jr., Karen A. Koos, Publisher: W.C. Brown Publisher, USA.
9. Principles of Anatomy and Physiology-Gerard T. Tortora and Sandra Reynolds Grabowski. Publisher: Harpers Collins College Publishers (7^{th}Edition).
10. Developmentalbiology-Gilbert.DevelopmentofChick-Patten.DevelopmentalBiology-Wolpert.
11. Textbook of Embryology-N. Arumugam.
12. Chicken Development-Embryology; W.H. Freeman &B. Bracegirdle.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	Marks
Class test	20
Assignment	10
Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 12 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (60 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	Answer any two out of the three (6 marks each)	1	12
2.	Answer any two out of the three (6 marks each)	2	12
3.	Answer any two out of the three (6 marks each)	3	12
4.	Answer any two out of the three (6 marks each)	4	12
5.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3,4	12

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	**Practical**
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (T. Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Taxonomy - Chordates and Type Study**
Course Code (refer to student handbook)	USZO601 (Course-XV)
Class	T.Y.B. Sc.
Semester	VI
No of Credits	4
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: **Taxonomy - Chordates and Type Study**

CO1- Learners will get an idea of origin of Chordates, its taxonomy upto class with reference to phylogeny and their special features.

CO2- Learners will understand the characteristic features and examples of class of Reptilia, Aves and Mammalia.

CO3- Learners will get an idea of vertebrate animal life after studying one representative animal-shark.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Phylum Chordata: Group Protochordata and Group Euchordata I**	**1.1**General characters, Difference between non-chordates and chordates Origin of chordates: Annelids as ancestors, Arachnids as ancestors and affinities with Echinodermata **1.2**: **Protochordata** 1.2.1: General characters of Group Protochordata 1.2.2: Distinguishing characters of Subphylum Urochordata and Cephalochordata 1.2.3: Subphylum Urochordata • Class Ascidiacea e.g. *Herdmania* • Class Thaliacea e.g. *Salpa* • Class Larvacea e.g. *Oikopleura* 1.2.4: Subphylum Cephalochordata Class Leptocardii e.g. *Branchiostoma* (*Amphioxus*) **1.3: Group Euchordata I** Group Euchordata: General characters • Subphylum Vertebrata: General characters • Division Agnatha and Gnathostomata: Distinguishing characters. General characters with examples of: • Class Ostracodermii e.g. Cephalaspis • Class Cyclostomata e.g. Petromyzon (Lamprey)	**15**
II	**Group Euchordata II**	2.2.1: Division: Gnathostomata Superclass: Pisces and Tetrapoda Superclass - Pisces: Distinguishing characters • Class Placodermi e.g. Climatius • Class Chondrichthyes e.g. Rhinobatos (Guitar fish) • Class Osteichthyes e.g. Exocetus (Flying fish) 2.2.2: Dipnoi (Lungfish): Distribution, habit and habitat, external and internal characters, affinities with superclass Pisces, affinities and differences	**15**

		with class Amphibia	
III	**Group Euchordata III**	**3.1Class Reptilia**: General characters Examples a. Extinct reptile e.g. Ichthyosaurus b. Living fossil e.g. Sphenodon (Tuatara) c. Aquatic reptile e.g. Chelonia (Sea turtle) d. Arboreal reptile e.g. Chamaeleon(Chamaeleon) **3.2**: **Class Aves**: General Characters Examples a. Arboreal bird e.g. Melanerpes (Wood pecker) b. Terrestrial bird e.g. Gallus (Fowl) c. Swimming bird e.g. Phalacrocorax (Cormorant) d. Wading bird e.gs. Ardeola (Heron) e. Birds of prey e.g. Tyto (Owl) f. Flightless birds e.g. Dromaius (Emu) **3.3 Class Mammalia**: General characters Examples a. Egg-laying mammals e.g. Ornithorhyncus (Duck-billed platypus) b. Pouched mammals e.g. Macropus (Kangaroo) c. Insect eating mammals e.g. Sorex (Common shrew) d. Toothless mammals e.g. Bradypus (Sloth) e. Gnawing mammals e.g. Funambulus (Squirrel) f. Primates e.g. Macaca (Monkey)	**15**
IV	**Type study: Shark**	**4.1: Habit & habitat, distribution, external characters, classification and economic importance.** **4.2: Skin, exoskeleton, endoskeleton and systems** a) Digestive system b) Respiratory system c) Blood vascular system d) Nervous system and receptor organs e) Urinogenital system, copulation, fertilization and development	**15**

	PRACTICALS	**1.5 Credits**
1.	**Group Protochordata** Subphylum Urochordata • Class Larvacea e.g. Oikopleura (Sea squirt) • Class Ascidiacea e.g. Ciona (Transparent Sea squirt) • Class Thaliacea e.g. Salpa (Common salp) Subphylum Cephalochordata • Class Leptocardii e.g. Branchiostoma (Amphioxus) Subphylum Vertebrata: Division Agnatha • Class Ostracodermi e.g. Pharyngolepis • Class Cyclostomata e.g. Petromyzon (Lamprey)	
2.	**Division Gnathostomata** Superclass Pisces: • Class Placodermi e.g. Bothriolepis	

	• Class Chondrichthyes e.g. Rhinobatos (Guitar fish), Chimaera (Rabbitfish) • Class Osteichthyes e.g. Protopterus, Clarius (Catfish) Superclass Tetrapoda: • Class Amphibia e.g. Alytes (Midwife toad) and Triton (Salamander) • Class Reptilia e.g. Varanus (Monitor lizard) and Crocodylus (Crocodile)	
3.	**Class Aves**: Examples: Eudyptes (Penguin), Phoenicopterus (Flamingo) and Gyps (Vulture)	
4.	**Class Mammalia**: Examples: Dasyurus (Quoll), Petaurista (Flying squirrel) and Macaca (Monkey).	
5.	**Study of Shark with the help of diagram / Photograph / Simulation whichever possible. No animal shall be dissected.** a. Digestive system b. Heart and Aortic arches c. Urinogenital System d. Endoskeleton of shark: i. Axial - Skull and vertebral column ii. Appendicular - Pelvic and pectoral fins, pelvic and pectoral girdle	
6.	Visit to fish market / Aquarium / Zoo/ National Park / Local Gardens / Local available niche/ Sanctuaries / and such other places in Maharashtra and / or India and / or abroad to observe chordates and prepare a report. College may conduct more than one field visit for wide exposure, if feasible. However, at least one field visit should be such that it is affordable to every student.	

Learning Resources recommended:

1. Modern text book of Zoology - Vertebrates; Professor R.L. Kotpal; Rastogi publication; Third Edition 2012.
2. Vertebrate Zoology for Degree students; V. K. Agarwal; S. Chand Publication; 2012. Fundamentals of Zoology, Dr. K. C. Ghosh and Dr. B. Manna, New Central book Agency
3. (P) Ltd.
4. Chordate Zoology Volume II, Prof. N. Arumogam. Saras Publication. Chordate Anatomy Mohan P. Arora, Himalaya Publishing House, First edition.
5. The life of Vertebrates; J.Z. Young; ELBS - Oxford University Press; Third edition, 2006 Textbook of chordate Zoology, Vol. II, G.S. Sandhu, H. Bhaskar; Campus Book International, First edition, 2005.
6. Introduction to Zoology - Vol II: K. K. Chaki, G. Kundu and S. Sarkar, New Crystal Book Agency.
7. URL for search on net: https://www.amazon.com/Protozoology-Susheel-Vilas- Nikam /dp/9350300044.
8. Chordate Zoology by E. L. Jordan and P. S. Verma, edition,2009, Chand publications. Chordate Zoology by P. S. Verma, edition,2009, Chand publications.

9. Modern Textbook of Zoology Vertebrates by R.L. Kotpal, edition Jan 2015, Rastogi publications.
10. Practical Zoology: Vertebrate, by S. S. Lal, 2015.
11. A Textbook of Invertebrate Zoology & Cell Biology, by V. S. Kanwate, A. N. Kulkarni *et al.* ed. Alka Prakashan.
12. The Animal Kingdom: An Elementary Textbook in Zoology; Specially Classified and Arranged for the Use of Science Classes, Schools and Colleges (Classic Reprint), by Ellis
13. Davidson, Sept. 2015, Publisher: Forgotten Book.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class test	20
Assignment	10
Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 12 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (60 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	**Options**	**Unit**	**Marks**
1.	Answer any two out of the three (6 marks each)	1	12
2.	Answer any two out of the three (6 marks each)	2	12
3.	Answer any two out of the three (6 marks each)	3	12
4.	Answer any two out of the three (6 marks each)	4	12
5.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3,4	12

Practical Examination Pattern:

(A) Internal Examination

Heading	**Practical**
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	**Practical**
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (T. Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Physiology and Tissue Culture**
Course Code (refer to student handbook)	USZO602 (Course-XVI)
Class	T.Y.B. Sc.
Semester	VI
No of Credits	4
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: **Physiology and Tissue Culture**

CO1 – The learner shall understand fundamentals of enzyme structure, action and kinetics.

CO2 – The learner shall appreciate the enzyme assay procedures and the therapeutic applications of enzymes.

CO3 – The learner shall comprehend the adaptive responses of animals to environmental changes for their survival.

CO4 – The learner shall understand the types and secretions of endocrine glands and the functions.

CO5 -The learner shall understand the significance of tissue culture as a tool in specialized areas of research.

CO6 – The learner will appreciate its applications in various industries.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Enzymology**	**1.1 Introduction and Nomenclature:** Definition; concept of activation energy; nomenclature and classification (based on IUB - Enzyme Commission) of enzymes; chemical nature of enzyme, co-factors and co-enzymes **1.2 Enzyme Action and Kinetics:** Mechanism; Factors affecting enzyme activity-substrate, pH and temperature. Derivation of Michaelis-Menten equation and Lineweaver-Burk plot; Concept and significance of Km, Vmax and Kcat **1.3 Enzyme Inhibition:** Competitive and non-competitive inhibitors and their kinetics; therapeutic applications of enzyme inhibitors. **1.4 Regulation of Enzyme Activity:** Allosteric regulation and regulation by covalent modification of enzymes; Isozymes (LDH) **1.5 Industrial applications of enzymes**: Food and detergents	**15**
II	**Homeostasis**	**2.1 Homeostasis** 2.1.1: External and internal environment; Acclimation and acclimatization 2.1.2: Body clock-Circadian &Diurnal rhythm **2.2 : Thermoregulation** 2.2.1: Endothermy and ectothermy Temperature balance: Heat production shivering and non-shivering thermogenesis; brown fat, mechanisms of heat loss 2.2.2: Adaptive response to temperature-daily torpor, hibernation, aestivation **2.3: Osmotic and Ionic Regulation** 2.3.1: Living in hypo-osmotic, hyper-osmotic and terrestrial environment-Water absorption, salt water ingestion and salt excretion, salt glands, metabolic water	**15**

		2.3.2: Role of kidney in ionic regulation	
III	**Endocrinology**	**3.1**General organization of mammalian endocrine system **3.2** Hormones: Classification, properties, mechanism of hormone action **3.3** Histology, functions and disorders of the following endocrine glands: Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal	**15**
IV	**Animal Tissue Culture**	**4.1 Aseptic techniques** 4.1.1**:** Sterilization-basic principles of sterilization, importance of sterility in cell culture 4.1.2**:** Sterile handling-swabbing, capping, flaming, handling bottles and flasks, pipetting, pouring **4.2 Culture media** 4.2.1: Types of media-Natural and Artificial media. 4.2.2: Balanced Salt Solutions 4.2.3: Complete Media amino acids, vitamins, salts, glucose, oxygen supplements, hormones and growth factors, antibiotics 4.2.4: Factors influencing cell culture-surface tension and foaming, viscosity, temperature, osmolality, pH, CO2, bicarbonate and O2 **4.3:** Advantages of tissue culture-control of the environment, *in vitro* modeling of *in vivo* conditions **4.4:** Limitations of tissue culture **4.5 Culture techniques** 4.5.1: Preparation of cells / organs for culture 4.5.2**:** Cover slip, Flask and Tube culture 4.5.3: Primary and established cell lines 4.5.4: Hybridoma technology	**15**

	PRACTICALS	**1.5 Credits**
1	Effect of varying pH on activity of enzyme Acid Phosphatase.	
2	Effect of varying enzyme concentration on activity of enzyme Acid Phosphatase.	
3	Effect of varying substrate concentration on activity of enzyme Acid Phosphatase.	
4	Effect of inhibitor on the activity of enzyme Acid Phosphatase.	
5	Separation of LDH isozymes by agarose/polyacrylamide gel electrophoresis.	
6	Histology of endocrine glands: T. S. of pituitary, thyroid, parathyroid, pancreas, adrenal.	
7	Instruments for tissue culture-Autoclave Millipore filter, CO_2incubator, Laminar air-flow. (Principle and use).	
8	Packaging of glassware for tissue culture.	
9	Aseptic transfer techniques.	
10	Trypsinization and vital staining using Trypan blue stain.	

Learning Resources recommended:

1. Comparative Animal Physiology; Knut Schmidt Nielson; Cambridge Press. Comparative Animal Physiology; Prosser and Brown.
2. Comparative Animal Physiology; William S Hoar.
3. Text book of Comparative Physiology; R Nagabhushanam, M S Kodarkar, Sarojini R. India Book House Pvt. Ltd.
4. Animal Physiology; N. Arumugam, A. Mariakuttikan; Saras Publication. Text book of Endocrinology; Williams.
5. Textbook of Endocrinology Hardcover; Dharmalingam; 2010. Endocrinology; 6th Edition; Mac Hadley, Jon E. Levine.
6. Bailey's textbook of histology Hardcover; Frederick R Bailey.
7. Mechanisms of Body Functions; Second Edition; Dexter M. Easton; Prentice-Hall of India Pvt. Ltd., New Delhi; 1978.
8. Culture of animal cells - A manual of basic technique; R. Ian Freshney; John Wiley and Sons Publications; 2005.
9. Basic cell culture - A practical approach; J. M. Davis; Oxford University Press; Indian edition; 2005.
10. Animal cell culture - Biotechnology Series: Vol.1; Bina Mishra, B. P. Mishra, Pran P. Bhat, P.N. Bhat; Studium Press (India) Pvt. Ltd; 2011.
11. Animal cell culture - Concept and Applications; Shweta Sharma; Oxford book Company; 2012.
12. Biotechnology of Animal Tissues; Dr. P. R. Yadav and Dr. Rajiv Tyagi; Discovery Publishing House, New Delhi; 2006.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class test	20
Assignment	10
Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 12 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (60 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	Answer any two out of the three (6 marks each)	1	12
2.	Answer any two out of the three (6 marks each)	2	12
3.	Answer any two out of the three (6 marks each)	3	12
4.	Answer any two out of the three (6 marks each)	4	12
5.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3,4	12

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (T. Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Genetics and Bioinformatics**
Course Code (refer to student handbook)	USZO603 (Course-XVII)
Class	T.Y.B. Sc.
Semester	VI
No of Credits	4
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: **Genetics and Bioinformatics**

CO1- Learner shall get an insight into the intricacies of chemical and molecular processes that affect genetic material.

CO2- The course shall prepare learner to recognize the significance of molecular biology as abasis for the study of other areas of biology and biochemistry.

CO3- Learner shall understand related areas in relatively new fields of genetic engineering and biotechnology.

CO4- The learner shall get acquainted with the vast array of techniques used to manipulate genes which can be applied in numerous fields like medicine, research, etc. for human benefit.

CO5- The learner shall become aware of the impact of changes occurring at gene level on human health and its diagnosis.

CO6- Learner shall become aware of the computational point of view of studying the genomes.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Molecular Biology**	**1.1 Types of mutation** 1.1.1**:** Point mutations-substitution, deletion and insertion mutations Substitution mutations- silent, missense and nonsense mutations, transition and transversion Deletion and Insertion mutations-frameshift mutations 1.1.2**:** Trinucleotide repeat expansions - fragile X syndrome, Huntington disease 1.1.3: Spontaneous mutation - tautomeric shifts, spontaneous lesions **1.2**: Induced mutations 1.2.1: Physical agents: Ionizing radiation (X-rays, α, β and γ rays) Non-ionizing radiation (UV light) 1.2.2: Chemical agents: Base analogs (5-bromouracil) Intercalating agents (ethidium bromide) Deaminating agents (nitrous acid) Hydroxylating agents (hydroxylamine) Alkylating agents (mustard gas) Aflatoxin (aflatoxin B1) **1.3 Preventative and repair mechanisms for DNA damage** 1.3.1: Mechanisms that prevent DNA damage-superoxide dismutase and catalase 1.3.2: Mechanisms that repair damaged DNA-direct DNA repair (alkyl transferases, photo-reactivation, excision repair) 1.3.3: Post replication repair-recombination repair, mismatch repair, SOS repair **1.4 Eukaryotic gene expression** 1.4.1: Regulatory protein domains - zinc fingers, helix-turn-helix domain and leucine zipper 1.4.2**:** DNA methylation	**15**

II	**Genetic Engineering**	**2.1 Tools in Genetic Engineering** 2.1.1: Enzymes involved in Genetic Engineering: Introduction, nomenclature and types of restriction enzymes with examples, Ligases-*E. coli* DNA ligase, T4 DNA ligase, polynucleotide kinase, phosphatases, DNA polymerases, reverse transcriptase, terminal transferase 2.1.2: Vectors for gene cloning: General properties, advantages and disadvantages of cloning vectors-plasmid vectors (pBR322), phage vectors (λ Phage), cosmid vectors(c2XB) 2.1.3**:** Cloning techniques: Cloning after restriction digestion - blunt and cohesive end ligation, creation of restriction sites using linkers and adapters, cloning after homopolymer tailing, cDNA synthesis (Reverse transcription), genomic and cDNA libraries **2.2: Techniques in Genetic Engineering** 2.1.1**:** PCR techniques: Principle of polymerase chain reaction (PCR), Applications of PCR 2.2.2**:** Sequencing techniques: DNA sequencing: Maxam-Gilbert method, Sanger's method Protein sequencing: Sanger's method, Edman's method Applications of sequencing techniques 2.2.3**:** Detection techniques: Blotting Techniques-Southern blotting, Northern blotting and Western blotting Applications of blotting techniques	**15**
III	**Human Genetics**	**3.1 Non-disjunction during mitosis and meiosis** 3.1.1: Chromosomal Aberrations: Structural: Deletion: types, effects and disorders; Translocation: types: Robertsonian and non-Robertsonian disorders; Inversion: types, effect and significance; Duplication and their evolutionary significance (multigene families) Numerical: Aneuploidy and Polyploidy (Auto polyploidy and Allo polyploidy) **3.2 Genetic Disorders** 3.2.1**:** Inborn Errors of Metabolism: Phenylketonuria, G-6-PD deficiency, Alkaptonuria, Albinism 3.2.2 Single gene mutation: Cystic fibrosis 3.2.3: Multifactorial: Breast Cancer 3.2.4**:** Uniparental Disomy: Angelman Syndrome and Prader –Willi Syndrome **3.3: Diagnosis** 3.3.1**:** Prenatal Diagnosis: Amniocentesis and Chorionic villus sampling, Banding techniques (G, C, Q), FISH, Protein truncation test (PTT) 3.3.2**:** Genetic counselling	**15**

IV	**Bioinformatics**	**4.1 Introduction** 4.1.1**:** Introduction to Bioinformatics and Bioinformatics web resource (NCBI, EBI, OMIM, PubMed) 4.1.2**:** Applications of Bioinformatics **4.2 Databases - Tools and their uses** 4.2.1: Biological databases; Primary sequence databases: Nucleic acid sequence databases (GenBank, EMBLEBI, DDBJ) Protein sequence databases (Uni ProtKB, PIR) Secondary sequence databases Derived databases - PROSITE, BLOCKS Structure databases and bibliographic databases **4.3: Sequence alignment methods** 4.3.1**:** BLAST, FASTA 4.3.2: Types of sequence alignment (Pairwise & Multiple sequence alignment) 4.3.3 Significance of sequence alignment **4.4 Predictive applications using DNA and protein sequences** 4.4.1: Evolutionary studies: Concept of phylogenetic tree, convergent and parallel evolution 4.4.2**:** Pharmacogenomics: Discovering a drug: Target identification 4.4.3: Protein Chips and Functional Proteomics: Different types of protein chip (detecting and quantifying), applications of Proteomics 4.4.4: Metabolomics: Concept and applications	**15**

	PRACTICALS	**1.5 credits**
1.	Quantitative Estimation of RNA by Orcinol method.	
2.	Quantitative Estimation of DNA by Diphenyl amine method.	
3.	Separation of Genomic DNA by Agarose gel electrophoresis.	
4.	Colorimetric estimation of proteins from given sample by Folin-Lowry's method.	
5.	Problems based on Restriction endonucleases.	
6.	Karyotype (Idiogram) analysis for the following syndromes with comments on numerical and /or structural variations in chromosomes (no cutting of chromosomes):	
	a. Turner's syndrome	
	b. Klinefelter's syndrome	
	c. Down's syndrome	
	d. Cri-du-chat syndrome	
	e. D-G translocation	

	f. Edward's syndrome	
	g. Patau's syndrome	
7.	Interpretation of genetic formulae: Deletion, duplication, inversion and translocation.	
8.	Calculation of mitotic index from the photograph or stained preparation of onion root tip or cancer cells.	
9.	Explore BLAST for nucleotide sequence comparison.	
10.	Explore the databases (Nucleotide, Protein) at NCBI for query in a nucleotide or protein sequence.	
11.	Exploring bibliographic database PubMed for downloading a research paper on subject of interest with the use of operators.	

Learning Resources recommended:

1. Genetics - The continuity of life; Daniel Fairbanks and Ralph Andersen; Brooks/ Cole Publishing Company; 1999.
2. Introduction to Molecular Biology; Peter Paolella; Tata McGraw Hill; 2010. Molecular Biology; David Freifelder; Narosa Publishing House; 2008.
3. i Genetics - A Molecular Approach; Third Edition; Peter J. Russell; Pearson Education, Inc. (Benjamin Cummings), San Francisco; 2010.
4. Genetics; M.W. Farnsworth; Harper and Row Publishers, Inc., USA; 1978.
5. Principles of Genetics; Eighth Edition; Gardner, Simmons and Snustad; John Wiley and Sons (Asia) Pte. Ltd., Singapore; 2002.
6. The Science of Genetics - An Introduction to Heredity; Fourth Edition; George W. Burns;
7. Molecular cloning; Joseph Sambrook, David William Russell; Third Edition; CSHL Press; 2001.
8. Gene Cloning - An Introduction; Brown. T.A; Fourth Edition; Wiley-Blackwell; 2011. Recombinant DNA - Genes and Genomes- A short course; 3rd Edition; Watson, J.D., Myers, R.M., Caudy A., Witkowski, J.K.; Freeman and Co. NY; 2007.
9. Principles Of Gene Manipulation & Genomics; Primrose SB and R. Twyman; Blackwell Science Publications; 2006.
10. Microbiology; Fifth Edition; Pelczar, M.J. et al; Tata McGraw-Hill Co., New Delhi; 2001. Introduction to Protein Structure; Second Edition; Branden C. and Tooze J.; Garlan
11. Publishing; 1999.
12. Genetic engineering - Principles and Practice; Sandhya Mitra; Macmillan India Ltd., New Delhi.
13. Biotechnology - Fundamentals and Applications; Third Enlarged Edition; S.S. Purohit; Student Edition, Jodhpur; 2005.
14. Cell and Molecular Biology; Eighth Edition; E.D.P. De Robertis, E.M.F. De Robertis Jr.; Info-Med Ltd.; 1988.
15. Genetics (Bios Instant Notes); Third Edition; G.I. Hickey, H.L. Fletcher and P. Winter; Taylor and Francis Group, New York; 2007.
16. Genetics - A Conceptual Approach; Third Edition; Benjamin A. Pierce; W.H. Freeman and Company, New York; 2008.
17. Human Molecular Genetics; Fourth Edition; Tom Strachan and Andrew Read; Garland Science, USA; 2011.
18. Genetics; M.W. Farnsworth; Harper and Row Publishers, Inc., USA; 1978. Human Genetics - An Overview; Alice Marcus; Narosa Publishing House; 2010.

19. Bioinformatics - Concepts, Skills, and Applications; S.C. Rastogi & others; CBS Publishing; 2003.
20. Bioinformatics - A practical guide to analysis of Genes & Proteins; Andreas D Baxevanis & B F Francis; John Wiley; 2000.
21. Bioinformatics; 1st Edition; C S V Murthy; Himalaya Publishing House; 2003. Bioinformatics sequence and genome analysis; David W. Mount; Cold spring Harbor Laboratory Press; 2004.
22. Molecular Evolution: A Phylogenetic Approach; Roderick D.M. Page, Dr Edward C. Holmes; Well Publishing; 1998.
23. Proteomics - From Protein Sequence to Function; 12 S. R. Pennington, M. J. Dunn; First edition; Springer publications; 2001.
24. Metabolomics - A Powerful Tool in Systems Biology; Jens Hřiriis Nielsen, Michael C. Jewett; Springer; 2007.
25. Understanding Bioinformatics; Marketa Zvelebil and Jeremy O. Baum; Garland Science (Taylor and Francis Group); 2008.
26. Bioinformatics Computing - The complete practical guide to bioinformatics for life scientists; Bryan Bergeron; Eastern Economy Edition; Prentice-Hall of India Pvt. Ltd., New Delhi; 2003.
27. Bioinformatics; Prakash S. Lohar; MJP Publishers, Chennai; 2009.
28. Introduction to Bioinformatics; First Edition; S. Sundara Rajan and R. Balaji; Himalaya Publishing House, Mumbai; 2002.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class test	20
Assignment	10
Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 12 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (60 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options		Unit	Marks
1.	Answer any two out of the three (6 marks each)		1	12
2.	Answer any two out of the three (6 marks each)		2	12
3.	Answer any two out of the three (6 marks each)		3	12
4.	Answer any two out of the three (6 marks each)		4	12
5.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.		1,2,3,4	12

Practical Examination Pattern:

(A) Internal Examination

(B)

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(C) External (Semester end practical examination)

(D)

Particulars	Practical
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (T. Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Environmental Biology and Zoo pharmacognosy**
Course Code (refer to student handbook)	USZO604 (Course-XVIII)
Class	T.Y.B. Sc.
Semester	VI
No of Credits	4
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: **Environmental Biology and Zoo pharmacognosy**

CO1- Learner will understand the different factors affecting environment, its impact and environment management laws.

CO2- Learner will be able to understand various methods for wildlife conservation.

CO3- Learner will be able to apply knowledge to overcome the issues related to wildlife conservation and management.

CO4- Learner will understand the paradigms of discovery and commercialization of biological resources and knowledge gained from self-medication observed in animals.

CO5-The learners will become acquainted with how and why different animal species are distributed around the globe.

Curriculum:

Unit	Title	Learning Points	No of Lectures
I	**Environment management**	**1.1 Natural resources and their Classification** 1.1.1: Forest resources, water resources (surface and ground) and mineral resources 1.1.2: Energy resources: renewable (solar, tidal, wind, biofuel) and non-renewable resources (coal, petroleum oil, natural gas) **1.2: Exploitation and Modification of Natural Resources:** Impact on climate, flora and fauna **1.3: Waste Management** 1.3.1: Technologies in solid waste management: a) Traditional methods for solid waste management: Composting, Incineration, Landfill Recycling, Windrow composting b) Modern methods for solid waste management: Anaerobic digestion, ethanol production, bio-drying, pyrolysis, Up-flow anaerobic sludge blanket (UASB) technology, waste autoclave 1.3.2: e-waste and hazardous waste (biological, chemical, medical and nuclear) management **1.4: Water management** 1.4.1: Rain water harvesting: Definition ways of harvesting, components, model of rain water harvesting: Rural and Urban, Advantages and disadvantages 1.4.2: Watershed management: Definition, need and objectives, classification (mini, micro, mili, sub-watershed, macro-watershed), Watershed management practices: Contour, gully control, stone bunds. Growing greenery and integrated watershed approach (IWA). 1.4.3: Case study: Ice-stupa artificial glaciers by Sonam Wangchuk 1.4.4: Effluent treatment, recycling plants, control and treatment of sewage water. **1.5: Acts and Rules of Environment Management** 1.5.1: Environment Protection Act- 1986, Air (Prevention and Control of Pollution) Act-1981,	**15**

		Water (Prevention and Control of Pollution) Act-1974 1.5.2: Hazardous Wastes (Management and Handling) Rules-1989 1.5.3: EIA (Environmental Impact Assessment) 1.5.4: Role of Central and State Government (Pollution Control Board) and NGOs	
II	**Wildlife Management**	**2.1 Habit, Habitat, Territory and Niche of Wild Animals:** Herbivores, carnivores, solitary, social (flock, pod, community), pack and herd, types of habitats and territories, niche concept **2.2: Threats to Wildlife** 2.2.1: Poaching and hunting, deforestation, encroachment, competition (intra-specific and inter-specific), overgrazing and climate change, diseases (zoonosis and reverse zoonosis) 2.2.2: Tourism and human animal conflict **2.3: Wildlife Conservation** 2.3.1: Techniques and methods used for wildlife census: Aerial counts, camera trap, line transect census and track surveys, capture mark recapture method, wildlife radio telemetry 2.3.2: Forest management, policies and Acts: Harvesting Trees, Thinning harvest, Clear cut Harvest, Shelterwood harvest, Seed tree harvest, Group selection harvest, Single-tree selection harvest, Prescribed burning, Reforestation Forestpolicy1894, 1952,1988; The Indian ForestAct,1927; Forest (Conservation) Act, 1980	**15**
III	**Bioprospecting and Zoo pharmacognosy**	**3.1: Bioprospecting** 3.1.1: Traditional and modern bioprospecting, economic value of bioprospecting 3.1.2: Bioprospecting and conservation, advantages and disadvantages **3.2: Zoo pharmacognosy** 3.2.1: Definition and types 3.2.2: Self-medication and its mechanism 3.2.3: Methods of self-medication through: a) Ingestion-ants and mammals b) Geophagy-invertebrates and birds c) Absorption and adsorption 3.2.4: Applications - Social and trans-generational aspects of insects, birds and mammals 3.2.5: Contribution to human medicines	**15**
IV	**Zoogeography**	**4.1: Introduction:** Plate tectonics and continental drift theory **4.2: Animal Distribution and Barriers** 4.2.1: Isolating Mechanisms	**15**

		4.2.2: Patterns of animal distribution-continuous, discontinuous and bipolar 4.2.3: Barriers of distribution-Topographic, climatic, vegetative, large water masses, landmass, lack of salinity and special characteristic habit (homing instinct). 4.2.4: Means of dispersal-land bridges, natural rafts and driftwood, favouring gales, migration by host, accidental transportation and by human agencies **4.3: Zoogeographical Realms:** Palearctic, Ethiopian, Oriental, Australian, Neotropical, Nearctic and Antarctic	

	PRACTICALS	**1.5 Credits**
1.	Estimation of phosphates from sample water.	
2.	Estimation of BOD from sample water.	
3.	Estimation of COD from sample water.	
4.	Estimation of Nitrates from sample water.	
5.	Estimation ofacidityandalkalinityofsamplewaterbymethylorangeandphenolphthaleini ndicator.	
6.	Comparative study of sound intensity in different places by Decibel meter.	
7.	Study of bioprospecting:	
	Tumour suppression compounds e.g. Sponge.	
	Skin erythema treatment from gel-*Aloe vera, Aloe ferox.*	
8.	Study of Zoo pharmacognosy in ants, cats, elephants and dogs.	
9.	Indicate the distribution of fauna in the world map with respect to its realm and comment on the pattern of distribution. a. Palearctic: Giant Panda and Japanese Macaque b. Ethiopian: Common ostrich and African bush elephant c. Oriental: Indian one-horned Rhinoceros and Gharial d. Australian: Platypus and Red Kangaroo e. Neotropical: Guanaco and South American Tapir f. Nearctic: Virginia opossum and Sea otter g. Antarctic: Emperor Penguin and Antarctic Minke Whale	
10.	Excursion (Study tour / Visit) to Zoo / Sanctuary / National Park / Research institute, etc. and submit a report. College may conduct more than one field visit for wide exposure, if feasible. However, at least one field visit should be such that it is affordable to every student.	

N.B:

I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

II) Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority / Body from time to time, every college should constitute the following Committees:

1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and

2) A Dissection Monitoring Committee (DMC) to ensure that no dissections or mountings are done using animals.

Composition of DMC shall be as follows:

i) Head of the Concerned Department (Convener / Chairperson)
ii) Two Senior Faculty Members of the concerned Department
iii) One Faculty of related department from the same College
iv) One or two members of related department from neighbouring colleges.

USE OF ANIMALS FOR ANY EXPERIMENT /DISSECTION /MOUNTING IS BANNED. SIMULATIONS, AUTHORIZED PERMANENT SPECIMENS/SLIDES, CHARTS, MODELS AND OTHER INNOVATIVE METHODS ARE ENCOURAGED.

Learning Resources recommended:

1. Essentials of Environmental Science; N. Vasudevan; Narosa Publishing House Pvt. Ltd. New Delhi 110002.
2. Environmental Biology; P.S Verma, V.K Agarwal; S. Chand & company Ltd. New Delhi 110055.
3. A textbook of Environmental Science; Arvind Kumar; A P H Publishing Corporation, New Delhi 110002.
4. Environmental Biotechnology - Basic Concepts and Application; Indu Shekhar Thakur; I.
5. K. International Pvt. Ltd. New Delhi 110016.
6. Text book of environmental science; S. C.Santra. Wildlife management; Rajesh Gopal.
7. Wildlife Management and Conservation - Contemporary Principles and Practices; Paul R. Krausman and James W. Cain III.
8. Wildlife Ecology, Conservation, and Management; John M. Fryxell, Anthony R. E. Sinclair, Graeme Caughley.
9. Molecular Biotechnology - Principles and Practices; Channarayappa. Biotechnology - P. K. Gupta.
10. Biotechnology - B. D. Singh.
11. Biotechnology Fundamentals & Applications - S. S. Purohit. Pharmacognosy and Pharmaco biotechnology- Ashutosh Kar. Trease and Evans Pharmacognosy - Evans, W.C. Pharmacognosy - Kokate, C. K. A. and Purohit, A.P.
12. Practical Pharmacognosy- Gokhale, S. B. and Kokate, C. K. Text book of Pharmacognosy; T. E. Wallis.
13. Zoogeography - The Geographical Distribution of Animals; Philip J. Darlington JR;
14. Academic Publishers, Kolkata Animal Geography - Newbegin. Vertebrate Paleontology - Romer.
15. Ecological animal geography- Allee, Park and Schmidt.
16. Zoogeography of India and South East Asia - Dr. S. K. Tiwari; CBS Publishers and Distributors, Delhi; 1985.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	Marks
Class test	20
Assignment	10
Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 12 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (60 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	Answer any two out of the three (6 marks each)	1	12
2.	Answer any two out of the three (6 marks each)	2	12
3.	Answer any two out of the three (6 marks each)	3	12
4.	Answer any two out of the three (6 marks each)	4	12
5.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3,4	12

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	**Practical**
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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R.E. Society's

R. P. GOGATE COLLEGE OF ARTS & SCIENCE AND R.V. JOGALEKAR COLLEGE OF COMMERCE, RATNAGIRI (AUTONOMOUS)

NAAC accredited 'A' Grade (3rd Cycle)

Ratnagiri-415612 (Maharashtra-India)

Bachelor of Science (B. Sc.) Programme

Program: T.Y.B. Sc.
Course: Fishery Biology
(Applied Component)

Syllabus for Semester III & IV

Under Choice Based Credit System (CBCS)

To be implemented from Academic Year 2023-2024

PREAMBLE:

Welcome to the exciting world of Fishery Biology at the T. Y. B. Sc. (Third Year Bachelor of Science) level! This syllabus has been thoughtfully crafted to cater to the unique coastal environment and rich aquatic resources surrounding Gogate College, Ratnagiri, a coastal district in Maharashtra. Our program aims to equip you with the knowledge and practical skills required to understand, manage, and sustainably utilize the diverse aquatic ecosystems of this region.

Gogate College, situated in the heart of a coastal district, is uniquely positioned to offer an applied component of Fishery Biology that draws from the local marine and freshwater environments. The study of fishery biology here takes on special significance as it directly contributes to the conservation and management of the region's aquatic resources, which play a vital role in the livelihoods of local communities and the overall health of our coastal ecosystems.

Throughout this course, you will explore various aspects of fishery biology, including the biology and ecology of fish and other aquatic organisms, fisheries management, aquaculture techniques, and the sustainable use of aquatic resources. You will gain hands-on experience in collecting data from local aquatic ecosystems, analysing it, and using the information to make informed decisions about fisheries and conservation.

As a student of Fishery Biology at Gogate College, you have a unique opportunity to connect classroom learning with real-world challenges. Your education will extend beyond the four walls of the classroom as you engage in fieldwork, interact with local stakeholders, and contribute to the sustainable management of the region's fisheries and aquatic biodiversity.

This syllabus is designed to empower you with the knowledge and skills needed to pursue careers in fisheries management, marine conservation, aquaculture, research, and more. It is our hope that you will become ambassadors for responsible and sustainable fisheries practices, contributing to the long-term health and prosperity of the coastal communities in Ratnagiri and beyond.

As you embark on this academic journey, remember that the coastal waters of Ratnagiri hold a wealth of opportunities and knowledge waiting to be discovered. Embrace this unique learning experience, immerse yourself in the rich marine environment, and let your studies in Fishery Biology be a source of inspiration and stewardship for the aquatic ecosystems of this remarkable coastal region.

Best wishes for your academic and practical endeavours in Fishery Biology at Gogate College, Ratnagiri.

Chairperson,
BOS in Zoology,
Gogate Jogalekar College,
Ratnagiri.

Syllabus for T. Y. B. Sc. Course: ZOOLOGY

Applied Component

Fishery Biology

Credit Based Semester and Grading System

(To be implemented from the Academic Year 2023-2024)

SEMESTER – V

COURSE CODE	UNIT	TOPIC	CREDITS	LECTURES /WEEK
USACFBIO501	I	Oceanography	2	1
	II	Crafts and Gear		1
	III	Farming of major carps		1
	IV	Quality control and packaging		1
			2	**4**
USACFBIO501		Practicals based on all four courses	1	**4**
Total Number of Credits and Workload			3	**8**

SEMESTER – VI

COURSE CODE	UNIT	TOPIC	CREDITS	LECTURES /WEEK
USZO501	I	Marine Fin-fish of India	2	1
	II	Nutrition		1
	III	Diseases		1
	IV	By-products and Value-Added Products		1
			2	**4**
USZOP05		Practicals based on all four courses	1	**4**
Total Number of Credits and Workload			3	**8**

Syllabus for (T.Y.B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Oceanography, Aquaculture Practices, Marketing and Finance**
Course Code (refer to student handbook)	USACFBIO501
Class	T.Y.B.Sc.
Semester	05
No of Credits	02
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Applied Component
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: Oceanography, Aquaculture Practices, Marketing and Finance

Course Outcomes:

CO1-Learner shall understand and learn about the use of sea safety, navigational equipments and oceanographic instruments

CO2- Learner shall understand basic physical, chemical and biological oceanography

CO3-Learner shall comprehend boat building techniques and design of engines used in mechanized boats

CO4-Learner will gain knowledge about the postmortem changes, spoilage mechanisms and methods involved in evaluating the freshness and quality of fishes and prawns / shrimps

CO5-Learner shall comprehend the value of maintaining and taking sanitary precautions during the processing and packaging operations

CO6- Learner shall understand the operations of various types of nets and fishing method learner shall understand breeding techniques, hatchery and management of fin- fish and shell fishes

Curriculum:

Unit	Title	Learning Points	No of Lectures
1.	**Oceanography**	1.1 Navigational and sea safety equipments i) Life saving devices ii) Global Positioning System (GPS) iii) Rudder iv) Signaling devices 1.2 Oceanographic Instruments i) Niskin water sampler ii) Peterson's grab iii) Dredges iv) Fish finding instruments / Methods v) Remote sensing 1.3 Introduction to basic physical, chemical and biological oceanography	**15**
2.	**Crafts and Gear**	2.1 Basic boat building (parts, design, material used), methods of protection from fouler and borers 2.2 Basic studies of marine engines: i) Outboard and Inboard Engines ii) Sectional View of 2-stroke and 4-stroke Diesel engines iii) Winch and Deck Side Equipment 2.3 Operations: i) Gill, Trawl, Purse seine Nets ii) Hooks and Lines iii) Non-conventional Fishing Methods such as • Light Fishing • Hose Pipe Fishing • Electric Fishing	**15**
3.	**Farming of major carps**	3.1 Breeding techniques of major carps and common carp	**15**

		3.2 Hatchery and nursery management of: • Major carps: i) IMCs: *Labeo rohita* (Rohu), *Catla catla* (Catla), *Cirrhinus mrigala* (Mrigal) ii) Exotic carps: *Hypophthalmichthys molitrix* (Silver carp), *Ctenopharyngodon idella* (Grass carp) iii) *Cyprinus carpio* (Common carp) 3.3 Mono-culture and polyculture practices: i) Extensive ii) Semi-intensive iii) Intensive	
4.	**Quality control and packaging**	6.1 Post mortem changes and mechanism of spoilage: i) Hyperaemia ii) Rigor mortis iii) Autolysis iv) Rancidity 6.2 Brief methods for evaluating freshness and quality of fish and prawns / shrimps i) Organoleptic ii) Microbial iii) Chemical 6.3 Sanitary operations i) Maintenance of hygiene of food contact surfaces, storage and equipment ii) Water quality, ice, sewage and waste water disposal and effluent treatment plant 6.4 Various packaging materials used in freezing and canning industry i) Polyolefin ii) Wax duplex carton iii) Master carton iv) Can v) Lacquered can vi) Retort vii) Freezing procedures including hygienic washing, dressing 6.5 Quality Policy and Quality Analysis: ISO 22000/HACCP/ BRC/IFS	**15**

	PRACTICALS USACFBIO501	1 Credits
1.	Identification and functioning of oceanographic instruments: • Niskin water sampler • Peterson's Grab • Dredge	
2.	Layout of fishing vessels and sectional view of 2 stroke and 4 stroke diesel engines, lifesaving equipment, winch and deck side equipment.	
3.	Identification of various stages of development of carps and study of sexual dimorphism in adults. Indian major carps: • *Labeo rohita* (Rohu) • *Catla catla* (Catla) • *Cirrhinus mrigala* (Mrigal) Exotic carps: • *Cyprinus carpio* (Common Carp) • *Hypophthalmichthys molitrix* (Silver Carp) • *Ctenopharyngodon idella* (Grass Carp)	
4.	Identification of fishes: • *Anabas testudineus* (Climbing perch) • *Clarius batrachus* (Walking catfish) • *Boleophthalmus spp.* (Mudskipper) • *Pangasianodon hypophthalmus* (Iridescent shark) • *Pangasius bocourti* (Basa catfish) • Tilapia(GIFT)	
5.	Study of models and functioning of D 81 hatchery, Shirgur's hatcheries and Chinese hatchery.	
6.	Microbial studies: i. Dilution of sample ii.Gram staining technique iii.Identification of Bacilli, Cocci, Vibrio bacteria	
7.	Organoleptic tests for fish and prawn / shrimp	
8.	Total Plate Count (TPC) of bacteria from fish.	
9.	Identification of packaging materials: • Waxed duplex carton • Master carton • Simple cans • Coated [Lacquered] cans • Polyolefin • Retort	
10.	Estimation of toxins and moulting retardant • H2S (qualitative) • Ammonia (qualitative) • Ca (quantitative) • Mg (quantitative)	
11.	Assignment (may be submitted in a group not exceeding three students)	

Please refer the Annexure I for the suggested topics for assignment for Course code USACFBIO5P1.

***Note – The practicals may be conducted by using specimens authorized by the wild life and such other regulating authorities though it is strongly recommended that the same should be taught by using photographs/audio-visual aids/simulations/ models etc. as recommended by the UGC and as envisaged in the regulation of the relevant monitoring bodies. No new specimens, however, shall be procured for the purpose of conducting practicals mentioned here-in above.**

N.B:

I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).

II) Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority / Body from time to time, every college should constitute the following Committees:

1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and

2) A Dissection Monitoring Committee (DMC) to ensure that no dissections or mountings are done using animals.

Composition of DMC shall be as follows:

i) Head of the Concerned Department (Convener / Chairperson)

ii) Two Senior Faculty Members of the concerned Department

iii) One Faculty of related department from the same College

iv) One or two members of related department from neighbouring colleges.

USE OF ANIMALS FOR ANY EXPERIMENT /DISSECTION /MOUNTING IS BANNED. SIMULATIONS, AUTHORIZED PERMANENT SPECIMENS/SLIDES, CHARTS, MODELS AND OTHER INNOVATIVE METHODS ARE ENCOURAGED.

Evaluation pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	**Marks**
Class test	20
Assignment	10
Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 12 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (60 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	Answer any two out of the three (6 marks each)	1	12
2.	Answer any two out of the three (6 marks each)	2	12
3.	Answer any two out of the three (6 marks each)	3	12
4.	Answer any two out of the three (6 marks each)	4	12
5.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3,4	12

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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Syllabus for (T.Y. B. Sc.) Autonomous from the year 2023-24

Name of the Course	**Marine resources, Post-harvest and Farm Engineering**
Course Code (refer to student handbook)	USACFBIO601
Class	T.Y.B.Sc.
Semester	06
No of Credits	02
Nature	Theory/ Practical/ Field visit
Type (applicable to NEP only)	Applied Component
Highlight revision specific to employability/ entrepreneurship/ skill development (if any) 100 words	

Nomenclature: Marine resources, Post-harvest and Farm Engineering Course Outcomes:
CO1- Learner shall understand deep sea and coastal fishes.
CO2- Learner shall understand commercial potential and know about the major landing centers of the fishes.
CO3-Learner will get acquainted with basics of nutritional requirements at various developmental stages of fish and crustaceans.
CO4-Learner will be oriented towards understanding causes, pathogenicity, prophylaxis and preventive measures of various fish diseases and physiological disorders
CO5-Learner will gain sound knowledge about the fish by-products and value-added products
CO6- Learner will explore good manufacturing practices while manufacturing these products

Curriculum:

Unit	Title	Learning Points	No of Lectures
1	**Marine Fin-fish of India**	1.1 Coastal fisheries: i) *Stromateus cinereus* (Silver pomfret) ii) *Stromateus niger* (Black pomfret) iii) *Polynemus tetradactylus* (Threadfin) iv) *Pseudosciaena diacanthus* (Two-spined Jewfish or Ghol) v) *Synagris japonicus* (Blackmouth splitfin) vi) *Scomber microlepidotus* (Mackerel) vii) *Cybium guttatum* (Seerfish or Surmai) viii) *Sardinellal ongiceps* Indian Oil Sardine 1.2 Deep sea fisheries (more than 45 fathoms) of Indian exclusive economic zone • *Thunnus alalunga* (Longfin tuna) • *Sarda orientalis* (Striped bonito) 1.3 Commercial potential and major landing centers of the above fishes	**15**
2	**Nutrition**	3.1 Nutritional requirements at various stages of development of fish and crustaceans 3.2 Culture of natural feed: i) Chaetoceros ii) Infusoria iii) Artemia iv) Brachionus v) Daphnia / Moina spp. 3.3 Algology – Identification and culture of commercially important nutritious algae and its products 3.4 Formulated / Pelleted feed – Understanding the composition and use of formulated feed for fish and prawns / shrimps at various stages	**15**
3	**Diseases**	4.1 Viral diseases, prophylaxis and preventive measures	**15**

		4.2 Bacterial, fungal, protozoan infections and treatment 4.3 Crustacean infections and treatment 4.4 Physiological disorders (Dropsy) / diseases and treatment	
4	**By-products and Value-Added Products**	6.1 Proximate composition of fish meat and products 6.2 Introduction to by-products i) Fish protein concentrate ii) Fish maws / Isinglass iii) Fish hydrolysates iv) Chitin, Chitosan v) Glucosamine hydrochloride vi) Gelatin vii) Fish silage viii) Surimi and imitation products ix) Pearl essence 6.3 Different types of value added products from fish and shell fish i) Fish / Prawn / Shrimp pickle ii) Fish wafers iii) *Acetes indicus* (Prawn) chutney iv) Fish soup powder v) Fish / Crab steaks vi) RTE (Ready To Eat) vii) Battered and breaded products viii) Marinated tandoori prawns ix) Prawn curry 6.4 Good manufacturing practices: Health and training of personnel, hygiene	**15**

	PRACTICALS USACFBIO501	1 Credit
1.	Identification of marine fishes. • *Stromateus cinereus* (Silver pomfret) • *Stromateus niger* (Black pomfret) • *Polynemus tetradactylus* (Threadfin) • *Pseudosciaena diacanthus* (Two-spinned jewfish or Ghol) • *Trichiurus haumela* (Ribbon fish) • *Synagris japonicus* (Blackmouth splitfin) • *Scomber microlepeidotus* (Mackerel) • *Cybium guttatum* (Seerfish or Surmai) • *Sardinella longiceps* (Indian Oil Sardine) • *Thunnus alalunga* (Longfin tuna)	
2.	Preparation of formulated feed for fish and prawn.	
3.	Identification of parasitic infections in aquatic organisms. • Fungal – Dermatomycosis	

	• Bacterial – Fin/Tail rot and Dropsy • Protozoan – Costiasis and White Spot • Crustacean – Argulosis	
4.	Fish dressing, filleting, prawn peeling – PUD, DV and grading.	
5.	Fish morphometry – Length weight relationship of a suitable fish.	
6.	Preparation of Surimi, Fish protein concentrate.	
7.	Preparations of fish burger, fish fingers, fish/prawn pickle, fish chutney, fish curry.	
8.	Preparation of Chitin – Chitosan, Pearl essence.	
9.	Identification of various farm equipment such as: • Feeding cups / Trays • Paddle wheel aerator • Fountains • Sluice gate models • Elbow pipe outlets	
10.	Study of models of raft, pen, cage culture and materials used in rope culture.	
11.	Project – Feasibility / Scientific.	
12.	Field Visit Report. **(Refer Annexure-I)**	

Learning Resources recommended:

1) A Text Book of Marine Ecology by Nair M.B. and Thumpy D.H. – Tata MacGraw Hill Pub. – New Delhi.
2) An Introduction to Fishes by Khanna S.S. – Central Book Depot, Allahabad (1993).
3) Aquaculture, Principles and Practices by Pillay T.V.R. – Fishing New Books (1988).
4) Course Manual in Fishing Technology by Latha Shenoy, CIFE, Versova, Mumbai.
5) Crafts and Gear of India by Y. Shrikrishnan and Latha Shenoy – ICAR Pub.
6) Ecological Methods for Field and Laboratory Investigations by P. Michael. The Oceans By Svedrup H.V. – et.al. - Asian Pub. House.
7) Financial management by Prasanna Chandra- Seventh Edition.
8) Financial management by Khan and Jain.
9) Financial management by I. M. Pandey.
10) Fish Biology by C.B.C. Srivastava – Narendra Pub. House.
11) Fish and Fisheries by Chandy – National Book Trust.
12) Fish and Fisheries in India – by Jhingran V.G. – Hindustan Pub. Corporation – New Delhi.
13) Fisheries Biology, Assessment and Management by Michael King – Fishing News Publishers (1995).
14) Fishery Science by Santhanam R. – Daya Pub. House – 1990.
15) Fisheries Bioeconomic – Theory, Modelling and Management – FAO Fisheries Technical Paper 368 – FAO, 2001.
16) General and Applied Ichthyology by Gupta and Gupta, S Chand Publishers.
17) Handbook of Fish Biology and Fisheries Edited By J.B. Hart and John Reynold.
18) Hand Book of Fresh Water Fishes of India by Beaven C.R. – Narendra Pub. House.
19) Introductory Oceanography by Harold Thurman – Printis Hall Pub. London – 8th Edition.
20) Marine Ecology by Tait R.B. – Oxford Press.
21) Marine Fish and Fisheries by Dr. D. V. Bal and K.V. Rao - Tata MacGraw Hill Pub. – New

Delhi.
22) Marketing Management by Philip Kotler.
23) Modern Fishing Gear Technology by N. Shahul Hameed, Boopendranath – Daya Pub. House – 2000.
24) Prawn and Prawn Fisheries by Kurian and Sebestian.
25) Project Management by Prasanna Chandra.

For Additional and Latest Information on the topics, various Web Sites can be visited.

Please refer the **Annexure II** for the suggested field visits and **Annexure – III** for suggested topics for projects for Course code USACFBIO6P1.
*Note – The practicals may be conducted by using specimens authorized by the wild life and such other regulating authorities though it is strongly recommended that the same should be taught by using photographs/audio-visual aids/simulations/ models etc. as recommended by the UGC and as envisaged in the regulation of the relevant monitoring bodies. No new specimens, however, shall be procured for the purpose of conducting practical mentioned here-in above.

N.B:
I) It is pertinent to note that we have to adhere strictly to the directions as given in the UGC Circular F14-4/2006 (CPP-II).
II) Apart from the Institutional Animal Ethics Committee (IAEC) and any other Committee appointed by a Competent Authority / Body from time to time, every college should constitute the following Committees:
1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and
2) A Dissection Monitoring Committee (DMC) to ensure that no dissections or mountings are done using animals.

Composition of DMC shall be as follows:
i) Head of the Concerned Department (Convener / Chairperson)
ii) Two Senior Faculty Members of the concerned Department
iii) One Faculty of related department from the same College
iv) One or two members of related department from neighbouring colleges.

USE OF ANIMALS FOR ANY EXPERIMENT /DISSECTION /MOUNTING IS BANNED. SIMULATIONS, AUTHORIZED PERMANENT SPECIMENS/SLIDES, CHARTS, MODELS AND OTHER INNOVATIVE METHODS ARE ENCOURAGED.

Annexures

Annexure -I

Suggested Topics for Assignment USACFBIO5P1 (Teachers are expected to develop additional innovative topics, varying every year, to be assigned to the students)

1) Market survey for various preserved and processed fish / prawns.
2) Observation on handling of fish on board, at landing center, in secondary market and at consumer level.
3) Survey of the local market for the availability of various by-products / value added products and its price.
4) Comparative study of the shelf life of various fishes / fish by-products / value added products in relation to their cost.
5) Study of economics of brackish water pond culture.
6) Study of working of fisheries co-operative societies in your area.
7) Study of cost of construction of fishing vessel and subsidies available for the same.
8) Study of cost of gear manufacturing with different materials and subsidies available for the same.
9) Study of cost and profit analysis of any one of the following methods – Trawler / Gill netter / Purse seiner /hooks and lines and non-mechanized fishing units.
10) Survey of various packaging materials used in fish processing industries.
11) Survey of various feeds used in local aqua farms.
12) Study of economics of pond culture from nearby area.
13) Comparative cost analysis of fingerlings of major carps from your area.
14) Setting up of marine / fresh water aquarium with various accessories and its costing.
15) Survey of costing of aquaria of different sizes and shape.
16) Study of various courses run by Institutes in your area in relation to fisheries.
17) Survey of aquarium shops to compare the costs of various aquarium fishes.
18) Study of economics involved in breeding / rearing of aquarium fishes.
19) Review of different marketing strategy (w.r.t. attracting target clients) used by manufacturers of fish products / byproducts / value added products.
20) Survey of target clients of manufacturers of fish products / byproducts / value added products.
21) Study of working of financial institutions involved in funding fishing industry.
22) Review of export import procedures followed by the fishing industry in your area.
All the topics mentioned above are suggestive in nature and more creative and innovative topics are expected from the students under the able guidance of concerned teachers, to suit the expertise, human resources, infrastructure and local needs as also the interest of the students.
The assignment may be submitted in a group not exceeding three students.

Annexure - II
Suggested Field Visits USACFBIO6P1

- There shall be various short and long excursions / study tours / field visits / industrial visits in every semester, at least one of which shall be financially affordable to every student in the class; and that assessment and marks of field trips shall be solely based upon such where no student was restrained for financial limitations.

- Field visits are to be organized to facilitate students to have firsthand experience and exposure to technology / production / functioning of an organization / unit or witness a relevant activity.

- Each student must make at least 01 (one) such visits to the units/markets/sea shores out of 2 to 3 such visits organized by the college.

- **The list is suggestive and not exhaustive**

I) Visit to one of the units with one or multiple activities such as:
- Ornamental / Brackish water / Fresh water fish farm / hatchery

II) Visit to witness one of the activities such as
- Fish angling / trawling / purse seining / gill netting
- Fish finding operations, etc. (Echo Sounder / Sonar / Fish Magnifier)

III) Visit any production units such as
- Food / Fish processing and preservation
- Ornamental articles

IV) Hi-tech and multinational total export-oriented units such as
- IQF plant
- Surimi plant
- Fishery plant
- Microbiological units
- Hi–tech fish / prawn / chick hatcheries
- Fish consumer product industries

V) Others –
- Self-Sale Groups
- Co-operative Societies

VI) Govt. Offices such as
- Fishery Department
- MPEDA
- Wild-life Authority

- CITES
- JDEI (Jt. Director-Export and Import)
- Sales Tax
- Income Tax
- Excise Department
- Customs Authority of India
- Local Self Govt. (BMC)
- Clearing Agencies / Agents
- FDA
- ISI
- Agmark, etc.

VII) Visit any ancillary unit such as

- Ice plant
- Can reforming
- Packaging
- Cold storage

VIII) Visit to National Laboratories, National Research Labs and Training Institutes such as NIO, CIFE, CMFRI, CIFT, FSI, IFP, CIFI, CIFNET, NBFGR, etc.

IX) Following places may be considered for short/long excursions:
- Ganpatipule beach
- Dapoli (Harnai / Harne Port Fish Auctioning)/ Dabhol / Burondi
- Mirkarwada Harbour (Major fish landing and assembling centre, Ratnagiri)
- Rajiwada (Satellite landing centre, Ratnagiri town)
- Guhagar beach (Use of Solunar Clock for fishing)
- Karla (Ratnagiri) – First Fisherman co-operative society of India (Estd. 1913)
- Marine Biological Research Station, Zadgaon, Ratnagiri (Aquarium Management Training Programme)

Annexure III

Suggested Topics for Project USACFBIO6P1 (Teachers are expected to develop additional innovative topics, varying every year, to be assigned to the students)

1) Feasibility report of the maintenance of aquarium fishes in high profile residences.
2) Feasibility report of fresh water / brackish water fish / prawn culture for extensive, semi-intensive and intensive.
3) Probability report of maintenance of a culture of Chaetopteros and Artemia by the fish farmers.
4) Project report for the establishment of small / medium / large scale ice factory, freezing and canning industry.
5) Feasibility report of various packaging materials in freezing / canning industry.
6) Feasibility report for establishing an aquarium shop.
7) Feasibility report for establishing a fish feed industry.
8) Monitoring various physico-chemical parameters of an aquarium / pond / lake / river / sea.
9) Feasibility report for establishing value added products of fish / shell fish.
10) Project report for culture of commercially important nutritious algae and its products.
11) Project report on survey of fish markets for fluctuation in the availability and price of fishes.

The project may be submitted in a group not exceeding three students.

Evaluation Pattern:

A. Internal Evaluation- 40 % 40 Marks

Method	Marks
Class test	20
Assignment	10

Class participation & overall conduct	10
Total	**40**

B. External Evaluation - 60%

Semester End Evaluation (Paper Pattern)- 60 Marks

1. The examination shall be of 2 Hours duration. Maximum marks 60.
2. There shall be four questions each of 12 marks. On each unit there will be one question and the fourth question will be based on entire syllabus or as per the directive of BOS.
3. All questions shall be compulsory with internal choice within the questions.
4. Question may be subdivided into sub-questions A and B and the allocation of marks depend on the weightage of the topic.

Distribution of marks for descriptive external examination (60 marks)
All the Questions are compulsory

Time: 2 hours **Total marks: 60**

Question No.	Options	Unit	Marks
1.	Answer any two out of the three (6 marks each)	1	12
2.	Answer any two out of the three (6 marks each)	2	12
3.	Answer any two out of the three (6 marks each)	3	12
4.	Answer any two out of the three (6 marks each)	4	12
5.	Multiple Choice Questions/True or false/One sentence answer/Define/Give appropriate answer etc.	1,2,3,4	12

Practical Examination Pattern:

(A) Internal Examination

Heading	Practical
Journal	05
Lab Participation	05
Lab work/ Field work	05
Viva-voce	05
Total	**20**

(B) External (Semester end practical examination)

Particulars	Practical
Lab work	30
Total	**30**

PRACTICAL BOOK/JOURNAL

Students must present a duly certified journal to be eligible for the practical examination; otherwise, they will not be permitted to participate. If a journal and/or report is lost, a Lost Certificate must be obtained from the Head/Coordinator/Department In-charge. Failure to do so will result in the student being unable to participate in the practical examination.

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