

**UNIVERSITY OF MUMBAI**

No. UG/34 of 2018-19

**CIRCULAR:-**

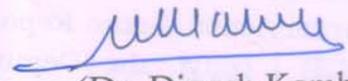
Attention of the Principals of the affiliated Colleges and Directors of the recognized Institutions in Science & Technology Faculty is invited to this office Circular No. UG/02 of 2016-17, dated 21<sup>st</sup> April, 2016 relating to syllabus of the Bachelor of Science (B.Sc.) degree course.

They are hereby informed that the recommendations made by the Board of Studies in Zoology at its meeting held on 9<sup>th</sup> April, 2018 have been accepted by the Academic Council at its meeting held on 5<sup>th</sup> May, 2018 **vide** item No. 4.31 and that in accordance therewith, the revised syllabus as per the (CBCS) for the S.Y.B.Sc. in Zoology (Sem - III & IV) has been brought into force with effect from the academic year 2018-19, accordingly. (The same is available on the University's website [www.mu.ac.in](http://www.mu.ac.in)).

MUMBAI-400 032

22<sup>nd</sup> June, 2018

To



(Dr. Dinesh Kamble)

I/c REGISTRAR

The Principals of the affiliated Colleges & Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9<sup>th</sup> January, 2018.)

**A.C/4.31/05/05/2018**

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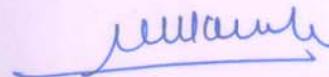
No. UG/ 34 -A of 2018

MUMBAI-400 032

22<sup>nd</sup> June, 2018

Copy forwarded with Compliments for information to:-

- 1) The I/c Dean, Faculty of Science & Technology,
- 2) The Chairman, Board of Studies in Zoology,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Co-Ordinator, University Computerization Centre,



(Dr. Dinesh Kamble)

I/c REGISTRAR

**UNIVERSITY OF MUMBAI**



**Program: S.Y.B. Sc.**

**Course: Zoology**

**Syllabus for Semester III & IV**

(Choice Based Credit System with effect  
from the academic year 2018-2019)

## S. Y. B. Sc. Syllabus Framing Committee

Sr. No.	Name	Address	Status
1	Dr. Anita Jadhav readersmailbox@rediffmail.com	Head & Associate Prof., Department of Zoology, ICL College, Vashi, Navi-Mumbai	I/C Chairperson, BoS in Zoology
2	Mr. Vinayak Dalvie <a href="mailto:dalvie@gmail.com">dalvie@gmail.com</a>	Head & Associate Prof., Mithibai College, Vile Parle (W), Mumbai- 56	Chief Coordinator
3	Dr. Gulabrao B. Raje <a href="mailto:drgbraje@rediffmail.com">drgbraje@rediffmail.com</a>	Head & Associate Prof., Department of Zoology, D. B. J College, Chiplun, Dist: Ratnagiri	Coordinator
4	Capt. Nilima S. Prabhu nilsprabhu@rediffmail.com	Assistant Prof., Department of Zoology, S.S. &L.S. Patkar College, Goregaon, Mumbai-62	Convenor USZO301& USZO401
5	Dr. Dilip K. Kakavipure dlpkakavipure@gmail.com	Associate Prof., Department of Zoology, BNN College, Bhiwandi, Dist: Thane	Convenor USZO302& USZO402
6	Mr. Venkatesh Hegde <a href="mailto:drvnhegde@rediffmail.com">drvnhegde@rediffmail.com</a>	Assistant Prof., Department of Zoology, Mithibai College, Vile Parle (W), Mumbai-56	Convenor USZOE303A & USZOE403A (Elective 1)
7	Dr. Surekha Manoj Gupta <a href="mailto:gupta.surekha@yahoo.com">gupta.surekha@yahoo.com</a>	Assistant Prof., Department of Zoology, G. N. Khalsa College, Matunga, Mumbai-19	Convenor USZOE303B& USZOE403B (Elective 2)
8	Dr. Shaheda Rangoonwala shaheda.rangoonwala@gmail.com	Principal, V. N. College, Murud Janjira, Dist: Raigad	Co-Convenor USZO301 & USZO401
9	Dr. Shashibhal M. Pandey pandey.shashibhal@gmail.com	Assistant Prof., Department of Zoology, CHM College, Ulhasnagar-3	Co-Convenor USZO302 & USZO402
10	Dr. Leena Murlidharan <a href="mailto:leena.doctor@gmail.com">leena.doctor@gmail.com</a>	Associate Prof., Department of Zoology, VKK Menon College, Bhandup (E), Mumbai -42	Co-Convenor USZOE303A & USZOE403A (Elective 1)
11	Dr. Shirley Bless Agwuocha shirley_bless@rediffmail.com	Assistant Prof., Department of Zoology, Thakur College of Science & Com., Kandivali (E)	Co-Convenor USZOE303A & USZOE403A (Elective 1)
12	Dr. Nisar Shaikh <a href="mailto:nisargmmwc@gmail.com">nisargmmwc@gmail.com</a>	Principal, DRT's A. E. Kalsekar Degree College, Kausa Mumbra, Dist: Thane -12	Co-Convenor USZOE303B& USZOE403B (Elective 2)
13	Dr. Sushant Mane <a href="mailto:sushantmane@yahoo.com">sushantmane@yahoo.com</a>	Assistant Prof., Department of Zoology, Wilson College, Girgaon, Mumbai-7	Member USZO301 & USZO401
14	Dr. Meena Poonja meenaprasad123@gmail.com	Assistant Prof., Department of Zoology, CHM College, Ulhasnagar-3	Member USZO301 & USZO401
15	Mr. T. V. Bicheesh Balan <a href="mailto:bicheesh@gmail.com">bicheesh@gmail.com</a>	Assistant Prof., Department of Zoology, Mithibai College, Vile Parle (W), Mumbai-56	Member USZO301 & USZO401

16	Mr. Nandu R. Hedulkar <a href="mailto:hedulkar@gmail.com">hedulkar@gmail.com</a>	Head & Assistant Prof., Department of Zoology, Anandibai Raorane College, Vaibhavwadi, Dist: Sindhudurg	Member USZO302 & USZO402
17	Dr. Pratiksha P. Sawant <a href="mailto:sawant.pratiksha52@gmail.com">sawant.pratiksha52@gmail.com</a>	Associate Prof., Department of Zoology, S.P.K. College, Sawantwadi, Dist: Sindhudurg	Member USZO302 & USZO402
18	Dr. Kamran Abbas <a href="mailto:kamranabbas14@gmail.com">kamranabbas14@gmail.com</a>	Head & Associate Prof., Department of Zoology, GMM College, Bhiwandi, Dist: Thane	Member USZO302 & USZO402
19	S/Lt. (Dr.) Kantilal Hiridas Nagare <a href="mailto:birlasparc11@gmail.com">birlasparc11@gmail.com</a>	Assistant Prof., Department of Zoology, Birla College, Kalyan, Dist: Thane -421304	Member USZOE303A & USZOE403A (Elective 1)
20	Mr. Nikhil Disoria <a href="mailto:nikhil.disoria@gmail.com">nikhil.disoria@gmail.com</a>	Assistant Prof., Department of Zoology, National College, Bandra (W), Mumbai -50	Member USZOE303A & USZOE403A (Elective 1)
21	Dr. Minakshi Gurav <a href="mailto:minakshi.gurav@ruparel.edu">minakshi.gurav@ruparel.edu</a>	Assistant Prof., Department of Zoology, Ruparel College, Mahim, Mumbai -16	Member USZOE303B & USZOE403B (Elective 2)
22	Dr. Harish T. Babar <a href="mailto:harishbabar@gmail.com">harishbabar@gmail.com</a>	Assistant Prof., Department of Zoology, D. B. J College, Chiplun, Dist: Ratnagiri- 415605	Member USZOE303B & USZOE403B (Elective 2)

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## **PREFACE**

Holistic development of students is the main purpose of the curriculum. While this is attempted through prescribing dynamic and updated curricular inputs, the new course that will be effective from the academic year 2018- 2019, will follow the Semester mode. The main aim of the revision of syllabus was to modify it to meet the unique requirements of students, up gradation of knowledge in the subject of zoology and to inculcate the skill of reasoning. The contents of the syllabus have been drawn-up to accommodate the widening horizons of the discipline of Biological Sciences. All possible attempts have been made to update the syllabus by incorporating current and most recent developments in various branches of Zoological Sciences, nevertheless, classical zoology also has been given due weightage. Introduction of an elective paper in zoology will also provide a glimpse of its application. Inclusion of research methodology to the undergrads is the highlight of the course. I am sure that these revised syllabi will cater to better understanding of the subject and beyond.

I appreciate and congratulate the entire team of syllabus framing for the co-operation, tireless work and wish them success.

**Chairperson,  
Ad-hoc Board of Studies in Zoology**

## **PREAMBLE**

As a traditional procedural norm of the University of Mumbai, it is the Board of Studies that includes various disciplines, which revive the syllabi after completion of a cycle of five years. Due to rapid advancement in technology, new ideas and concepts, and an ocean of information being generated every day that necessitates updating the students in this present era of exponential information and knowledge. However, in the former practice of syllabus revision, students were unable to imbibe new ideas and concepts as there was limited scope of including them within the syllabi that was theoretical with poor applicability

Looking at the employment generating potential and need of trained human resource in various service sectors in our state, it was became imperative to make a breakthrough from the traditional practice of revising syllabus; and instead giving an opportunity to the stakeholders to adapt and acclimatize with the changes around them and imbibe knowledge which shall enable them to develop entrepreneurship and / or employment avenues and opportunities after pursuing the coveted degree.

With this intention, the Board of Studies in Zoology took decision to put before the S. Y. B. Sc. Zoology students one elective, so that they can study topics of their interest. Board of Studies in Zoology is the only Board in the University that has offered two electives for the S. Y. B. Sc. students and safeguarded their career. Further, BoS formulated Four Syllabus Review Committees (one per course with composition of 01 Convenor and 04 Members). All the committee members worked extensively and exhaustively; and prepared draft of the syllabus. The said draft was uploaded on the website of University of Mumbai for public criticism. The invited opinions were thereby incorporated in the syllabus to make it versatile and student friendly with high applicability. Further, the draft syllabus was re-discussed in the workshop where several teachers and students contributed their views to improve it. In the academic year 2016-17, new syllabus was introduced but it is revived immediately after two years with inclusion of new concepts and techniques. Due care is taken to make the syllabus interdisciplinary, flexible and choice based. All the member teachers have tried their level best to come out with “Need Based Syllabus” that may spark motives in all the stakeholders. We hope that the stakeholders will enjoy the learning of this syllabus in the classrooms, laboratories and on the field.

**Dr. G. B. Raje**  
**Coordinator**

## PEDAGOGY

While disseminating the content of the present syllabus, it is imperative and expected that the facilitator is well versed or/and develops their Pedagogical Content Knowledge (PCK), which would include aspects like content, methodology, evaluation and so on. At the onset, the facilitator may include various topic-specific instructional strategies, employing the use of organizers (topic announcement in advance, making models, flip charts, photography, etc). Learning of topics on chromosomes, nucleic acids, cell biology, biomolecules, physiological processes are hence revised, and during the presentations by the learner, the facilitator is able to gauge the preconceptions and learning disabilities. Any misunderstanding of basic concepts can thus be clarified such as 'difference between gene and allele'. Peer teaching is another aspect of pedagogy which takes into account participative learning thus enhancing the learning of the content and making it enjoyable, for example, the use of 'Punnet squares' for working out the crosses in various illustrations on monohybrid and dihybrid ratios, problems based on inheritance, pedigree analysis, molecular biology etc. A declarative learning strategy, which employs the use of familiar contexts and analogies, illustrative diagrams, questioning techniques, discussions, may be used for topics like multiple alleles, polygenic inheritance, DNA testing for paternity issues, scientific attitude, methodology, scientific writing etc. This would enhance the relevance of these topics and engender motivation, thereby balancing the blend of content and pedagogy in teaching. The syllabus includes practical investigations, individual or group student experiments, simulations to assist learners in visualizing and /or internalizing the concepts and processes. The learner could be encouraged to organize field trips, nature trails and treks in and around the ecosystems like lakes, beaches, sanctuaries, national-parks etc. for learning topics like ethology and conservation, amazing animals, applied zoology, pollution and other such, where sensitization, awareness and action are to be invoked within the learner. Visits to museums, and an interdisciplinary approach with various departments like geology, history, geography, chemistry, psychology, medicine would bring about a multi and cross approach to learning concepts such as paleontological evidences, nucleic acids, physiological processes, biomolecules, holistic health and neurological and genetic diseases . ICT enabled learning is the need of the hour and could include screening of documentaries, videos, animations, PPT's, and the use of social media such as Whatsaap, Instagram, Facebook be employed for impactful and continued learning. Facilitators can upload the teaching material, videos of lectures, links to websites for not only enhancing but also focusing and developing the topics of interest by the learner by way of self-study. More importantly, the syllabus endeavours to develop life skills by discovering and

honing entrepreneurial skills of the learner. To accomplish this purpose, visits to apiary, vermicomposting units, and dairy could be encouraged, also interviews with various entrepreneurs, officials of funding agencies must be undertaken to comprehend the nuances of business. Also small projects on various entrepreneurial aspects like setting up vermicomposting bins and aquaria, sale of the vermicompost or setting up an ornamental fish farms, innovations in dairy products and its sale could be encouraged in the campuses. The elective papers are so construed that the learner is driven to gain knowledge, experience through activity-based assignments, and projects, which would enhance entrepreneurial skills, a logical understanding and analysis of business functions.

**Capt. Nilima Prabhu**  
**Dr. Dilip Kakavipure**  
**Mr. Venkatesh Hegde**  
**Dr. Surekha Gupta**  
Convenors

**Syllabus for S. Y. B. Sc. Course: ZOOLOGY**  
**Credit Based Semester and Grading System**  
**(To be implemented from the Academic Year 2018-2019)**

**SEMESTER – III**

<b>COURSE CODE</b>	<b>UNIT</b>	<b>TOPIC</b>	<b>CREDITS</b>	<b>LECTURES /WEEK</b>
<b>USZO301</b>	I	Fundamentals of Genetics	2	1
	II	Chromosomes and Heredity		1
	III	Nucleic Acids		1
<b>USZO302</b>	I	Nutrition and Excretion	2	1
	II	Respiration and Circulation		1
	III	Control and Coordination of Life Processes, Locomotion and Reproduction		1
<b>USZOE303A ELECTIVE 1</b>	I	Ethology	2	1
	II	Parasitology		1
	III	Economic Zoology		1
<b>USZOE303B ELECTIVE 2</b>	I	Maintenance of Aquarium	2	1
	II	Agricultural, Household Pests and their Control		1
	III	Amazing Animals		1
<b>USZOP3</b>	Practicals based on all three courses		03	<b>9</b>

**Important Note:** College may choose either Elective 1 or Elective 2 for Semester III and Semester IV as their third course depending on the preference selected by majority of the students and endorsed by Head of the Department of Zoology and the Principal of the college.

## SEMESTER IV

<b>COURSE CODE</b>	<b>UNIT</b>	<b>TOPIC</b>	<b>CREDITS</b>	<b>LECTURES /WEEK</b>
<b>USZO401</b>	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
<b>USZO402</b>	I	Cell Biology	2	1
	II	Endomembrane System		1
	III	Biomolecules		1
<b>USZOE403A ELECTIVE 1</b>	I	Comparative Embryology	2	1
	II	Aspects of Human Reproduction		1
	III	Pollution and its Effect on Organisms		1
<b>USZOE403B ELECTIVE 2</b>	I	Dairy Industry	2	1
	II	Sericulture		1
	III	Aquaculture		1
<b>USZOP4</b>	Practicals based on all three courses		03	9

**Important Note:** College may choose either Elective 1 or Elective 2 for Semester III and Semester IV as their third course depending on the preference selected by majority of the students and endorsed by Head of the Department of Zoology and the Principal of the college.

## UNIT WISE DISTRIBUTION OF SYLLABUS

Semester III				Semester IV			
Course 5	Course 6	(Elective 1) Course 7A	(Elective 2) Course 7B	Course 8	Course 9	(Elective 1) Course 10A	(Elective 2) Course 10B
Unit 1 Fundamentals of Genetics	Unit 1 Nutrition & Excretion	Unit 1 Ethology	Unit 1 Maintenance of Aquarium	Unit 1 Origin & Evolution of Life	Unit 1 Cell Biology	Unit 1 Comparative Embryology	Unit 1 Dairy Industry
Unit 2 Chromosomes & Heredity	Unit 2 Respiration & Circulation	Unit 2 Parasitology	Unit 2 Agricultural & Household Pests & their Control	Unit 2 Population Genetics & Evolution	Unit 2 Endomembrane System	Unit 2 Aspects of Human Reproduction	Unit 2 Sericulture
Unit 3 Nucleic Acids	Unit 3 Control and Coordination of Life Processes, Locomotion & Reproduction	Unit 3 Economic Zoology	Unit 3 Amazing Animals	Unit 3 Scientific Attitude, Methodology, Scientific Writing & Ethics in Scientific Research	Unit 3 Biomolecules	Unit 3 Pollution & its Effects on Organisms	Unit 3 Aquaculture
Practical (USZO P3)	Practical (USZO P3)	Practical (USZO P3)	Practical (USZO P3)	Practical (USZO P4)	Practical (USZO P4)	Practical (USZO P4)	Practical (USZO P4)

## SEMESTER III

Sr. No.	USZO301 (Course-V)	No. of lectures allotted	Learning pleasure
	<b>Fundamentals of Genetics, Chromosomes and Heredity, Nucleic acids</b>		
	<b>Unit 1: Fundamentals of Genetics</b>	<b>15L</b>	<b>25hrs</b>
	<b>Objectives:</b> ➤ <i>To introduce basic terms of genetics.</i> ➤ <i>To develop conceptual clarity of Mendelian principles of inheritance and other forms and pattern of inheritance</i>		
	<b>Desired outcome:</b> ➤ <i>Learner would comprehend and apply the principles of inheritance to study heredity.</i> ➤ <i>Learner will understand the concept of multiple alleles, linkage and crossing over.</i>		
<b>1.1</b>	<b>Introduction to Genetics</b> <ul style="list-style-type: none"> <li>• Definition, Scope and Importance of Genetics.</li> <li>• Classical and Modern concept of Gene (Cistron, Muton, Recon).</li> <li>• Brief explanation of the following terms: Allele, Wild type and Mutant alleles, Locus, Dominant and Recessive traits, Homozygous and Heterozygous, Genotype and Phenotype, Genome.</li> </ul>	<b>02L</b>	<b>02hrs</b>
<b>1.2</b>	<b>Mendelian Genetics</b> <ul style="list-style-type: none"> <li>• Mendelian Genetics: Monohybrid &amp; Dihybrid Cross, Test Cross, Back Cross, Mendel's Laws of Inheritance, Mendelian Traits in Man.</li> <li>• Exceptions to Mendelian inheritance: Incomplete dominance, Co-dominance, Lethal Genes, Epistasis - Recessive, Double recessive, Dominant and Double dominant.</li> <li>• Chromosome theory of inheritance.</li> <li>• Pedigree Analysis-Autosomal dominant and recessive, X- linked dominant, and recessive.</li> </ul>	<b>08L</b>	<b>12hrs</b>

1.3	<b>Multiple Alleles and Multiple Genes</b> <ul style="list-style-type: none"> <li>• Concept of Multiple Alleles, Coat colour in rabbit, ABO and Rh blood group system</li> <li>• Polygenic inheritance with reference to skin colour and eye colour in humans.</li> <li>• Concept of Pleiotropy.</li> </ul>	03L	06hrs
1.4	<b>Linkage and Crossing Over</b> <ul style="list-style-type: none"> <li>• Linkage and crossing over, Types of crossing over, Cytological basis of crossing over.</li> </ul>	02L	05hrs
<b>Unit: 2: Chromosomes and Heredity</b>		15L	26hrs
<b>Objectives:</b> <ul style="list-style-type: none"> <li>➤ <i>To familiarize the learners with the structure, types and classification of chromosomes.</i></li> <li>➤ <i>To introduce the concept of sex determination and its types, sex influenced and sex-limited genes.</i></li> </ul>			
<b>Desired outcome:</b> <ul style="list-style-type: none"> <li>➤ <i>Learner will comprehend the structure of chromosomes and its types.</i></li> <li>➤ <i>Learner will understand the mechanisms of sex determination.</i></li> <li>➤ <i>Learner would be able to correlate the disorders linked to a particular sex chromosome.</i></li> </ul>			
2.1	<b>Chromosomes</b> <ul style="list-style-type: none"> <li>• Types of Chromosomes–Autosomes and Sex chromosomes</li> <li>• Chromosome structure - Heterochromatin, Euchromatin</li> <li>• Classification based on the position of centromere</li> <li>• Endomitosis, Giant chromosomes- Polytene and Lampbrush chromosomes and Significance of Balbiani rings</li> </ul>	04L	08hrs

2.2	<b>Sex- determination</b> <ul style="list-style-type: none"> <li>• Chromosomal Mechanisms: XX-XO, XX-XY, ZZ-ZW</li> <li>• Sex determination in Honey bees: Haplo-diploidy</li> <li>• Sex determination in <i>Drosophila</i>- Genic balance theory, Intersex, Gynandromorphs</li> <li>• Parthenogenesis</li> <li>• Hormonal influence on sex determination- Freemartin and Sex reversal.</li> <li>• Role of environmental factors- <i>Bonelia</i> and Crocodile</li> <li>• Barr bodies and Lyon hypothesis</li> </ul>	07L	10hrs
2.3	<b>Sex linked, sex influenced and sex-limited inheritance.</b> <ul style="list-style-type: none"> <li>• X-linked: Colour-blindness, Haemophilia</li> <li>• Y-linked: Hypertrichosis</li> <li>• Sex-influenced genes</li> <li>• Sex-limited genes</li> </ul>	04L	08hrs
<b>Unit: 3 Nucleic acids</b>		15L	30hrs
<b>Objectives:</b> <ul style="list-style-type: none"> <li>➤ <i>To introduce the learner to the classical experiments proving DNA as the genetic material.</i></li> <li>➤ <i>To introduce the learner the structure of nucleic acids and the concept of central dogma of molecular biology.</i></li> <li>➤ <i>To familiarize the learner with the concept of gene expression and regulation.</i></li> </ul>			
<b>Desired outcome:</b> <ul style="list-style-type: none"> <li>➤ <i>Learner will understand the importance of nucleic acids as genetic material.</i></li> <li>➤ <i>Learner would comprehend and appreciate the regulation of gene expressions.</i></li> </ul>			
3.1	<b>Genetic material</b> <ul style="list-style-type: none"> <li>• Griffith's transformation experiment, Avery-Macleod &amp; McCarty</li> </ul>	07L	14hrs

	<p>experiment and Hershey Chase experiment of Bacteriophage infection</p> <ul style="list-style-type: none"> <li>• Chemical composition and structure of nucleic acids</li> <li>• Double helix nature of DNA, Solenoid model of DNA</li> <li>• Types of DNA – A, B, Z &amp; H forms</li> <li>• DNA in Prokaryotes - Chromosomal and Plasmid</li> <li>• Extra nuclear DNA - Mitochondria and Chloroplast</li> <li>• RNA as a genetic material in virus</li> <li>• Types of RNA: Structure and function</li> </ul>		
<b>3.2</b>	<p><b>Flow of genetic information in a eukaryotic cell</b></p> <ul style="list-style-type: none"> <li>• DNA Replication</li> <li>• Transcription of mRNA</li> <li>• Translation</li> <li>• Genetic code</li> </ul>	<b>05L</b>	<b>08hrs</b>
<b>3.3</b>	<p><b>Gene expression and regulation</b></p> <ul style="list-style-type: none"> <li>• One gene-one enzyme hypothesis /one polypeptide hypothesis</li> <li>• Concept of Operon</li> <li>• Lac Operon</li> </ul>	<b>03L</b>	<b>08hrs</b>

	<b>SEMESTER – III</b>		
<b>Sr. No</b>	<b>USZO302 (COURSE-VI)</b>	<b>No. of lect allotted</b>	<b>Learning pleasure</b>
	<b>Nutrition and Excretion, Respiration and Circulation, Control and Coordination of Life Processes, Locomotion and Reproduction</b>		
	<b>Unit: 1 Nutrition and Excretion</b>	<b>15L</b>	<b>23hrs</b>
	<b>Objectives:</b> <ul style="list-style-type: none"> <li>➤ <i>To introduce the concepts of physiology of nutrition, excretion and osmoregulation.</i></li> <li>➤ <i>To expose the learner to various nutritional apparatus, excretory and osmoregulatory structures in different classes of organisms.</i></li> </ul>		
	<b>Desired outcome:</b> <ul style="list-style-type: none"> <li>➤ <i>Learner would understand the increasing complexity of nutritional, excretory and osmoregulatory physiology in evolutionary hierarchy.</i></li> <li>➤ <i>Learner would be able to correlate the habit and habitat with nutritional, excretory and osmoregulatory structures.</i></li> </ul>		
<b>1.1</b>	Comparative study of nutritional apparatus (structure and function): Amoeba, Hydra, Cockroach, Amphioxus, Pigeon, Ruminants.	<b>05L</b>	<b>06hrs</b>
<b>1.2</b>	Physiology of digestion in man.	<b>02L</b>	<b>04hrs</b>
<b>1.3</b>	Comparative study of excretory and osmoregulatory structures and functions. a) Amoeba -Contractile vacuole b) Planaria -Flame cells c) Cockroach- Malpighian tubules	<b>05L</b>	<b>08hrs</b>
<b>1.4</b>	Categorization of animals based on principle nitrogenous excretory products	<b>01L</b>	<b>01hrs</b>
<b>1.5</b>	Structure of kidney, uriniferous tubule and physiology of urine formation in man	<b>02L</b>	<b>04 hr</b>

	<b>Unit: 2 Respiration and Circulation</b>	<b>15L</b>	<b>27hrs</b>
	<b>Objectives:</b> <ul style="list-style-type: none"> <li>➤ <i>To introduce the concepts of physiology of respiration and circulation</i></li> <li>➤ <i>To expose the learner to various respiratory and circulatory organs in different classes of organisms.</i></li> </ul>		
	<b>Desired outcome:</b> <ul style="list-style-type: none"> <li>➤ <i>Learner would understand the increasing complexity of respiratory and circulatory physiology in evolutionary hierarchy.</i></li> <li>➤ <i>Learner will be able to correlate the habit and habitat of animals with respiratory and circulatory organs.</i></li> </ul>		
<b>2.1</b>	Comparative study of respiratory organs (structure and function): Earthworm, Spider, Any bony fish (Rohu / <i>Anabas</i> / <i>Clarius</i> ), Frog and Pigeon.	<b>03L</b>	<b>06hrs</b>
<b>2.2</b>	Structure of lungs and physiology of respiration in man	<b>02L</b>	<b>03hrs</b>
<b>2.3</b>	Comparative study of circulation: (a) Open and Closed type, (b) Single and Double type.	<b>02L</b>	<b>04hrs</b>
<b>2.4</b>	Types of circulating fluids- Water, Coelomic fluid, Haemolymph, Lymph and Composition of blood	<b>02L</b>	<b>03hrs</b>
<b>2.5</b>	Comparative study of hearts (structure and function): Earthworm, Cockroach, Shark, Frog, Crocodile and Pigeon.	<b>04L</b>	<b>07hrs</b>
<b>2.6</b>	Structure and mechanism of working of heart in man.	<b>02</b>	<b>04hrs</b>
	<b>Unit: 3 Control and Coordination, Locomotion and Reproduction</b>	<b>15L</b>	<b>25hrs</b>
	<b>Objectives:</b> <ul style="list-style-type: none"> <li>➤ <i>To introduce the concepts of physiology of control and coordination, locomotion and reproduction.</i></li> <li>➤ <i>To expose the learner to various locomotory and reproductive structures in different classes of organisms.</i></li> </ul>		
	<b>Desired outcome:</b> <ul style="list-style-type: none"> <li>➤ <i>Learner would understand the process of control and coordination by nervous and endocrine regulation.</i></li> </ul>		

	<ul style="list-style-type: none"> <li>➤ <i>Learner would be amazed by various locomotory structures found in the animal kingdom.</i></li> <li>➤ <i>Learner would be acquainted with various reproductive strategies present in animals.</i></li> </ul>		
<b>3.1</b>	<b>Control and co-ordination</b> <ul style="list-style-type: none"> <li>• Irritability in <i>Paramecium</i>, nerve net in <i>Hydra</i>, nerve ring and nerve cord in earthworm.</li> <li>• Types of neurons based on the structure and function.</li> <li>• Conduction of nerve impulse: Resting potential, Action potential and Refractory period</li> <li>• Synaptic transmission</li> </ul>	<b>05L</b>	<b>08hrs</b>
<b>3.2</b>	<b>Movement and Locomotion</b> Locomotory organs- structure and functions; <ol style="list-style-type: none"> <li>a. Pseudopodia in <i>Amoeba</i> (Sol- Gel theory), Cilia in <i>Paramecium</i></li> <li>b. Wings and legs in cockroach</li> <li>c. Tube feet in starfish</li> <li>d. Fins of fish</li> </ol>	<b>04L</b>	<b>08hrs</b>
<b>3.3</b>	Structure of striated muscle fibre in human and sliding filament theory	<b>02L</b>	<b>02hrs</b>
<b>3.4</b>	<b>Reproduction</b> <ol style="list-style-type: none"> <li>a. <b>Asexual Reproduction</b>- Fission, Fragmentation, Gemmule formation and Budding</li> <li>b. <b>Sexual reproduction</b> <ol style="list-style-type: none"> <li>i. Gametogenesis</li> <li>ii. Structure of male and female gametes in human</li> <li>iii. Types of fertilization</li> <li>iv. Oviparity, Viviparity, Ovo-viviparity</li> </ol> </li> </ol>	<b>04L</b>	<b>07hrs</b>

	<b>SEMESTER III</b>		
	<b>USZOE1303 (COURSE-VIIA) ELECTIVE 1</b>		
	<b>Ethology, Parasitology, Economic Zoology</b>	<b>15L</b>	<b>26hrs</b>
	<b>Unit: 1 Ethology</b>		
	<p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ <i>To equip learner with a sound knowledge of how animals interact with one another and their environment.</i></li> <li>➤ <i>To enable the learner to understand different behavioural patterns.</i></li> </ul>		
	<p><b>Desired Outcome:</b></p> <ul style="list-style-type: none"> <li>➤ <i>Learner would gain insight into different types of animal behaviour and their role in biological adaptations.</i></li> <li>➤ <i>Learner would be sensitized to the feelings which are instrumental in social behaviour.</i></li> </ul>		
<b>1.1</b>	<p><b>Introduction to Ethology:</b></p> <ul style="list-style-type: none"> <li>• Definition, History and Scope of Ethology</li> <li>• Animal behaviour : Innate and Learned behaviour</li> <li>• Types of learning: Habituation, Imprinting and Types of imprinting - Filial and sexual, Classical conditioning</li> <li>• Instrumental learning and insight learning.</li> </ul>	<b>04L</b>	<b>06hrs</b>
<b>1.2</b>	<p><b>Aspects of animal behaviour:</b></p> <ul style="list-style-type: none"> <li>• Communication in bees and ants</li> <li>• Mimicry and colourations</li> <li>• Displacement activities, Ritualization</li> <li>• Migration in fish, schooling behaviour</li> <li>• Habitat selection, territorial behaviour.</li> </ul>	<b>07L</b>	<b>12hrs</b>
<b>1.3</b>	<p><b>Social behaviour:</b></p> <ul style="list-style-type: none"> <li>• Social behaviour in primates-Hanuman langur</li> <li>• Elements of socio-biology: Altruism and Kinship</li> </ul>	<b>04L</b>	<b>08hrs</b>

	<b>Unit: 2 Parasitology</b>	<b>15L</b>	<b>27hrs</b>
	<p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ <i>To acquaint the learner with the concepts of parasitism and its relationship in the environment.</i></li> <li>➤ <i>To introduce the learner to modes of transmission of parasites.</i></li> </ul>		
	<p><b>Desired Outcome:</b></p> <ul style="list-style-type: none"> <li>➤ <i>Learner would understand the general epidemiological aspects of parasites that affect humans and take simple preventive measures for the same.</i></li> <li>➤ <i>Learner would comprehend the life cycle of specific parasites, the symptoms of the disease and its treatment.</i></li> </ul>		
<b>2.1</b>	<p><b>Introduction to Parasitology and Types of Parasites</b></p> <ul style="list-style-type: none"> <li>• Definitions: Parasitism, Host, Parasite, Vector-biological and mechanical</li> <li>• Types of parasite- Ectoparasite, Endoparasite and their subtypes</li> <li>• Parasitic adaptations in Ectoparasites and Endoparasites</li> <li>• Types of host: Intermediate and definitive, reservoir</li> </ul>	<b>03L</b>	<b>06hrs</b>
<b>2.2</b>	<p><b>Host-parasite relationship and host specificity</b></p> <ul style="list-style-type: none"> <li>• Different types of host- parasite relationship, structural specificity, physiological specificity and ecological specificity</li> </ul>	<b>02L</b>	<b>06hrs</b>
<b>2.3</b>	<p><b>Life cycle, pathogenicity, control measures and treatment</b></p> <ul style="list-style-type: none"> <li>• <i>Entamoeba histolytica, Fasciola hepatica, Taenia solium, Wuchereria bancrofti</i></li> </ul>	<b>04L</b>	<b>06hrs</b>
<b>2.4</b>	<p><b>Morphology, life cycle, pathogenicity, control measures and treatment</b></p> <ul style="list-style-type: none"> <li>• Head louse (<i>Pediculus humanus capitis</i>), Mite (<i>Sarcoptes scabiei</i>), Bed bug (<i>Cimex lectularis</i>)</li> </ul>	<b>02L</b>	<b>06hrs</b>
<b>2.5</b>	<p><b>Parasitological significance</b></p> <ul style="list-style-type: none"> <li>• Zoonosis- Bird flu, Anthrax, Rabies and Toxoplasmosis</li> </ul>	<b>04L</b>	<b>03hrs</b>

	<b>Unit 3 Economic Zoology</b>	<b>15L</b>	<b>24hrs</b>
	<p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ To disseminate information on economic aspects of animals like apiculture, vermiculture and dairy science.</li> <li>➤ To encourage young learner for self-employment.</li> </ul>		
	<p><b>Desired Outcome:</b></p> <ul style="list-style-type: none"> <li>➤ Learner would gain knowledge on animals useful to mankind and the means to make the most of it.</li> <li>➤ Learner would learn the modern techniques in animal husbandry.</li> <li>➤ Learner would pursue entrepreneurship as a career.</li> </ul>		
<b>3.1</b>	<b>APICULTURE</b>	<b>06L</b>	<b>08hrs</b>
<b>3.1.1</b>	<p><b>Methods of bee keeping and management</b></p> <ul style="list-style-type: none"> <li>• Introduction to different species of honey bees used in apiculture.</li> <li>• Selection of flora and bees for apiculture.</li> <li>• Advantages and disadvantages of traditional and modern methods of apiculture.</li> <li>• Pests and Bee enemies- Wax moth, wasp, black ants, bee-eaters, king crow and disease control</li> </ul>		
<b>3.1.2</b>	<p><b>Economic importance</b></p> <ul style="list-style-type: none"> <li>• Honey- Production, chemical composition and economic importance</li> <li>• Bee wax- Composition and economic importance.</li> <li>• Role of honey bee in pollination.</li> </ul>		
<b>3.2</b>	<b>VERMICULTURE</b>	<b>04L</b>	<b>08hrs</b>
<b>3.2.1</b>	<p><b>Rearing methods, management and economic importance</b></p> <ul style="list-style-type: none"> <li>• Introduction to different species of earthworms used in vermiculture.</li> <li>• Methods of vermiculture.</li> <li>• Maintenance and harvesting</li> </ul>		

	<ul style="list-style-type: none"> <li>Economic importance: Advantages of vermiculture, demand for earthworms; market for vermicompost and scope for entrepreneurship.</li> </ul>		
<b>3.3</b>	<b>DAIRY SCIENCE</b>	<b>05L</b>	<b>08hrs</b>
<b>3.3.1</b>	<b>Dairy development in India</b> <ul style="list-style-type: none"> <li>Role of dairy development in rural economy, employment opportunities</li> </ul>		
<b>3.3.2</b>	<b>Dairy Processing</b> <ul style="list-style-type: none"> <li>Filtration, cooling, chilling, clarification, pasteurization, freezing</li> </ul>		
<b>3.3.3</b>	<b>Milk and milk products</b> <ul style="list-style-type: none"> <li>Composition of milk</li> <li>Types of milk: <ul style="list-style-type: none"> <li>a) Buffalo milk</li> <li>b) Cow milk (A1 &amp;A2)</li> </ul> </li> <li>Whole milk and toned milk</li> <li>Milk products</li> </ul>		

	<b>SEMESTER III</b>		
	<b>USZOE2303 (COURSE-VIIB) – ELECTIVE 2</b>		
	<b>Maintenance of Aquarium, Agricultural and Household pests and their control , Amazing animals</b>	<b>15L</b>	<b>26hrs</b>
	<p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ <i>To develop skills for maintenance of aquarium and budgeting for setting up an aquarium and ornamental fish farm.</i></li> <li>➤ <i>To study the biology of ornamental fishes, its food and feeding and their transportation.</i></li> </ul>		
	<p><b>Desired Outcome:</b></p> <ul style="list-style-type: none"> <li>➤ <i>Learner will develop skills for maintenance of aquarium and become familiar with the budgeting aspects for setting up an ornamental fish farm.</i></li> <li>➤ <i>Learner will derive knowledge about the biology of ornamental fishes, its food and feeding habits and their transportation.</i></li> </ul>		
	<b>Unit.1 Maintenance of Aquarium</b>		
<b>1.1</b>	Introduction and scope.	<b>02L</b>	<b>04hrs</b>
<b>1.2</b>	Exotic and Endemic species.	<b>02L</b>	<b>06hrs</b>
<b>1.3</b>	Biology of aquarium fishes: <ul style="list-style-type: none"> <li>• Guppy</li> <li>• Molly</li> <li>• Gold fish</li> </ul>	<b>02L</b>	<b>08hrs</b>
<b>1.4</b>	Common characters and sexual dimorphism of marine fishes: <ul style="list-style-type: none"> <li>• Anemone fish</li> <li>• Butterfly fish</li> </ul>	<b>02L</b>	<b>06hrs</b>

<b>1.5</b>	Food and feeding: <ul style="list-style-type: none"> <li>• Live fish feed</li> <li>• Formulated fish feed</li> </ul>	<b>02L</b>	<b>04hrs</b>
<b>1.6</b>	Fish transportation: i) Handling ii) Packing iii)Transport	<b>03L</b>	<b>05hrs</b>
<b>1.7</b>	General maintenance of aquarium and budget for setting up an ornamental fish farm.	<b>02L</b>	<b>04hrs</b>
	<b>Unit: 2 Agricultural pests and their control</b>	<b>15L</b>	<b>27hrs</b>
	<b>Objectives:</b> <ul style="list-style-type: none"> <li>➤ <i>To study different types of pests.</i></li> <li>➤ <i>To comprehend various aspects of agricultural and household pests and their economic implications.</i></li> <li>➤ <i>To learn about the different pest control measures and plant protection appliances.</i></li> </ul>		
	<b>Desired Outcome:</b> <ul style="list-style-type: none"> <li>➤ <i>Learner will gain information on the different types of pests and comprehend various aspects of agricultural and household pests and its economic implications.</i></li> <li>➤ <i>Learner will derive knowledge of pest control measures and appliances used for plant protection against pests.</i></li> </ul>		
<b>2.1</b>	Introduction and concept of pest	<b>02L</b>	<b>06hrs</b>
<b>2.1.1</b>	Types of pests: <ul style="list-style-type: none"> <li>• Agricultural: Locust</li> <li>• Household: Bed bug</li> <li>• Stored grains: Flour beetle</li> <li>• Structural: Termites</li> <li>• Veterinary: Tick</li> <li>• Forestry: Grasshopper</li> </ul>	<b>03L</b>	<b>06hrs</b>

<b>2.2</b>	Major insect pests of agricultural importance (Life cycle, nature of damage and control measures). a) Jowar stem borer b) Brinjal fruit borer c) Aphids d) Rice weevil e) Pink bollworm	<b>03L</b>	<b>06hrs</b>
<b>2.3</b>	Other pests: Rats, bandicoots, crabs, snails, slugs, birds and squirrels	<b>02L</b>	<b>06hrs</b>
<b>2.4</b>	Pest control measures: i) Cultural control ii) Physical control iii) Mechanical control iv) Chemical control v) Biological control, vi) Concept of IPM	<b>03L</b>	<b>03hrs</b>
<b>2.5</b>	Plant protection appliances: Rotary duster, knapsack sprayer and cynogas pump, hazards of pesticides and antidotes.	<b>02L</b>	<b>03hrs</b>
<b>Unit 3 Amazing animals</b>			
	<b>Unit 3 Amazing animals</b>	<b>15L</b>	<b>24hrs</b>
	<b>Objectives:</b> ➤ <i>To comprehend the concept of life timeline, and the natural history of some amazing animals.</i> ➤ <i>To kindle interest and yearning to study amazing animals.</i>		
	<b>Desired Outcome:</b> ➤ <i>Learner would understand the concept of life time-line.</i> ➤ <i>Learner will gain knowledge of and develop various skills while studying amazing animals.</i>		
<b>3.1</b>	Natural History a) Introduction and life timeline b) Butterflies the flying jewels- Blue Mormon, Striped tiger c) Herpetofauna of India- Flying frog, Fan Throated	<b>04L</b>	<b>08hrs</b>

	<p>lizard and Gharial</p> <p>d) Feathered Bipeds: Kingfisher, Drongo</p> <p>e) Mammals of India: Malabar giant squirrel</p>		
<b>3.2</b>	<p>The world's most amazing animals (emphasis should be given only on amazing aspects)</p> <p>a) Octopus</p> <p>b) Spider</p> <p>c) Mudskipper</p> <p>d) Flying fish</p> <p>e) Pebble toad</p> <p>f) Strawberry poison frog</p> <p>g) Komodo dragon</p> <p>h) Lesser flamingo</p> <p>i) Great white pelican</p> <p>j) Spatule-tailed hummingbird</p> <p>k) Cheetah</p>	<b>05L</b>	<b>10hrs</b>
<b>3.3</b>	<p>Five most incredible animals discovered within the last decade</p> <p>a) The Purple (joker) crab,</p> <p>b) The African dwarf saw-shark (stabbing shark),</p> <p>c) The Psychedelic (crime fighting) gecko,</p> <p>d) The Matilda viper</p> <p>e) The Myanmar snub-nosed monkey</p>	<b>03L</b>	<b>5hrs</b>
<b>3.4</b>	<p>Marvels of Animals</p> <p>a) Mantis shrimp: Fastest punch</p> <p>b) Homing in Pacific salmon</p> <p>c) Sperm whale: Mechanism of deep sea diving.</p>	<b>03L</b>	<b>08hrs</b>

<b>PRACTICAL SEMESTER III</b>	
<b>Practical USZOP3 (Course - V)</b>	
<b>1</b>	Extraction and detection of DNA
<b>2</b>	Extraction and detection of RNA
<b>3</b>	Mounting of Barr bodies
<b>4</b>	Study of polytene chromosome
<b>5</b>	Study of mitosis- temporary squash preparation of Onion root tip
<b>6</b>	Detection of blood groups and Rh factor
<b>7</b>	Problems in Genetics a) Monohybrid/ Dihybrid Cross: b) X- linked inheritance: c) Multiple Alleles
<b>8</b>	Chromosome morphology: (photograph to be provided)
<b>9</b>	Pedigree analysis
<b>10</b>	Problems based on molecular biology

<b>SEMESTER III</b>	
<b>Practical USZOP3 (Course - VI)</b>	
<b>1</b>	Urine analysis—Normal and Abnormal constituents
<b>2</b>	Detection of ammonia excreted by fish from aquarium water
<b>3</b>	Detection of uric acid from excreta of birds
<b>4</b>	Study of striated and non-striated muscle fibre
<b>5</b>	Study of nutritional apparatus (Amoeba, Hydra, Earthworm, Pigeon, Ruminant stomach)
<b>6</b>	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 <i>Anabas / Clarius</i> e. Air sacs of Pigeon
<b>7</b>	Study of locomotory organs (Amoeba, Bivalve, Cockroach, Starfish, Fish, and Bird).
<b>8</b>	Study of different types of hearts (Cockroach, Shark, Frog, Garden lizard, Crocodile and Mammal).
<b>9</b>	Study of permanent slides on Reproduction: (a) Sponge gemmules, (b) Hydra budding, (c) T.S. of mammalian testis, (d) T.S. of mammalian ovary.

<b>SEMESTER III</b>	
<b>Practical USZOE1P3 (Course - VIIA) Elective I</b>	
<b>1</b>	Extraction of casein from milk and its qualitative estimation
<b>2</b>	Preparation of paneer from given milk sample
<b>3</b>	Measurement of density of milk using different samples by Lactometer
<b>4</b>	Study of Honey Bee: a) Life Cycle of Honey Bee and Bee Hive b) Mouthparts of Honey Bee c) Legs of Honey Bee d) Sting Apparatus of Honey Bee
<b>5</b>	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 behaviour in animals and Ritualization
<b>6</b>	Study of Protozoan parasites: a. <i>Trypanosoma gambiense</i> b. <i>Giardia intestinalis</i>
<b>7</b>	Study of Helminth parasites: a. <i>Ancylostoma duodenale</i> b. <i>Dracunculus medinensis</i>
<b>8</b>	Parasitic adaptations: Scolex and mature proglottid of Tapeworm
<b>9</b>	Study of Ectoparasites: a) Leech    b) Tick    c) Mite
<b>10</b>	Project- Suggested topics on economic zoology (e.g. Apiculture/ Sericulture/ Lac culture / Vermicompost technique / Construction of artificial beehives /Animal husbandry/ Aquaculture / any other )

<b>SEMESTER III</b>	
<b>Practical USZOE2P3 (Course - VIIB) Elective 2</b>	
<b>1</b>	Maintenance of Aquarium– Equipments required for setting up of aquarium – types of filter, type of gravel, aerator pump, lighting, nets, different species of aquatic plants and ornamental fishes.
<b>2</b>	Types of pest – Agricultural-aphids, Household-cockroaches, housefly, Structural-termites, Stored grains- borer, Veterinary- fleas, Forestry- caterpillar.
<b>3</b>	Other pests- a) Invertebrates -nematodes, leech, snails, slugs. b) Vertebrates- rats, birds
<b>4</b>	Types of pest control –a) Physical b) Biological c) Electronic d) Insecticides, Rodenticides and Special Treatments
<b>5</b>	Hybrid animals- a) Liger b) Wholphin c) Zebroid d) Savannah cat
<b>6</b>	Most incredible animals in last decades – a) Joker crab b) Snub nose monkey c ) Matilda viper
<b>7</b>	Endangered animals of India – a) Amboli bush frog b) Indian egg- eating snake ( Wester mann’s snake) c) Spoon- billed sandpiper d) Snow leopard
<b>8</b>	A project on aquarium setting in laboratory / vermicomposting.
<b>9</b>	A field visit to study the natural flora and fauna; and submission of report with photographs.

**\*Note-** The practicals may be conducted by using preserved specimens/permanent slides authorized by the wild life and such other regulating bodies 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 regulations of the relevant monitoring bodies. No new specimens, however, shall be procured for 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)
  - 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 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.**

## Semester –III

### REFERENCE BOOKS AND ADDITIONAL READING

#### USZO301 (COURSE-V)

1. Principles of Genetics. Gardner, E. J., Simmons, M.J and Snustad, D.P. John Wiley and Sons
2. Concepts of Genetics. Klug, W. S., Cummings M. R., Spencer, C.A. Benjamin Cummings
3. Genetics- A Molecular Approach. Russell, P. J Benjamin Cummings
4. Genetics: Analysis of Genes and Genomes. Daniel L., Hartl, Elizabeth W. Jones Jones & Bartlett Publishers
5. Introduction to Genetic Analysis. Griffiths, A. J. F., Wessler. S.R., Lewontin, R.C. and Carroll, S. B. W. H. Freeman and Co
6. Cell Biology Genetics, Molecular Biology Evolution and Ecology Verma P. S. and Agrawal P.K., 9<sup>th</sup> edition, S. Chand Publication, New Delhi
7. Principles of Genetics – Eight edition- Eldon John Gardner, Michael J. Simmons, D. Peter Snustad
8. Genetics- Weaver, Hedrick, third edition, McGraw Hill Education
9. Genetics A Mendelian approach Peter J. Russel, Pearson Benjamin Cummings
10. 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, Leeland H. Hartwell, Leeroy Hood, Michael 7. L. Goldberg, Ann E. Reynolds, Lee M. Silver, McGraw Hill Education

#### USZO302 (COURSE-VI)

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., NaginS.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.

### **USZOE1303 (COURSE-VIIA)**

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 text book 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.

### **USZOE2303 (COURSE-VIIB)**

1. A General textbook of entomology -- A D Imms. Asia Publication.
2. Agricultural insect pests and their control. V.B. Awasthi. Scientific Publication.
3. A manual of practical entomology. – M. M. Trigunayat. Scientific Publication.
4. Applied Entomology – Alaka Prakash and Fennemore. New Age Publishers.
5. Applied Entomology – Awasthi. Scientific Publication.
6. A Text book of insect morphology, physiology and endocrinology – Tembhare D. B.– Chand Publication
7. Entomology and Pest Management –Larry P. Pedigo. Pearson Education.

8. Forensic Entomology-The utility of Arthropods in legal investigations. –Jason H. Byrd and James L. Castner. CRC Press.
9. General and applied Entomology – David and Ananthkrishnan. Tata McGraw Hill
10. Insect endocrinology and physiology – Tembhare D B – S Chand publication.
11. Insect Jewelry by Roger D. Akre., Laurel D. Hansen, and Richards S. Zack: in Summer (1991). (Online available as research article).
12. Insect Year Book of Agriculture- American Agriculture Department Publication.
13. Economic Zoology- Shukla G.S. & Upadhyay V. B., Rastogi Publications.
14. A handbook on Economic Zoology, S. Chand & Co.
15. Candler, W., & Kumar, N. (1998). India: The dairy revolution: The impact of dairy development in India and the World Bank's contribution. World Bank Publications.
16. Milk and dairy products in human nutrition: production, composition and health. John Wiley & Sons, Park, Y. W., & Haenlein, G. F. (Eds.). (2013).
17. Dairy development in India: An appraisal of challenges and achievements. Concept Publishing Company, Venkatasubramanian, V., Singh, A. K., & Rao, S. V. N. (2003).
18. Dairy Development in The New Millennium (The Second White Revolution). Deep and Deep Publications, Shrivastava, J. S. M. (2008).
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20. [www.toptenz.net/top-10-amazing-animals-discovered-within-the-last-decade.php](http://www.toptenz.net/top-10-amazing-animals-discovered-within-the-last-decade.php)
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22. <https://www.pinterest.com/pin/16044142395584735/>
23. [www.naturalhistorymag.com/](http://www.naturalhistorymag.com/)
24. <https://naturalhistory.si.edu/>.

## SEMESTER IV

Sr. No	USZO401 (COURSE-VIII)	No. of lect allotted	Learning pleasure
	<b>Origin and Evolution of Life, Population Genetics and Evolution, Scientific Attitude, Methodology, Scientific Writing and Ethics in Scientific Research</b>		
	<b>Unit 1: Origin and Evolution of Life</b>	<b>15L</b>	<b>30hrs</b>
	<b>Objective:</b> ➤ <i>To impart scientific knowledge about how life originated on our planet</i>		
	<b>Desired outcomes:</b> ➤ <i>Learner will gain insights into the origin of life.</i> ➤ <i>Learner will analyse and critically view the different theories of evolution.</i>		
<b>1.1</b>	<b>Introduction</b> <ul style="list-style-type: none"> <li>• Origin of the Universe</li> <li>• Chemical evolution - Miller-Urey experiment, Haldane and Oparin theory</li> <li>• Origin of life</li> <li>• Origin of eukaryotic cell</li> </ul>	<b>05L</b>	<b>10hrs</b>
<b>1.2</b>	<b>Evidences in favour of organic evolution</b> <ul style="list-style-type: none"> <li>• Evidences from geographical distribution, palaeontology, anatomy, embryology, physiology and genetics</li> </ul>	<b>04L</b>	<b>08hrs</b>
<b>1.3</b>	<b>Theories of organic evolution</b> <ul style="list-style-type: none"> <li>• Theory of Lamarck</li> <li>• Theory of Darwin and Neo- Darwinism</li> <li>• Mutation Theory</li> <li>• Modern synthetic theory</li> <li>• Weismann's Germplasm theory</li> </ul>	<b>06L</b>	<b>12hrs</b>

	<b>Unit: 2: Population Genetics and Evolution</b>	<b>15L</b>	<b>28hrs</b>
	<p><b>Objective:</b></p> <p>➤ <i>To develop an understanding of genetic variability within a population and learn as to how the change in the gene pool leads to evolution of species</i></p>		
	<p><b>Desired outcomes:</b></p> <p>➤ <i>Learner would understand the forces that cause evolutionary changes in natural populations</i></p> <p>➤ <i>Learner would comprehend the mechanisms of speciation</i></p> <p>➤ <i>Learner will be able to distinguish between microevolution, macroevolution and megaevolution</i></p>		
<b>2.1</b>	<p><b>Introduction to Population genetics</b></p> <ul style="list-style-type: none"> <li>• Definition</li> <li>• Brief explanation of the following terms: Population, Gene pool, Allele frequency, Genotype frequency, Phenotype frequency, Microevolution</li> </ul>	<b>01L</b>	<b>03hrs</b>
<b>2.2</b>	<p><b>Population genetics</b></p> <ul style="list-style-type: none"> <li>• Hardy- Weinberg Law</li> <li>• 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)</li> <li>• Natural Selection: Patterns of Natural Selection-Stabilizing selection, Directional selection (examples: peppered moth, antibiotic resistance in bacteria, pesticide resistance) and Disruptive selection</li> </ul>	<b>05L</b>	<b>08hrs</b>
<b>2.3</b>	<p><b>Evolutionary genetics</b></p> <ul style="list-style-type: none"> <li>• 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)</li> <li>• Nature of genetic variations: Genetic polymorphism, Balanced polymorphism, Mechanisms that preserve balanced polymorphism-</li> </ul>	<b>07L</b>	<b>13hrs</b>

	<p>Heterozygote advantage and frequency dependent selection,</p> <ul style="list-style-type: none"> <li>• Neutral variations</li> <li>• Geographic variation (Cline)</li> <li>• Species concept: Biological species concept and evolutionary species concept</li> <li>• Speciation and Isolating mechanisms: Definition and modes of speciation (allopatric, sympatric, parapatric and peripatric)</li> <li>• Geographical isolation</li> <li>• Reproductive isolation and its isolating mechanisms (prezygotic and postzygotic)</li> </ul>		
<b>2.4</b>	<p>Macroevolution and megaevolution: Concept and Patterns of macroevolution (stasis, preadaptation /exaptation, mass extinctions, adaptive radiation and coevolution), Megaevolution</p>	<b>02L</b>	<b>04hrs</b>
<b>Unit: 3 Scientific Attitude Methodology, Scientific Writing and Ethics in Scientific Research</b>			
	<p><b>Objective:</b></p> <p>➤ <i>To inculcate scientific temperament in the learner</i></p>	<b>15L</b>	<b>32hrs</b>
	<p><b>Desired outcome:</b></p> <p>➤ <i>The learner would develop qualities such as critical thinking and analysis</i></p> <p>➤ <i>The learner will imbibe the skills of scientific communication and he/she will understand the ethical aspects of research</i></p>		
<b>3.1</b>	<p><b>Process of science:</b></p> <ul style="list-style-type: none"> <li>• A dynamic approach to investigation: The Scientific method, Deductive reasoning and inductive reasoning, Critical thinking, Role of chance in scientific discovery (serendipity)</li> <li>• Scientific research: Definition, difference between method and methodology, characteristics, types</li> <li>• 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</li> </ul>	<b>04L</b>	<b>10hrs</b>

	<p>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</p> <ul style="list-style-type: none"> <li>• Dissemination of data: Reporting results to scientific community (publication in peer- reviewed journals, thesis, dissertation, reports, oral presentation, poster presentation)</li> <li>• Application of knowledge: Basic research, Applied research and Translational research</li> </ul>		
<b>3.2</b>	<p><b>Scientific writing:</b></p> <ul style="list-style-type: none"> <li>• 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</li> </ul>	<b>04L</b>	<b>10hrs</b>
<b>3.3</b>	<p><b>Writing a review paper</b></p> <ul style="list-style-type: none"> <li>• Structure and components of review</li> <li>• Report writing and types of report</li> <li>• Computer application: Plotting of graphs, Statistical analysis of data. Internet and its application in research-Literature survey, online submission of manuscript for publication</li> </ul>	<b>03L</b>	<b>05hrs</b>
<b>3.4</b>	<p><b>Ethics</b></p> <ul style="list-style-type: none"> <li>• Ethics in animal research: The ethical and sensitive care and use of animals in research, teaching and testing, approval from Dissection Monitoring Committee (DMC)</li> <li>• Ethics in clinical research: Approval from clinical research ethics committee or/and informed consent</li> </ul>	<b>03L</b>	<b>05hrs</b>
<b>3.5</b>	<p><b>Plagiarism</b></p>	<b>01L</b>	<b>02hrs</b>

	<b>SEMESTER IV</b>		
<b>Sr. No.</b>	<b>USZO402 (Course - IX)</b>	<b>No. of lectures allotted</b>	<b>Learning pleasure</b>
	<b>Unit 1: Cell Biology</b>	<b>15L</b>	<b>24hrs</b>
	<b>Objective:</b> ➤ <i>To study the structural and functional organization of cell with an emphasis on nucleus, plasma membrane and cytoskeleton.</i>		
	<b>Desired outcome:</b> ➤ <i>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</i>		
<b>1.1</b>	<b>Introduction to cell biology</b> <ul style="list-style-type: none"> <li>• Definition and scope</li> <li>• Cell theory</li> <li>• Generalized prokaryotic, eukaryotic cell: size, shape and structure</li> </ul>	<b>02L</b>	<b>04hrs</b>
<b>1.2</b>	<b>Nucleus</b> <ul style="list-style-type: none"> <li>• Size, shape, number and position</li> <li>• Structure and functions of interphase nucleus</li> <li>• Ultrastructure of nuclear membrane and pore complex</li> <li>• Nucleolus: general organization, chemical composition &amp; functions</li> <li>• Nuclear sap/ nuclear matrix</li> <li>• Nucleocytoplasmic interactions</li> </ul>	<b>05L</b>	<b>06hrs</b>
<b>1.3</b>	<b>Plasma membrane</b> <ul style="list-style-type: none"> <li>• Fluid Mosaic Model</li> <li>• Junctional complexes</li> <li>• Membrane receptors</li> <li>• Modifications: Microvilli and Desmosomes</li> </ul>	<b>04L</b>	<b>08hrs</b>
<b>1.4</b>	<b>Transport across membrane</b> <ul style="list-style-type: none"> <li>• Diffusion and Osmosis</li> <li>• Transport: Passive and Active</li> <li>• Endocytosis and Exocytosis</li> </ul>	<b>02L</b>	<b>04hrs</b>
<b>1.5</b>	<b>Cytoskeletal structures</b> <ul style="list-style-type: none"> <li>• Microtubules: Composition and functions</li> <li>• Microfilaments: Composition and functions</li> </ul>		

<b>Unit: 2: Endomembrane System</b>		<b>15L</b>	<b>28hrs</b>
	<b>Objective:</b> ➤ <i>To acquaint the learner with ultrastructure of cell organelles and their functions</i>		
	<b>Desired outcome:</b> ➤ <i>Learner would appreciate the intricacy of endomembrane system.</i> ➤ <i>Learner would understand the interlinking of endomembrane system for functioning of cell</i>		
<b>2.1</b>	<b>Endoplasmic reticulum (ER):</b> General morphology of endomembrane system, ultrastructure, types of ER and biogenesis of ER • Functions of Rough Endoplasmic Reticulum (RER) and Smooth Endoplasmic Reticulum (SER)	<b>01L</b>	<b>03hrs</b>
<b>2.2</b>	<b>Golgi complex:</b> Ultrastructure of Golgi complex, functions of Golgi complex (protein glycosylation, lipid and polysaccharide metabolism, protein sorting and secretion, Golgi Anti-Apoptotic Protein -GAAP)	<b>06L</b>	<b>10hrs</b>
<b>2.3</b>	<b>Lysosomes:</b> Origin, occurrence, polymorphism and functions; <b>Peroxisomes:</b> Origin, morphology & functions	<b>03L</b>	<b>5hrs</b>
<b>2.4</b>	<b>Mitochondria:</b> Ultrastructure, chemical composition, functions of mitochondria and bioenergetics (Chemical energy & ATP, Krebs's cycle, respiratory chain and oxidative phosphorylation)	<b>05L</b>	<b>10hrs</b>
<b>Unit: 3 Biomolecules</b>		<b>15L</b>	<b>30hrs</b>
	<b>Objective:</b> ➤ <i>To give learner insight into the structure of biomolecules and their role in sustenance of life.</i>		
	<b>Desired outcome:</b> ➤ <i>The learner will realize the importance of biomolecules and their clinical significance.</i>		
<b>3.1</b>	<b>Biomolecules:</b> Concept of micromolecules and macromolecules	<b>02L</b>	<b>05hrs</b>

3.2	<b>Carbohydrates:</b> <ul style="list-style-type: none"> <li>• Definition classification, properties and isomerism, glycosidic bond</li> <li>• Structure of Monosaccharides (glucose and fructose); Oligosaccharides (lactose and sucrose); Polysaccharides (cellulose, starch, glycogen and chitin)</li> <li>• Biological role and clinical significance</li> </ul>	04L	08hrs
3.3	<b>Amino Acids and Proteins:</b> <ul style="list-style-type: none"> <li>• Basic structure, classification of amino acids,</li> <li>• Essential and Non-essential amino acids, Peptide bond,</li> <li>• Protein conformation: Primary, Secondary, Tertiary, Quaternary</li> <li>• Types of proteins – Structural (collagen) and functional proteins (haemoglobin)</li> <li>• Biological role and clinical significance</li> </ul>	05L	08hrs
3.4	<b>Lipids:</b> <ul style="list-style-type: none"> <li>• Definition, classification of lipids with examples, ester linkage</li> <li>• Physical and chemical properties of lipids</li> <li>• Saturated and unsaturated fatty acids</li> <li>• Essential fatty acids; Triacylglycerols; Phospholipids (lecithin and cephalin); Steroids (cholesterol)</li> <li>• Biological role and clinical significance</li> </ul>	04L	05hrs
3.5	<b>Vitamins:</b> <ul style="list-style-type: none"> <li>• Water soluble vitamins (e.g. Vit C, Vit B<sub>12</sub>)</li> <li>• Lipid soluble vitamins (e.g. Vit A, Vit D)</li> <li>• Biological role and clinical significance</li> </ul>	02L	04hrs

	<b>SEMESTER IV</b>		
	<b>USZOE1403 (Course-XA) Elective 1</b>		
	<b>Comparative Embryology, Aspects of Human Reproduction, Pollution and its effect on organisms</b>		
	<b>UNIT 1: Comparative Embryology</b>	<b>15L</b>	<b>25hrs</b>
	<b>Objective:</b> ➤ <i>To acquaint the learner with key concepts of embryology.</i>		
	<b>Desired Outcome:</b> ➤ <i>Learner will be able to understand and compare the different types of eggs and sperms</i> ➤ <i>Learner will be able to understand and compare the different pre- embryonic stages</i>		
<b>1.1</b>	Types of Eggs- Based on amount and distribution of yolk	03L	4hrs
<b>1.2</b>	Structure and Types of Sperm	02L	4hr
<b>1.3</b>	Types of Cleavages	02L	4hrs
<b>1.4</b>	Types of Blastulae	02L	4hrs
<b>1.5</b>	Types of Gastrulae	02L	4hrs
<b>1.6</b>	Coelom -Formation and types	04L	6hrs
	<b>UNIT 2: Aspects of Human Reproduction</b>	<b>15L</b>	<b>30 hrs</b>
	<b>Objectives:</b> ➤ <i>To acquaint the learners with different aspects of human reproduction.</i> ➤ <i>To make them aware of the causes of infertility, techniques to overcome infertility and the concept of birth control</i>		
	<b>Desired Outcome:</b> ➤ <i>Learners will be able to understand human reproductive physiology</i> ➤ <i>Learners will become familiar with advances in ART and related ethical issues.</i>		
<b>2.1</b>	<b>Human reproductive system and hormonal regulation</b> <ul style="list-style-type: none"> <li>• Anatomy of human male and female reproductive system</li> </ul>	02L	4hrs

	<ul style="list-style-type: none"> <li>• Hormonal regulation of reproduction and impact of age on reproduction - menopause and andropause</li> </ul>		
<b>2.2</b>	<p><b>Contraception &amp; birth control</b></p> <ul style="list-style-type: none"> <li>• Difference between contraception and birth control</li> <li>• Natural Methods: Abstinence, rhythm method, temperature method, cervical mucus or Billings method, coitus interruptus, lactation amenorrhea</li> <li>• Artificial methods : Barrier methods, hormonal methods, intrauterine contraceptives, sterilization, termination, abortion</li> </ul>	02L	4hrs
<b>2.3</b>	<p><b>Infertility</b></p> <p><b>Female infertility:</b></p> <ul style="list-style-type: none"> <li>• <b>Causes</b> - 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)</li> <li>• <b>Infertility associated disorders</b> - 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</li> <li>• <b>Role of endocrine disruptors</b></li> </ul>	04L	8hrs
<b>2.5</b>	<p><b>Treatment of infertility</b></p> <ul style="list-style-type: none"> <li>• Removal /reduction of causative environmental factors</li> <li>• Surgical treatment</li> <li>• Hormonal treatment- fertility drugs</li> <li>• Assisted Reproductive Technology (ART) - <i>In vitro</i> fertilization (IVF); Embryo transfer (ET); Intra-Fallopian transfer (IFT), Gamete Intra-Fallopian Transfer (GIFT) &amp; Intra-Zygote Transfer (ZIFT); Intra-cytoplasmic Sperm Injection (ICSI) with ejaculated sperm and sperm retrieved from testicular biopsies; Testicular sperm extraction (TESE).</li> </ul>	04L	8hrs

	<ul style="list-style-type: none"> <li>• Sperm bank, cryopreservation of gametes and embryos</li> <li>• Surrogacy</li> </ul>		
<b>UNIT3: Pollution and its effect on organisms</b>			
	<p><b>Objective:</b></p> <p>➤ <i>To provide a panoramic view of impact of human activities leading to pollution and its implications.</i></p>	<b>15L</b>	<b>27hrs</b>
	<p><b>Desired Outcome:</b></p> <p>➤ <i>The learners will be sensitized about the adverse effects of pollution and measures to control it.</i></p>		
<b>3.1</b>	<p><b>Air Pollution</b></p> <ul style="list-style-type: none"> <li>• Types and sources of air pollutant</li> <li>• Effects of air pollution on organisms, its control and abatement measures</li> </ul>	03L	6hrs
<b>3.2</b>	<p><b>Water Pollution</b></p> <ul style="list-style-type: none"> <li>• Types and sources of water pollutant</li> <li>• Effects of water pollution on organisms, its control and abatement measures</li> </ul>	03L	6hrs
<b>3.3</b>	<p><b>Soil Pollution</b></p> <ul style="list-style-type: none"> <li>• Types and sources of soil pollutant</li> <li>• Effects of soil pollution on organisms, its control and abatement measures</li> </ul>	03L	4hrs
<b>3.4</b>	<p><b>Sound pollution</b></p> <ul style="list-style-type: none"> <li>• Different sources of sound pollution</li> <li>• Effects of sound pollution on organisms, its control and abatement measures</li> </ul>	01L	3hrs
<b>3.5</b>	<b>Pollution by radioactive substances</b>	01L	2hrs
<b>3.6</b>	<p><b>Pollution by solid wastes</b></p> <ul style="list-style-type: none"> <li>• Types and sources,</li> <li>• Effects of solid waste pollution, its control and abatement measures</li> </ul>	02L	4hrs
<b>3.7</b>	<b>Pollution – Climate Change and Global Warming</b>	02L	2hrs

<b>USZOE2403 (Course-XB) Elective 2</b>				
<b>Dairy Industry, Sericulture and Aquaculture</b>				
<b>UNIT 1: Dairy Industry</b>			<b>15L</b>	<b>30hrs</b>
	<p><b>Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ <i>To comprehend the functioning of various aspects of dairy industry.</i></li> <li>➤ <i>To study different indigenous and exotic cattle breeds including buffalo breeds of India.</i></li> <li>➤ <i>To develop an understanding of the different systems of breeding and various aspects dealing with housing of dairy animals.</i></li> </ul>			
	<p><b>Desired Outcome:</b></p> <ul style="list-style-type: none"> <li>➤ <i>Learner would gain knowledge on the functioning of various aspects of dairy industry, indigenous, exotic cattle and buffalo breeds in India.</i></li> <li>➤ <i>Learner will study different systems of breeding and gain information regarding various aspects pertaining to housing of dairy animals.</i></li> </ul>			
<b>1.1</b>	<p>Indian Cattle breeds – Origin, distribution, distinguishing characters and economic uses:</p> <ul style="list-style-type: none"> <li>• Malvi</li> <li>• Hariyana</li> <li>• Deoni</li> <li>• Red sindhi</li> <li>• Khillari</li> </ul>	02L	4hrs	
<b>1.2</b>	<p>Exotic breeds - Origin, distribution, distinguishing characters and economic uses:</p> <ul style="list-style-type: none"> <li>• Jersey</li> <li>• Holstein</li> </ul>	02L	4hr	
<b>1.3</b>	<p>Indian buffalo breeds - Origin, distribution, distinguishing</p>	02L	4hrs	

	characters and economic uses: <ul style="list-style-type: none"> <li>• Nagpuri</li> <li>• Bhadawari</li> <li>• Murrah</li> <li>• Jafrabadi</li> </ul>		
1.4	Systems of inbreeding and crossbreeding	03L	6hrs
1.5	Maintenance of dairy farm	02L	4hrs
1.6	Weaning of calf, castration and dehorning	02L	4hrs
1.7	Diseases and control	02L	4hrs
<b>UNIT 2: Sericulture</b>			
	<b>Objectives:</b> <ul style="list-style-type: none"> <li>➤ <i>To comprehend the functioning of sericulture industry and its scope in India.</i></li> <li>➤ <i>To study the varieties of silk-worms and host plants.</i></li> <li>➤ <i>To critically study the life history and rearing of <i>Bombyx mori</i>, harvesting, processing of cocoon, production of silk and diseases afflicting silk-worms.</i></li> </ul>	15L	30 hrs
	<b>Desired Outcome:</b> <ul style="list-style-type: none"> <li>➤ <i>Learner would understand the basics of the functioning of sericulture industry and its scope in India.</i></li> <li>➤ <i>Learner shall gain knowledge on the varieties of silk-worms, host-plants and aspects on silk extraction and the diseases afflicting silk-worms.</i></li> </ul>		
2.1	Introduction and scope of sericulture	02L	4hrs
2.2	Varieties of silk worm, host plants	02L	4hrs
2.3	Life history and rearing of <i>Bombyx mori</i>	02L	8hrs
2.4	Harvesting and processing of cocoon	02L	4hrs

2.5	Reeling and extraction of silk	03L	4hrs
2.6	Diseases and control measures	03L	4hrs
<b>UNIT3: Aquaculture</b>			
		<b>15L</b>	<b>27hrs</b>
	<b>Objectives:</b> <ul style="list-style-type: none"> <li>➤ <i>To comprehend various kinds of aquaculture practices and its scope as fishery resource in India.</i></li> <li>➤ <i>To study various techniques employed in aquaculture practices</i></li> </ul>		
	<b>Desired Outcome:</b> <ul style="list-style-type: none"> <li>➤ <i>Learner shall understand the aquaculture practices and the scope of fishery in India.</i></li> <li>➤ <i>Learner would gain knowledge of various techniques employed in aquaculture practices.</i></li> </ul>		
3.1	<b>Pisciculture:</b> <ul style="list-style-type: none"> <li>• Definition and scope of fishery resources in India</li> <li>• Finfish culture – monoculture and polyculture</li> <li>• Role of exotic fishes in polyculture</li> <li>• Cage culture</li> <li>• Fish seed transport</li> <li>• Fish diseases -- symptoms and control</li> </ul>	05L	6hrs
3.2	<b>Prawn/shrimp culture:</b> Sources, seed, culture methods – <ul style="list-style-type: none"> <li>• Giant fresh water prawn (<i>Macrobrachium rosenbergii</i>)</li> <li>• White shrimp (<i>Penaeus vannamei</i>)</li> </ul>	05L	6hrs
3.3	<b>Pearl culture:</b> <ul style="list-style-type: none"> <li>• Pearl producing species and their distribution</li> <li>• Pearl culture methods</li> <li>• Composition of pearl</li> </ul>	05L	4hrs

<b>SEMESTER IV</b>	
<b>Practical USZOP4 (Course - VIII)</b>	
<b>1</b>	Study of population density by Line transect method & Quadrant method and calculate different diversity indices. <ul style="list-style-type: none"> <li>• Index of Dominance</li> <li>• Index of frequency</li> <li>• Rarity Index</li> <li>• Shannon Index</li> <li>• Index of species diversity</li> </ul>
<b>2</b>	Study of prokaryotic cells (bacteria) by Crystal violet staining technique
<b>3</b>	Study of eukaryotic cells (WBCs) from blood smear by Leishman's stain
<b>4</b>	Identification and study of fossils: <ul style="list-style-type: none"> <li>• Arthropods: Trilobite</li> <li>• Mollusca: Ammonite</li> <li>• Aves: Archaeopteryx</li> </ul>
<b>5</b>	Identification of : <ul style="list-style-type: none"> <li>• Allopatric speciation (Cyprinodont species)</li> <li>• Sympatric speciation (Hawthorn fly and Apple maggot fly)</li> <li>• Parapatric speciation (Snail)</li> </ul>
<b>6</b>	Bibliography/ Abstract writing
<b>7</b>	Preparation of Power Point Presentation based on research paper.

<b>SEMESTER IV</b>	
<b>Practical USZOP4 (Course - IX)</b>	
<b>1</b>	Study of permeability of cell through plasma membrane (osmosis in blood cells)
<b>2</b>	Measurement of cell diameter by occulometer (by using permanent slide)
<b>3</b>	Qualitative tests for carbohydrates (Molisch's test, Benedicts test, Barfoed's test, Anthrone test)
<b>4</b>	Qualitative tests for protein (Ninhydrin test, Biuret test, Millon's test, Xanthoproteic test)
<b>5</b>	Qualitative test for lipids (Solubility test, Sudan III test)
<b>6</b>	Study of rancidity of lipids by titrimetric method
<b>7</b>	Ultrastructure of cell organelles (Electron micrographs) of: <ul style="list-style-type: none"> <li>• Nucleus</li> <li>• Endoplasmic reticulum (Smooth and Rough)</li> <li>• Mitochondria.</li> <li>• Golgi apparatus</li> <li>• Lysosomes</li> </ul>
<b>8.</b>	Study of clinical disorders due to carbohydrates, proteins and lipid imbalance (Photograph to be provided / symptoms to be given and disorder to be identified): <ul style="list-style-type: none"> <li>• Hyperglycemia</li> <li>• Hypoglycemia</li> <li>• Anemia</li> <li>• Kwashiorkar</li> <li>• Marasmus</li> <li>• Fatty Liver</li> </ul>

<b>SEMESTER IV</b>	
<b>Practical USZOE1P4 (Course - XA)</b>	
<b>1</b>	Study of air microflora.
<b>2</b>	Estimation of dissolved oxygen from the given water sample.
<b>3</b>	Estimation of salinity by refractometer from the given water sample.
<b>4</b>	Estimation of conductivity by conductometer from the given water sample.
<b>5</b>	Study of physical properties of soil: temperature, moisture and texture
<b>6</b>	Study of chemical properties of soil- pH, organic matter
<b>7</b>	Study of sound pollution monitoring device
<b>8</b>	Detection of pregnancy from given sample of urine
<b>9</b>	Study of birth control measures applicable to humans – IUD, condom and hormonal pills.
<b>10</b>	Study of the following permanent slides, museum specimens and materials <ul style="list-style-type: none"> <li>• Mammalian sperm and ovum</li> <li>• Types of Egg– fish, frog and hen</li> <li>• Cleavage, blastula and gastrula (Amphioxus, Frog and Bird)</li> </ul>
<b>11</b>	Review writing based on programmes telecast by Doordarshan, Gyandarshan, UGC programmes or other media sources
<b>12</b>	Study of natural ecosystem and field report of the visit

<b>SEMESTER IV</b>	
<b>Practical USZOE2P4 (Course - XB) – Elective 2</b>	
<b>1</b>	Estimation and comparison of protein content in Cow and Buffalo milk sample
<b>2</b>	Estimation and comparison of fat content in Cow and Buffalo milk sample
<b>3</b>	Preparation of falooda
<b>4</b>	Preparation of caramel custard
<b>5</b>	Restraining devices used in cattle farming- Halters, gags, bull-rings, muzzles, cradle, crush and ropes.
<b>6</b>	Study of life cycle of <i>Bombyx mori</i>
<b>7</b>	Study of commercially important fishery. (Catla, Rohu, Catfish, Mackerel, Pomfret, Bombay duck, Prawn/Shrimp, Crab, Lobster, Edible oyster)
<b>8</b>	Study of Crustacean fishery – common characters and sexual dimorphism in lobster ( <i>Panulirus spp.</i> ), prawn ( <i>Penaeus spp.</i> ), crab ( <i>Scylla spp.</i> )
<b>9</b>	Visit to dairy farm /aquaculture/ fish landing centre/fishery institute and submit report of the same

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

**Note:** The practicals may be conducted by using specimens authorised by the wildlife 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 regulations of the relevant monitoring bodies. No new specimens, however, shall be procured for conducting practicals mentioned here in above.

**# There shall be at least one excursion / field trip.**

**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.**

## **Semester IV**

### **References and additional reading**

#### **USZO401 (COURSE-VIII)**

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 2<sup>nd</sup> edition- Paul D Leedy, Macmilan Publication

#### **USZO402 (COURSE - IX)**

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 cytologym 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<sup>th</sup> ed) by the Insertus
8. Principles of Biochemistry, 2005, 2<sup>nd</sup> and 3<sup>rd</sup> edn. Lehninger A.L. Nelson D.L. and Cox M.M ,
9. Biochemistry, Dushyant Kumar Shrma, 2010, Narosa Publishing house PVT.Ltd.
10. Fundamentals of Biochemistry, Dr AC Deb, 1983, New Central Book Agency Ltd.
11. A Textbook of Biochemistry, 9<sup>th</sup> edition, Dr. Rama Rao A.V.S.S and Dr A Suryalakshmi.
12. Biochemistry- G Zubay, Addison Wesley, 1983
13. Biochemistry, L Stryer, 3rd/4th/5th ed, 1989, Freeman and Co. NY
14. Harper's Biochemistry, 1996, 26<sup>th</sup> edition, Murray R.K. Granner D.K. Mayes P.A. Rodwell V.M. Hall international USA
15. Outline of Biochemistry, 1976, E.E. Conn and P.K. Stumpf. John Wiley and Sons USA

## USZOE1403 (COURSE-XA)

### References of Elective 1

1. Developmental Biology- 5<sup>th</sup> Edition, Scot F. Gilbert, Sinauer Associates Inc.
2. Developmental Biology- Subramoniam T., Narosa Publishers.
3. Developmental Biology-BerrilN.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. Marieb, 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. Nobil and JU. D. Neil, Raven Press, New York.
13. Air Pollution, Kudesia V. P. Pragati Prakasan, Meerut
14. Fundamentals of Air Pollution Daniel A. Vallero, Academic press 5<sup>th</sup> 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,

## **USZOE2403 (COURSE-XB)**

### **References of Elective 2**

1. Principles of Dairy Chemistry R. Jenness, S. Patton John Wiley and Sons Inc.
2. Fundamentals of dairy chemistry B.H. Webb, A.H. Johnson, J.A. Alford Avi Pub. Co.
3. Food Chemistry Owen R. Fennema CRC Press
4. Food Chemistry John M. De Man Springer
5. Technology of Dairy Products Early, Ralph. Academic & Professional, 1998
6. Quality of milk production and processing technology D.K. Thompkinson and lathasabikhi  
New India Publishing agency, New delhi
7. Outlines of Dairy Technology Sukumar De Oxford University Press, New delhi
8. Food Microbiology William C. Frazier, dennis C. Westoff Tata Mcgrew Hill publishing  
Company Ltd. New Delhi
9. Applied Dairy Microbiology Elmer H. Marth, James L. Steele CRC Press
10. Dairy plant engineering and management Tufail Ahmed Kitab Mahal
11. Latest Aquaculture, Principles and Practices by Pillay T.V.R. – Fishing New Books (1988).
12. Course Manual in Fishing Technology by Latha Shenoy, CIFE, Versova, Mumbai.
13. Prawn and Prawn Fisheries by Kurian and Sebestian

## MARKING SCHEME OF EXAMINATION (THEORY)

- (a) External assessment of one hundred (100) marks per course per semester should be conducted as per the following skeleton question paper pattern.
- (c) One practical examination of fifty (50) marks per course each should be conducted at the end of every semester.

### SKELETON- EXAMINATION PATTERN FOR THE ABOVE SYLLABUS

All Questions are compulsory

Figures to the right indicate full marks

Draw neat and labeled diagrams wherever necessary

**Time: 3 hours**

**Total Marks: 100**

Q1	Objective questions*	20 marks
Q.2.	UNIT 1 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.3.	UNIT 2 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.4.	UNIT 3 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.5.	Answer any four out of six Unit 1 - (Two notes of five marks each) Unit 2 - (Two notes of five marks each) Unit 3- (Two notes of five marks each)	20 marks

**\*Note:** For Question No. 01 it is recommended to have objective questions on all units, such as –

- |                       |                            |
|-----------------------|----------------------------|
| (a) Match the column  | (b) MCQ                    |
| (c) Give one word for | (d) True and False         |
| (e) Define the term   | (f) Answer in one sentence |

**PRACTICAL (SEMESTER III)**  
**USZOP3 (Course - V)**  
**Skeleton-Practical Examination Question Paper Pattern**

**Time: 2hrs 30 min**

**Marks: 50**

**Major Question**

**15**

Q1. Extraction and detection of DNA

**OR**

Q1. Extraction and detection of RNA

**Minor Question**

**07**

Q2. Mounting of Barr bodies / Polytene chromosomes

**OR**

Q2. Study of mitosis-Temporary squash preparation of Onion root tip

**OR**

Q2. Detection of blood groups and Rh factor

Q3. Problems based on Genetics and Molecular biology

(Transcription /Genetic code) (01 problem each)

**10**

Q4. Identification

**08**

A. Chromosome morphology

B. Pedigree analysis

Q5. Viva

**05**

Q6. Journal

**05**

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**PRACTICAL (SEMESTER III)**

**USZOP3 (Course - VI)**

**Skeleton-Practical Examination Question Paper Pattern**

**Time: 2hrs 30 min**

**Marks: 50**

**Major Question**

15

Q1. Urine analysis—Normal and abnormal constituents

**Minor Question**

10

Q2. Detection of ammonia excreted by fish in aquarium water

OR

Q2. Detection of uric acid from excreta of Birds

OR

Q2. Mounting of striated and non-striated muscle fibre

Q3. Identification

15

a. Nutritional apparatus

b. Respiratory structures

c. Locomotory organs

d. Study of hearts

e. Permanent slides on reproduction

Q4. Viva

05

Q5. Journal

05

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**PRACTICAL (SEMESTER III)**  
**USZOE1P3 (Course - VIIA) – Elective 1**

**Skeleton -Practical Examination Question Paper Pattern**

**Time: 2 hrs 30 min**

**Marks: 50**

**Major Question** 12

Q1. Extraction of casein from milk and its qualitative detection

OR

Q1. Preparation of paneer from the given milk sample.

OR

Q1. Measurement of density of different samples of milk by lactometer

**Minor Question (Sketch and label)** 08

Q2. Life cycle of honey bee

OR

Q2. Mouthparts of honey bee

OR

Q2. Legs of honey bee

OR

Q2. Sting apparatus of honey bee

Q3. Identify and describe as per instructions 15

- a. Ethology
- b. Protozoan parasite
- c. Helminth parasite
- d. Ectoparasite
- e. Parasitic adaptation

Q4. a) Project submission 06

b) Viva based on project 04

Q5. Journal 05

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**PRACTICAL (SEMESTER IV)**

**USZOP4 (Course - VIII)**

**Skeleton -Practical Examination Question Paper Pattern**

**Time: 2 hrs 30 min**

**Marks: 50**

**Major Question**

Q1. Study Population density by Line transect or Quadrant method and calculate Biodiversity

Indices. (Any 2) **12**

**Minor Question** **08**

Q2. Prepare a smear to show prokaryotic cell.

**OR**

Q2. Prepare a smear to show eukaryotic cell.

Q3. Identify and describe as per instructions. **08**

a) Fossil      b) Speciation

Q4. From the given article, prepare the bibliography/ abstract. **06**

Q5. Submission of power point presentation. **06**

Q6. Viva. **05**

Q.7. Journal. **05**

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**PRACTICAL (SEMESTER IV)**

**USZOP4 (Course - IX)**

**Skeleton -Practical Examination Question Paper Pattern**

**Time: 2 hrs 30 min**

**Marks: 50**

**Major Question**

**15**

Q1. Study of osmosis in R.B.Cs.

OR

Q1. Measurement of cell diameter by oculometer using permanent slide.

**Minor Question**

**10**

Q2. Qualitative tests for carbohydrates (Molisch's test, Benedicts test, Fehling's test, Anthrone test)

OR

Q2. Qualitative tests for protein (Ninhydrin test, Biuret test, Millon's test, Xanthoprotein test)

OR

Q2. Qualitative test for lipid (Solubility test, Sudan III test)

OR

Q2. Estimation of rancidity of lipids by titrimetric method

Q3. Identify and describe as per instructions

**15**

- Ultrastructure of cell organelles (a, b & c)
- Clinical disorders (d & e)

Q4. Viva

**05**

Q5. Journal

**05**

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**PRACTICAL(SEMESTER IV)**  
**USZOE1P4 (Course - XA) – Elective 1**  
**Skeleton -Practical Examination Question Paper Pattern**

**Time: 2 hrs 30 min**

**Marks: 50**

**Major Question** 12

Q1. Estimation of Dissolved Oxygen from the given water sample.

OR

Q1. Detection of pregnancy from given sample of urine.

OR

Q1. Determination of organic matter from the given soil sample.

**Minor Question** 08

Q2. Estimation of salinity by refractometer from the given water sample

OR

Q2. Estimation of conductivity by conductometer from the given water sample

OR

Q2. Determination the pH of the given soil sample

OR

Q2. Determine the texture of the given soil sample

Q3. Identify and describe as per instructions 15

- Permanent slides (a &b)
- Birth control measure (c)
- Fishery (d & e)

Q4. a) Field report submission 06

b)Viva based on field report 04

Q5. Journal 05

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**PRACTICAL (SEMESTER IV)**  
**USZOE2P4 (Course - XB) Elective 2**  
**Skeleton -Practical Examination Question Paper Pattern**

**Time: 2 hrs 30 min**

**Marks: 50**

**Major Question** 15

Q1.Comparison of protein content from cow and buffalo milk

OR

Q.1 Comparison of fat content from cow and buffalo milk

**Minor Question** 08

Q.2 Preparation of falooda

OR

Q.2 Preparation of caramel custard

Q.3 Identification (3 marks each) 12

- a) Restraining device
- b) Any stage of life cycle of *Bombyx mori*
- c) Commercial fishery
- d) Crustacean fishery

Q4. a) Project submission 06

b) Viva based on project 04

Q5. Journal 05

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## MODEL QUESTION BANK SEMESTER III

**Question bank is suggestive. The paper setters are free to modify the questions or include new questions to the best of their perception**

### **USZO301 (COURSE - V)**

#### **Unit1 (10 Marks)**

1. Define genetics and explain its scope and importance.
2. Explain Mendel's laws of inheritance
3. Describe in detail the monohybrid cross and state the Mendelian principle of inheritance derived from it. Add a note on Co-dominance
4. Describe in detail dihybrid cross and state the Mendelian principles of inheritance derived from it
5. Discuss in brief inheritance of Mendelian phenotypic traits in humans.
6. Describe incomplete dominance with a suitable example
7. Describe Co-dominance with a suitable example
8. What is epistasis? Give a detailed account of double dominant epistasis
9. What is epistasis? Give a detailed account of recessive epistasis
10. What is epistasis? Give a detailed account of dominant epistasis
11. What is epistasis? Give a detailed account of double recessive epistasis
12. Explain the pattern of inheritance of recessive and dominant lethal alleles
13. Explain the inheritance of multiple alleles with the help of a suitable example
14. Describe polygenic inheritance with reference to skin colour and eye colour in man
15. Compare pleiotropy and polygenic inheritance
16. Explain the phenomenon of linkage with respect to Morgan's Experiment. Add a note on the differences between complete and incomplete linkage
17. Describe the pattern of inheritance of blood group and Rh factor in man
18. Explain the cytological basis and molecular mechanisms of crossing over
19. Explain pedigree analysis of X-linked recessive traits

## Unit1 (5 Marks)

1. Describe the classical concept of gene
2. Explain the modern concept of gene
3. Differentiate between (Any two):
  - (a) Genotype and phenotype of an organism
  - (b) Dominant and recessive traits
  - (c) Gene and genome
  - (d) Homozygous and heterozygous
  - (e) Monohybrid and Dihybrid cross
  - (f) Incomplete Dominance and Co-dominance
  - (g) Multiple alleles and Polygenes
  - (h) Test cross and Backcross
4. Write a note on the chromosome theory of inheritance
5. Describe co-dominance with a suitable example
6. Give an account of the symbols used in human Pedigree analysis
7. Characteristics of autosomal dominant traits
8. Characteristics of X-linked recessive traits
9. Characteristics of autosomal recessive traits
10. Characteristics of X-linked dominant traits
11. Intermediate lethal alleles
12. Explain the inheritance of skin colour in humans
13. Write a note on pleiotropy.

## Unit 2 (10 Marks)

1. Explain the structure of eukaryotic chromosome
2. Classify chromosomes on the basis of the position of centromere
3. Explain any two mechanisms of chromosomal basis of sex determination
4. Explain the inheritance of colour blindness in man
5. Explain sex determination in honey bee and *Drosophila*

## **Unit 2 (5 Marks)**

1. Describe the terms euchromatin and heterochromatin
2. Write a note on polytene chromosomes
3. Write a note on Lampbrush chromosomes
4. Write a note on salivary gland chromosome of *Drosophila*
5. Write a note on Balbiani rings
6. Explain endomitosis
7. Write a note on Gynandromorphs
8. Explain the role of environment on sex determination
9. Explain the role of hormones in sex determination
10. Explain hypertrichosis
11. Differentiate between sex limited and sex influenced genes
12. Differentiate between human X and Y chromosomes
13. Differentiate between autosomes and sex chromosomes
14. Write a note on Lyons hypothesis
15. What are Barr bodies? Give a scientific reason that Barr bodies are present only in women and not in men
16. Give a scientific reason that Y chromosome is a sex determining chromosome in man
17. Explain parthenogenesis
18. Give scientific reason that the X-linked genes affect males more than females in human being

## **Unit 3 (10 marks)**

1. Describe Griffith's transformation experiment
2. Explain Avery, Macleod, McCarty's experiment
3. Give an account of Hershey Chase experiment of bacteriophage infection
4. Write a note on types of DNA
5. Explain RNA as a genetic material
6. Describe the process of DNA replication
7. Explain in detail the process of transcription
8. Explain in detail the process of translation
9. What is gene expression? Describe the regulation of genes with *lac operon* model

### **Unit 3 (5 Marks)**

1. Chemical composition of nucleic acid
2. A and B DNA
3. Plasmid
4. Function of rRNA
5. Function of mRNA
6. Function of tRNA
7. Genetic code
8. One gene-one enzyme hypothesis
9. Concept of operon
10. ZDNA
11. H DNA
12. Chromosomal DNA in prokaryotes
13. Mitochondrial DNA
14. DNA in chloroplast

## **MODEL QUESTION BANK SEMESTER – III**

**Question bank is suggestive. The paper setters are free to modify the questions or include new questions to the best of their perception.**

### **USZO302 (COURSE-VI)**

#### **Unit 1 (10 Marks)**

1. Explain in detail the digestive system of cockroach.
2. Describe the digestive system of pigeon.
3. With the help of a labeled diagram describe the structure and functions of ruminant stomach.
4. Explain the physiology of digestion in cockroach.
5. Give an account of the enzymes involved in the process of digestion in cockroach.
6. With the help of a labeled diagram describe the structure of mammalian kidney.
7. Give a detailed account of process of urine formation in man.

#### **Unit 1 (5 Marks)**

1. Write a note on nutritional apparatus in amoeba.
2. Describe briefly gastrovascular cavity in hydra.
3. Write a note on wheel-organ of Amphioxus.
4. Write a note on structure of ruminant stomach.
5. Write short note on digestion of proteins with respect to man.
6. Write short note on digestion of carbohydrates with respect to man
7. Write short note on digestion lipids with respect to man
8. Write short note contractile vacuoles in protozoa.
9. Write a note on flame cells.
10. Describe briefly excretory and osmoregulatory structures in cockroach.
11. Diagrammatic representation of structure of mammalian kidney.
12. Write a note on Ammonotelic organisms.
13. Write a note on Ureotelic organisms.
14. Write a note on Uricotelic organisms.
15. Schematic diagram of ultrafiltration in mammalian kidney.

## **Unit 2 (10 Marks)**

1. Describe briefly air sacs in pigeon.
2. Describe briefly the process of cellular respiration in human
3. Describe briefly the process of respiration in human
4. Give a brief account of types of circulating fluids present in animals.
5. Describe briefly mechanism of working of heart.
6. Describe briefly the heart of shark/fish.
7. Describe briefly the heart of frog.
8. Describe briefly heart of crocodile.
9. Give a brief account of heart of man.

## **Unit 2 (5 Marks)**

1. Write short note on cutaneous respiration.
2. Write a note on book lungs in spider.
3. Explain the structure of gills of bony fish
4. Describe briefly lungs as respiratory organs in frog.
5. Describe briefly lungs as respiratory organs in man.
6. Write short note on open circulation.
7. Write short note on closed circulation.
- 8 Write a note on heart of cockroach
10. Write a note on heart of earthworm

## **Unit 3(10 Marks)**

1. Describe different types of neurons on the basis of structure and function.
2. Explain conduction of nerve impulse.
3. Briefly describe synaptic transmission.
4. Explain Sol-Gel theory of amoeboid movement.
5. Describe ciliary movement in *Paramecium*.
6. Give an account on types of wings in insects.
7. Describe different types of fins in fishes.
8. Describe sliding filament theory.
9. Describe briefly asexual reproduction in animals.
10. Describe the structure and function of tube feet.

11. Describe spermatogenesis.
12. Describe oogenesis.
13. Describe briefly the structure of mammalian gametes.
14. Give a brief on types of fertilization.

### **Unit 3 (5 Marks)**

1. Write a note on irritability in *Paramecium*.
2. Write a note on resting potential of nerve membrane.
3. Write a note on action potential of nerve membrane.
4. Describe different types of neurons on the basis of structure.
5. Describe briefly different types of neurons on the basis of functions.
6. Describe the structure of synapse.
7. Describe striated muscle fibre.
8. Describe the structure of cilia.
9. Give an account on types of legs in insects.
10. Write a note on ovo-viviparity.
11. Write a note on viviparity.
12. Write a note on oviparity.
13. Describe the structure of mammalian egg.
14. Describe the structure of mammalian sperm.
15. Describe the formation of gemmule in sponges.
16. Write a note on budding as asexual reproduction in animals.

## MODEL QUESTION BANK SEMESTER – III

Question bank is suggestive. The paper setters are free to modify the questions or include new questions to the best of their perception.

### USZOE1303 (COURSE - VIIA) – Elective 1

#### Unit 1 (10 marks each)

1. How do honey bees communicate for foraging?
2. What is classical conditioning? Explain with an example.
3. What is imprinting? Explain different types of imprinting.
4. What do you mean by animal learning? Describe any two types of learning.
5. Describe the various ways in which ants communicate.
6. What is the significance of mimicry and warning coloration?
7. What is mimicry? Explain different types of mimicry with examples.
8. What is displacement activity? In what situations do displacement activities occur?  
Explain with examples.
9. Comment on any two aspects of non-human primate social behaviour.

#### Unit 1 (5 marks)

- i. Mimicry
- ii. Innate learning
- iii. Acquired learning
- iv. Warning colouration
- v. Imprinting
- vi. Classical Conditioning
- vii. Territorial behaviour
- viii. Schooling behaviour
- ix. Altruism
- x. Kinship
- xi. Displacement activities
- xii. Ritualization

## Unit 2 (10 Marks)

1. Give an account of the life history and pathogenicity of the parasite causing amoebic dysentery.
2. Describe the life history of *Taenia solium*.
3. Give an account of parasitic adaptive features of *Taenia solium*.
4. Give an account of the life history of *Fasciola hepatica*.
5. Give an account of the life history of filarial worm and discuss its pathogenic effects.
6. Describe the life history of bedbug and suggest some control measures.
7. Give an account of the life history of *Sarcoptes scabiei*.
8. Give an account of the life history of head louse *Pediculus*.
9. What is bird flu? How it spreads and what are its symptoms?
10. How would you control the transmission of anthrax among humans?
11. How is anthrax transmitted to man?

## Unit 2 (5 Marks)

1. Describe the structure of *E. histolytica*.
2. Write a brief note on amoebiasis.
3. Write a short note on pathogenicity of *E. histolytica*.
4. Briefly describe the life cycle of *E. histolytica*.
5. Illustrate the complete life history of *T. solium* with the help of diagram only.
6. What is the effect of *Fasciola* on the hosts?
7. Describe the life cycle of *Wuchereria bancrofti*.
10. What is host specificity?
11. What are the signs and symptoms of bird flu?
12. How is rabies transmitted in human?
13. What are the preventive measures to be taken to prevent infection of rabies virus?
14. What is toxoplasmosis and what are its causes?
15. Write notes on:
  - i. Parasitic adaptations in endoparasites
  - ii. Cysticercus or bladder worm.
  - iii. Pathogenicity of *Wuchereria*
  - iv. Control measures of bedbug.
  - v. Types of hosts

### **Unit 3 (10 Marks)**

1. What does the modern method of apiculture include? Explain in brief.
2. How is an artificial bee hive constructed?
3. How do you select the flora and bee species for apiculture?
4. Enumerate the advantages of vermiculture
5. Describe any two methods of vermiculture.
6. Describe the processing of raw milk.
7. Write a brief note on Type A1 and A2 cow milk.

### **Unit 3 (5 Marks)**

1. State the economic importance of honey and beeswax.
2. What are the disadvantages of the indigenous method of apiculture?
3. How does the wax moth cause damage to the honey comb?
4. Name any two bee enemies and explain how they harm the bees.
5. Give an account of the commonly found species of honey bee in India.
6. What are the advantages of the modern method of apiculture?
7. Which type of flora is beneficial for apiculture?
8. Which type of bee is suitable for apiculture?
9. What is the chemical composition of honey?
10. What is the suitable material for culturing earthworms?
11. What are the advantages of processing dairy products?
12. What is whole milk and toned milk? How is toned milk prepared?

## **MODEL QUESTION BANK SEMESTER – III**

**Question bank is suggestive. The paper setters are free to modify the questions or include new questions to the best of their perception.**

### **USZOE2303 (COURSE - VIIB)**

#### **Unit 1 10 mark each**

1. Give a brief account on exotic species used in aquarium.
2. Give a brief account on endemic species used in aquarium.
3. Give sexual dimorphism in fresh water fishes along with examples.
4. Give sexual dimorphism in marine water fishes along with examples.
5. Give a brief account on feed used in aquarium.
6. Give a brief account on fish transportation in aquarium.

#### **Unit 2 (10 mark each)**

1. Explain agricultural pests along with suitable example.
2. Explain household pests along with suitable example.
3. Explain stored grains pests along with suitable example.
4. Explain structural pests along with suitable example.
5. Explain veterinary pests along with suitable example.
6. Explain forestry pests along with suitable example.

#### **Unit 3(10 mark questions):**

1. Give a brief account on Blue Mormon butterfly and Striped Tiger butterfly
2. Describe the behaviour of Octopus and spider as most dedicated mothers in the world.
3. Describe marvellous characters of fan throated lizard and flying frog.
4. Describe marvellous characters of Mantis shrimp.
5. Give a brief account on Malabar giant squirrel
6. Describe marvellous characters of the Purple (Joker) crab and lesser flamingo.
7. Describe marvellous characters of the Stabbing Shark and Crime fighting gecko.
8. Describe marvellous characters of the Gharial and the Matilda Viper

## **Unit 1 (5 Marks)**

Write short note on:-

1. Budgeting for setting up of an aquarium
2. Fish packing
3. Formulated fish feed
4. Gold fish
5. Molly
6. Guppy

## **Unit 2(5 Marks)**

Write short note on:-

1. Jowar stem borer
2. Brinjal fruit borer
3. Aphids
4. Rice weevil.
5. Non-insect pests
6. Cultural control of pests
7. Physical control of pests
8. Mechanical control of pests
9. Chemical control of pests
10. Biological control of pests
11. Concept of IPM

## **Unit 3(5 Marks)**

Write short note on the amazing characters in following amazing animals.

1. Blue Mormon butterfly
2. Striped Tiger butterfly
3. Mudskipper
4. Komodo dragon
5. Pebble toad
6. Lesser flamingo
7. Great white pelican
8. Drongo

9. Malabar giant squirrel

10. Cheetah

11. Octopus

## MODEL QUESTION BANK SEMESTER - IV

**Question bank is suggestive. The paper setters are free to modify the questions or include new questions to the best of their perception**

### **USZO401 (COURSE - VIII)**

#### **Unit 1 (10 Marks)**

1. Write explanatory notes on: 1. Lamarckism 2. Darwinism and Neo Darwinism  
3. Mutation Theory 4. Modern Synthetic theory 5. Weismann's germplasm theory
2. Discuss evidences in favour of organic evolution by giving examples of geographical distribution
3. Discuss evidences in favour of organic evolution by giving examples based on genetic studies.
4. Discuss evidences in favour of organic evolution by giving examples based on physiological studies.
5. Give a brief account on the origin of eukaryotic cell

#### **Unit 1 (5 Marks)**

1. Describe Miller-Urey experiment simulating Chemical evolution.
2. Describe chemical evolution as postulated by the Haldane and Oparin theory
3. Write short notes on: 1. Mutation Theory 2. Modern Synthetic theory

#### **Unit 2 (10 Marks)**

1. Define the term 'population genetics'. Describe in brief the various evolutionary forces that tend to disturb genetic equilibrium and introduce changes in the gene pool of a population
2. State Hardy Weinberg's law of equilibrium and discuss its salient features
3. Give an account of the different factors involved in speciation
4. Describe the different types of speciation
5. Explain the role of geographic isolation in the development of new species
6. Explain the role of reproductive isolation in the development of new species
7. Discuss the pre-zygotic barriers responsible for reproductive isolation

8. Discuss the post-zygotic barriers which lead to reproductive isolation
9. Describe the sources of genetic variation in natural populations
10. Explain the nature and extent of genetic variation within populations
11. Describe the mechanisms that preserve balanced polymorphisms
12. Describe the salient features of microevolution
13. Compare and contrast microevolution and macroevolution
14. Explain the salient features of macroevolution
15. Give an account of the different patterns of macroevolution
16. Elaborate on the role of adaptive radiation and extinction in macroevolution
17. What do you understand by the term natural selection? Describe the different types of natural selection with suitable examples
18. What is megaevolution? Explain the mechanism of megaevolution using a suitable example

## **Unit 2(5 Marks)**

1. Explain the term 'gene pool'. How does evolution operate via the gene pools of populations?
2. Differentiate between:
  - a. Allopatric and Sympatric speciation
  - b. Biological and evolutionary species
  - c. Microevolution and macroevolution
  - d. Stabilizing selection and disruptive selection
3. Explain stabilizing selection with the help of a suitable example
4. How does the example of sickle cell allele illustrate heterozygote advantage?
5. How does frequency-dependent selection affect genetic variation within a population over time?
6. Write short notes on:
  - a. Role of mutations in evolution
  - b. Role of migration in evolution
  - c. Non-random mating
  - d. Role of natural selection in evolution
  - e. Genetic drift

- f. Bottleneck effect
  - g. Founder effect
  - h. Directional evolution in peppered moth
  - i. Evolution of Antibiotic resistance in bacteria
  - j. Geographic variation
  - k. Genetic polymorphism
  - l. Parapatric speciation
  - m. Adaptive radiation
7. What is the biological species concept? What are its limitations? How does it differ from the evolutionary species concept?
  8. Explain the concept of coevolution using suitable examples

### **Unit 3 (10 Marks)**

1. Describe briefly, the steps towards preparing a research design
2. Describe literature survey, collection of data and its analysis
3. What is a patent and how is it obtained?
4. Write an account on application of statistics in research

### **Unit 3 (5 Marks)**

1. Define research. State the difference between research method and research methodology
2. Write a note on computer application in research
3. Describe briefly identification of research problem and formulation of research hypothesis
4. Write a note on abstract writing?
5. Write a note on plagiarism?
6. Write a note on bibliography?
7. Write a short note on ethics in scientific research

## MODEL QUESTION BANK SEMESTER - IV

**Question bank is suggestive. The paper setters are free to modify the questions or include new questions to the best of their perception**

### **USZO402 (COURSE - IX)**

#### **Unit 1 (10 Marks)**

1. Explain prokaryotic cell.
2. Explain Eukaryotic cell.
3. Give an account of cell theory.
4. Describe the ultrastructure of nuclear membrane.
5. State the chemical composition and functions of nucleolus.
6. Describe nucleocytoplasmic interactions.
7. Describe fluid mosaic model of plasma membrane.
8. Give an account of active and passive transport
9. Describe various modifications of plasma membrane
11. Explain endocytosis and exocytosis
12. Give an account on cell permeability
13. Differentiate prokaryotic and eukaryotic cell

#### **Unit 1 (5 Marks)**

Write a short note on:

1. Virus
2. Nuclear matrix
3. Number and position of nucleus.
4. Nucleolus
5. Membrane receptors

#### **Unit 2 (10 Marks)**

1. Write a note on structural organization & importance of endomembrane system.
2. Describe ultrastructure of Endoplasmic Reticulum
3. Describe the types and functions of ER.
4. Give an account of ultrastructure and functions of Golgi complex.
5. Write an essay on functions of Golgi complex.

6. Give an account of polymorphism in lysosomes.
7. Write an essay on peroxisomes.
8. Describe the structure and chemical composition of mitochondria.
9. Write a note on mitochondria as powerhouse of the cell.
10. Describe the major functions of mitochondria.

### **Unit 2 (5 Marks)**

1. Importance of endomembrane system
2. Write a short note on biogenesis of endomembrane system
3. Functions of Rough Endoplasmic Reticulum
4. Functions of Smooth Endoplasmic Reticulum
5. Structure of Golgi complex
6. Chemical composition of Golgi complex
7. Lipid & polysaccharide metabolism in Golgi complex
8. Secretion and protein sorting by Golgi complex
9. Write a brief note on GAAP
10. Write a brief note on protein glycosylation by Golgi complex
11. Origin and functions of lysosomes
12. Write a short note on peroxisomes
13. Structure of mitochondria
14. Chemical composition of mitochondria
15. Write a short note on ATP
16. Write a short note on glycolysis
17. Write a short note on Krebs's cycle
18. Write a short note on oxidative phosphorylation

### **Unit 3 (10 Marks)**

1. Explain the concept of micromolecules and macromolecules.
2. Define carbohydrate. Add a note on its classification.
3. What are carbohydrates? Classify carbohydrate with suitable examples.
4. Explain with suitable example monosaccharide and disaccharide.
5. Discuss the properties of carbohydrates.
6. Explain oligosaccharides with suitable examples.

7. What are polysaccharides? How are they classified? Write the structures of glycogen and heparin/ chitin and heparin.
8. Discuss about chemical structure of the monosaccharides / disaccharides.
9. What are amino acids? Classify amino acids based on functional group.
10. Give an account of primary and secondary structure of proteins.
11. Write an account on tertiary and quaternary structure of proteins.
12. Describe the structure of saturated and unsaturated fatty acids.
13. What are fatty acids? Add a note on types of fatty acids.
14. Describe the structure and functions of water soluble vitamins.
15. Describe the structure and functions of lipid soluble vitamins.

### **Unit 3 (5 Marks)**

1. Write a short note on monomers and polymers.
2. Write note on properties of carbohydrates.
3. Give an account of polysaccharides.
4. With suitable example explain glycosidic bond.
5. Explain the linkage in lactose and sucrose.
6. Give the biological importance of carbohydrates.
7. What are essential and nonessential amino acids?
8. Give an account of properties of amino acids.
9. Define and explain peptide bond with suitable example.
10. Explain the different types of proteins with suitable examples.
11. Explain the biological role of proteins.
12. Peptide bond
13. Types of fatty acids.
14. Biological role of lipids
15. Sterols
17. Describe properties of lipids.
18. Discuss the clinical significance of protein / carbohydrate.
19. Write short note on clinical significance of lipids.
20. Write a note on isomerism in carbohydrates/amino acids.
21. Describe the structure and functions of vitamin A/ vitamin B/ vitamin C/ vitamin D.

## MODEL QUESTION BANK SEMESTER - IV

Question bank is suggestive. The paper setters are free to modify the questions or include new questions to the best of their perception

### USZOE1403 (COURSE - XA) – Elective 1

#### Unit-1 (10 Marks)

- 1) Classify the different types of eggs.
- 2) Briefly explain types and structure of sperms (any two animals).
- 3) Define cleavage Explain types of cleavages.
- 4) Give brief account on various types of blastulae.
- 5) What is gastrulation? Explain gastrulation in frog.
- 6) Give an account of process of coelom formation and its types

#### Unit-1 (5 Marks)

- 1) Draw neat labeled diagram and explain any one of the following:  
(Microlecithal, Alecithal, Homolecithal, Heterolecithal, Isolecithal, Telolecithal, Centrolecithal, Discoidal).
- 2) Explain structure of sperm of frog/ reptile/ bird/ mammal.
- 3) Short note on holoblastic cleavage/ meroblastic cleavage.
- 4) Short note on equal or unequal cleavage.
- 5) Short note on discoblastula /coeloblastula.
- 6) Short note on centroblastula /amphiblastula /stereoblastula,
- 7) Explain the process of coelom formation
- 8) Explain the process of gastrulation.

#### Unit 2 (10 Marks)

1. Describe male reproductive system and its hormonal regulation.
2. Describe female reproductive system and its hormonal regulation.
3. Define reproduction. Explain the hormonal regulation of reproduction.
4. What is contraception? Explain different methods of contraception.
5. Explain the various measures of birth control.
6. Define infertility and explain the causes of female infertility.
7. What are the causes of male infertility?
8. Explain the hormonal treatment for infertility using drugs.

9. Describe the methods of treatment of infertility.
10. Give a brief account of infertility related disorders.
11. What are sperm banks? Add a note on cryopreservation of sperms.
12. What is testicular biopsy? Explain Testicular sperm extraction (TESE), Pronuclear stage transfer (PROST).
13. What are the steps involved in Embryo transfer (ET) and / Intra-fallopian transfer (IFT)/IVF? Add a note on its ethics.

## **Unit 2 (5 Marks)**

1. Write a note on impact of age on reproductive stage –
  - a. Menopause
  - b. Andropause
2. Write a note on amenorrhea.
3. How does sterilization act as a method of contraception?
4. Write a note on birth control.
5. What is the difference between natural and artificial methods of contraception?
6. How is T.B. a cause of female infertility?
7. What are the genetic causes of infertility?
8. Write a note on STD's as infertility related disorders?
9. What are the roles of endocrine disruptions in infertility?
10. Explain the role of the following in infertility:
  - a. Gonorrhoea
  - b. Syphilis
  - c. Genital Herpes
  - d. Chlamydia
11. Write a note on treatment of infertility by removal of causative environmental factors.

## **Unit 3 (10 Marks)**

1. What are the causes, effects and control measures for air pollution?
2. What are the causes, effects and control measures for water pollution?
3. What are the causes, effects and control measures for soil pollution?
4. What are the causes, effects and control measures for sound pollution?
5. Define air pollution and give an account of hazardous air pollutants.

6. What is ocean littering? Explain in detail the causes and control measures for ocean littering?
7. Describe the alteration of metabolism of micro-organisms due to soil pollution.
8. Explain sound pollution along with its measurement and permissible limits.
9. Give a brief account of methods to control gaseous / particulate matters.
10. What is pollution? Add notes on:
  - a. Effect of air pollution on vegetation.
  - b. Effect of sound pollution on animals.

### **Unit 3 (5 Marks)**

1. Explain the effects of air pollution on human beings.
2. What are different types of pollutants that cause air pollution?
3. Write short notes on:
  - a. Ozone depletion
  - b. Green house gases
  - c. Global warming
  - d. Acid rain
  - e. Sonic boom
  - f. Acoustic zoning
4. Explain the effect of thermal pollution on biodiversity.
5. Write a note on ionizing radiation
6. How is oil spill becomes a cause of water pollution / ocean littering?
7. How do pesticides and fertilizers contaminate water?
8. How can oil be retracted back from sea / ocean?
9. What are the effects of soil pollution on food chain?
10. What are the auditory / non – auditory effects of sound pollution?

## **MODEL QUESTION BANK SEMESTER - IV**

**Question bank is suggestive. The paper setters are free to modify the questions or include new questions to the best of their perception**

### **USZOE2403 (COURSE - XB) – Elective 2**

#### **Unit 1 (10 Marks)**

1. Give in brief different indigenous breed of cattle with a suitable example.
2. Give in brief different exotic breeds of cattle with a suitable example.
3. Give in brief different breed of buffalo with a suitable example.
4. Give in brief different housing types in dairy farm.
5. Explain different types of diseases in cattle and add a note on its control.

#### **Unit 1(05 Marks)**

Write short note on

1. Malvi
2. Hariyana
3. Deoni
4. Red sindhi
5. Khillari
6. Jersy
7. Holstein
8. Nagpuri
9. Bhadawari
10. Murrah
11. Jafrabadi
12. Weaning of calf
13. Castration
14. Dehorning
15. Cleaning and sanitation.

#### **Unit 2 (10 Marks)**

1. Give in brief life history of silkworm.
2. Give in brief reeling and extraction of silk.
3. Give in brief diseases and control measures in sericulture.

4. Give in brief harvesting and processing of cocoon.

### **Unit 2 (5 Marks)**

1. Varieties of silkworm
2. Rearing of silkworm
3. Silk extraction
4. Host plants for sericulture

### **Unit 3 (10 Marks)**

1. Give an account on pisciculture, add a note on finfish culture
2. Explain monoculture with respect to aquaculture
3. Explain polyculture with respect to polyculture
4. Give an account on fresh water prawn culture
5. Give an account on pearl culture.

### **Unit 3 (5 Marks)**

Write short notes on:-

1. Composition of pearl
2. White shrimp culture
3. Cage culture
4. Fish diseases
5. Symptoms of diseases
6. Control of diseases

-----*The End*-----