Academic Council dated 20th May, 2021 as per Item Number: 2.03

DOMBIVLI SHIKSHAN PRASARAK MANDAL'S,

K.V. PENDHARKAR COLLEGE OF ARTS, SCIENCE AND COMMERCE, (AUTONOMOUS)

DOMBIVLI (EAST), DIST. THANE

(Affiliated to University of Mumbai)

Faculty of Science

DEPARTMENT OF ZOOLOGY

(Programme: Bachelor of Science: B.Sc.)

SYLLABUS FOR

F. Y. B.Sc. Zoology(Semester I and II)

Choice Based Credit System (CBCS)

(with effect from the Academic Year: 2021-2022)

SYLLABUS F.Y.B.Sc. ZOOLOGY
UNIT WISE DISTRIBUTION

Semester I		**Semester II**	
Course 1 PUSZOI21-161	**Course 2** PUSZOI21-162	**Course 3** PUSZOII21-261	**Course 4** PUSZOII21-262
Unit 1 Wonders of animal world	Unit 1 Laboratory Safety and Units of Measurement	Unit 1 Population Ecology	Unit 1 Nutrition and Health
Unit 2 Biodiversity and its Conservation	Unit 2 Animal Biotechnology	Unit 2 Ecosystem	Unit 2 Public Health and Hygiene
Unit 3 Study of Vertebrates	Unit 3 Instrumentation	Unit 3 National Parks and Sanctuaries	Unit 3 Pollution
Practical PUSZOI21-P161	Practical PUSZOI21-P162	Practical PSZOII21-P261	Practical PSZOII21-P262

Syllabus for F. Y. B.Sc.
Course – ZOOLOGY
To be implemented from Academic year 2021-22

SEMESTER - I

PAPER CODE	UNIT	TOPICS	CREDITS	LECTURES/ WEEK
PUSZOI21-161	I	Wonders of animal world	2	1
	I I	Biodiversity and its Conservation		1
	III	Study of Vertebrates		1
PUSZOI21-162	I	Laboratory safety and Units of Measurement	2	1
	II	Animal Biotechnology		1
	III	Instrumentation		1
PUSZOI21-P161 & PUSZOI21-P162	Practical based on both courses		2	6

SEMESTER - II

COURSE CODE	UNIT	TOPICS	CREDITS	LECTURES/ WEEK
PUSZOII21-261	I	Population Ecology	2	1
	II	Ecosystem		1
	III	National Park and Sanctuaries		1
PUSZOII21-262	I	Nutrition and Health	2	1
	II	Public health and Hygiene		1
	III	Pollution		1
PSZOII21-P261 & PSZOII21-P262	Practical based on both courses		2	6

F. Y. B.Sc.-SEMESTER I

(PUSZOI21-161)
PAPER-I: Study of Animal world and its Biodiversity

OBJECTIVES:

1. *To make the learners aware of the animals around them and to develop in their interest the study of animal world.*
2. *To orient learners about rich heritage of biodiversity of India and make them understand significance of its conservation.*

COURSE OUT COME:

1. *Learners would develop an interest in the fascinating world of animals.*
2. *Learners would appreciate treasure of Biodiversity, its importance and hence would contribute their best for its conservation*

Unit 1: Wonders of Animal World (15 L)

1.1: **Echolocation** in Bats and Cetaceans - Dolphins and Whales

1.2: **Mechanism of Pearl formation in Mollusca**

1.3: **Bioluminescence in Animals:** Noctiluca, Glow worm, Firefly, Angler Fish (Mechanism and use for the animal)

1.4: **Regeneration in Animals** - Earthworm (Annelida) and Lizard (Reptile)

1.5: **Mimicry in Butterflies and its significance**: Great Egg fly and Common Crow, Common Palm fly and Plain Tiger.

1.6: **Mechanism of Coral formation and types of Coral reefs.**

1.7: **Bird migration:** Definition, types and factors inducing bird migration.

1.8: **Adaptive features of desert animals:** Reptiles (Phrynosoma) and Mammals (Camel).

1.9: **Breeding and Parental care**:

1.9.1: Pisces - Ovo-viviparous (Black Molly/Guppy), Mouth brooders (Tilapia), Brood pouches (Seahorse)

1.9.2: Amphibia - Mouth brooders (Darwin's Frog), Egg carriers (Midwife Toad)

1.9.3: Mammals- Egg-laying (Duck-billed Platypus), Marsupials (Kangaroo)

1 .10: Aves: Brood Parasitism (Cuckoo)

Unit 2: Biodiversity and its Conservation **(15 L)**

2.1: Introduction to Biodiversity - Definition, Concepts, Scope and Significance.

2.2: Levels of Biodiversity - Introduction to Genetic, Species and Ecosystem Biodiversity.

2.3: Introduction of Biodiversity Hotspots- (Western Ghats and Indo- Burma Border).

2.4: Values of biodiversity - Direct and Indirect use value.

2.5: Threats to Biodiversity - Habitat loss and Man-Wildlife conflict.

2.6: Biodiversity conservation and management-

2.6.1: Conservation strategies: *in situ,* ex-situ, National parks, sanctuaries and Biosphere reserves.

2.6.2: Introduction to International efforts: Convention on Biological Diversity (CBD), International Union for Conservation of Nature and Natural Resources (IUCN), United Nations Environment Program - World Conservation Monitoring Centre (UNEP-WCMC).

2.6.3: National Biodiversity Action Plan, 2002.

2.6.4: Introduction to Indian Wildlife (Protection) Act, 1972and Convention for International Trade of endangered species

Unit 3: Study of Vertebrates **(15 L)**

3.1: Introduction: Overview of Invertebrates Classification

3.1.1Unicellarity to Multicellularity- Cells, Tissues, Organs and System Grade Body
3.1.2 Symmetry: Asymmetry, Radial Symmetry and Bilateral Symmetry
3.13 Body wall: Diploblstic to Triploblastic Condition
3.1.4 Coelom: Acoelom, Pseudocoelom and True Coelom Condition

3.2: Study of General Organization of the vertebrate classes

3.2.1: Class**: -** Ostracodermi (Extinct), Example- *Cephalaspis*

3.2.2: Class: - Cyclostomata Example- *Petromyzon*

3.2.3: Class: - Placodermi Example- *climatius*

3.2.4: Class: - Chondricthyes Example- *Shark*

3.2.5: Class: - Osteichthyes Example-*Exocetus*

3.2.6: Class: - Amphibia Example- *Frog*

3.2: 7: Class: - Reptilia Example- *Crocodile*

3.2.8: Class: - Aves Example- *Duck, Heron*

3.2.9: Class: - Mammals Example- *Squirrel, Monkey*

3.3: Economic importance of Fishes, Amphibians, Reptiles and Mammals.

(PUSZOI21-162)

PAPER-II: Instrumentation and Biotechnology

OBJECTIVES:

1. To make learners aware of risks involved in handling of different hazardous chemicals, sensitive (electrical/electronic) instruments and infectious biological specimens especially during practical sessions in the laboratory and to train them to avoid mishap

2. To acquaint learners with the modern developments and concepts of Zoology and their role in human welfare.

COURSE OUTCOME:

1. *Learners would work safely in the laboratory and avoid occurrence of accidents (mishaps) which will boost their scholastic performance.*

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

3. *Students will be skilled to select and operate suitable instruments for the studies they would undertake.*

Unit 1: Laboratory safety, Units and Measurement (15L)

1.1: Introduction to good laboratory practices.

1.2: Use of safety symbols: meaning, types of hazards and precautions.

1.3: Units of Measurement:

1.3.1: Calculations and related conversions of each: Metric system- length (meter to micrometer); weight (gram to microgram), Volumetric (Cubic measures)**.**

1.3.2: Temperature: Celsius, Fahrenheit, Kelvin**.**

1.3.3: Concentrations: Percent solutions, ppt, ppm, ppb dilutions, Normality, Molarity and Molality.

1.3.4: Biostatistics: Introduction and scope, Sampling and its types, Central Tendencies (mean, median, mode) Tabulation, Graphical representations (Histograms, bar diagrams, pie diagrams).

Unit 2: Animal Biotechnology (15L)

2.1: Biotechnology: Scope and achievements of Biotechnology (Fishery, Animal Husbandry, Medical, Industrial).

2.2: Transgenesis: Retro viral method, Nuclear transplantation method, DNA microinjection method and Embryonic stem cell method.

2.3: Cloning (Dolly)

2.4: Ethical issues of transgenic and cloned animals

2.5: Applications of Biotechnology:

2.5.1: DNA fingerprinting: Technique in brief and its application in Forensic Science (Crime Investigation)

2.5.2: Recombinant DNA in medicines (recombinant insulin)

2.5.3: Gene therapy: Ex-vivo and *in vivo,* Severe Combined Immunodeficiency (SCID), Cystic Fibrosis

2.5.4: Green genes: Green Fluorescent Protein (GFP) from Jelly fish- valuable as reporter genes used to detect food poisoning.

Unit 3: Instrumentation (15L)

3.1: Microscopy- Construction, principle and applications of dissecting and compound microscope.

3.2: **Colorimetry and Spectroscopy -** Principle and applications.

3.3: pH- Sorenson's pH scale, pH meter - principle and applications.

3.4: Centrifuge - Principle and applications (clinical and ultracentrifuges).

3.5: Chromatography - Principle and applications (Partition and Adsorption)

3.6: Electrophoresis - Principle and applications (AGE and PAGE)

LEARNERS SPACE:

1. Some of the marine fishes generate electric current. Study it's mechanism by using any search engine from internet. Comment on its Biological significance.
2. What is meant by captive breeding? Where is it practiced?
3. Study the unique features of Ammocoetus larva and Axolotl larva in vertebrates.
4. What are Bionanomaterials? What would be the size of nanomaterils used in Nanotechnology?
5. How do you obtain distilled water and Deionised water in the laboratory? Give its significance in the laboratory work.
6. What are the properties of potable water?
7. Refer the principles and applications of GLC and TLC.

Paper I and Paper II

REFERENCES AND ADDITIONAL READING

1. Wonders of the Animal World - University Text Book of Zoology, F.Y.B.Sc. Semester I Course 1. V.V. Dalvie, G.B. Raje, P. Sardesai, N.S. Prabhu, University Press.
2. Vertebrate Zoology Volume I- Jordan and Verma, S. Chand andCo.
3. Introduction to Vertebrates- Moore Cambridge University- Low Priced Edition
4. Zoology- S. A. Miller and J. B. Harley, Tata McGrawHill
5. Modern Textbook of Zoology, Invertebrates, R. L.Kotpal
6. Modern Textbook of Zoology, Vertebrates, R. L.Kotpal
7. Biodiversity- S.V.S Rana- Prentice Hall Publications
8. Biology of Mollusca- D. R.Khanna
9. Wildlife Laws and its Impact on Tribes- Mona Purohit, Deep and Deep

Publications

10. Biodiversity- K.C. Agarwal- Agro Botanica Publications
11. Butterflies of India – Isaac Kehimkar- BNHS Publication.
12. Basic Laboratory Techniques, Instrumentation and Biotechnology- University Text Book of Zoology, F.Y.B.Sc. Semester I Course 2. V.V. Dalvie, R. G. Deshmukh, R. D'souza and H.U. Shingadia University Press.
13. Introduction to Practical Biochemistry – David T. Plummer (Tata McGraw Hill Publishing Co. Ltd.)
14. Introductory Practical Biochemistry – S.K. Sawhney and Randhir Singh (Narosa Publishing House)
15. Methods in Biostatistics – B. K. Mahajan, (JaypeePublications)
16. Microscopy and Cell Biology - V. K. Sharma, (Tata McGraw Hill Publishing Co. Ltd.)
17. Bioinstrumentation – L. Veerakumari, (M.J.P.Publishers)
18. Biotechnology –Glick and Pasternak
19. Biochemistry–Satyanarayana
20. Understanding biotechnology- AluizioBorem, David Bowe-Low price edition –Pearson Publication
21. A Textbook of Biotechnology – R. C. Dubey, S. Chand Publication.
22. Biological instruments and methodology – Dr. P. K. Bajpai,S. Chand company Ltd.
23. Dr.Parvish Pandya- A talk on Animal Behaviour https://youtu.be/hFSBx9F-fwg
24. Biodiversity in Konkan and Western Ghats https://youtu.be/mfSuc6C2mb0

Gel Electrophoresis MITK12 Videos

Transgenic mice You Tube Shomu's Biology

Microscope? You Tube Amoeba Sisters

Application of Biotechnology You Tube Kaye B

Adsorption Chromatography. You Tube Shomu's Biology

SEMESTER I: Practical I (PUSZOI21-P161)

1. Mounting of foraminiferan shells from sand (any3)
2. Study of types of Corals – Brain coral, Organ pipe, Stag Horn, Mushroom coral.
3. Study of six fish species with respect to their habitat. *(Tilapia, Catfish, Catla, Pomfret, Eel, Sting ray)*
4. Mounting of scales of fish (placoid, cycloid and ctenoid)
5. Breeding and parental care in Amphibia- *Rhacophorus*, *Midwife toad, Darwin's frog, Caecilian.*
6. Study of Adaptive radiation in Reptiles - *Turtle, Tortoise, Phrynosoma*, *Draco*).
7. Identification and differentiation of venomous and non-venomous snakes (Scales, Fangs, Bite marks, etc.).
8. Study of types of beaks and claws in birds (Beaks-Nectar feeding, Insect catching, fruit eating, scavenging), (Claws-perching, wading, swimming, climbing)
9. Identification of birds - *Coppersmith Barbet, Bulbul, Rose ringed Parakeet, Magpie Robin,* two local birds
10. Identification of Mammals on the basis of feeding habit- *Rabbit, Elephant, Dog, Tiger, Rat, Monkey.*

Field Report – Observation of fauna.
To be done in a group of ten students (submission of written / type report preferably along with photographs/ tables/graphs

Suggested topics for field observation: Butterflies/ Fishes/ Migratory birds of local area.

***Note - The practicals may be conducted by using specimens authorised by the wild life and such other regulating authorities though it is strongly recommended that the same should be taught by using photographs/audio-visual aids/ simulations / models, etc. as recommended by the UGC and as envisaged in the regulations of the relevant monitoring bodies. Specimens, however, shall be procured for the purpose of conducting practicals mention here-in-above. #There shall be at least one excursion/field trip**

SEMESTER I: Practical II (PUSZOI21-P162)

1. Interpretation of safety symbols (toxic, corrosive, explosive, flammable, skin irritant, oxidizing agent, compressed gases, aspiration hazards and Bio hazardous infectious material.)
2. Preparation of Molar solutions of any three chemicals.

3. Study of central tendencies and plotting of bar diagram, histogram and pie diagram.

4. Identification of transgenic fish (Trout and Salmon) / cloned animals (Dolly sheep, cc cat and Snuppy dog) from photograph.

5. a) Study of pH meter

   b) Calculation of pH of three different samples (one each acidic, alkaline and neutral) using pH paper/Universal Indicator and confirming the result with pH meter

6. a) Demonstration of Electrophoretic technique.

   b) Application of DNA Fingerprinting in criminology (photograph of electrophoretic pattern to be given for interpretation by the students)

7. a) Study of parts of microscope and their functions.
   b) Technique of focusing a permanent slide under 10x and 45x (objectives).

8. a) Study of Colorimeter. Dilution of given sample and estimation of OD by using colorimeter.

   b) Calculation of concentration from the given OD using formula.

9. a) Separation of amino acids from the mixture by paper chromatography.

   b) Calculation of Rf value of separated pigments/amino acids from given chromatogram and their identification from standard chart.

10. a) Separation of pigments by adsorption chromatography using chalk.
    b) Separation of lipids by TLC,

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Websites referred to change the syllabus

1. www.sgbau.ac.in Sant Gadgebaba Amravati University, Amravati, (M.S.)

2. bhu.ac.in Banaras Hindu University, Varanasi (U.P.)

3. nmu.ac.in Kavyatri Bahinabai North Maharashtra University, Jagaon(M.S.)

4.msubaroda.ac.in The Maharaja Sayajirao University, Vadodara (Gujrat)

SEMESTER-II

PUSZOII21-261

Paper I: Ecology and Wild life management

OBJECTIVES:

1. *To facilitate the learning of population ecology, its dynamics and regulatory factors important for its sustenance.*
2. *To impart knowledge of different components of ecosystem and educate about essentials of coexistence of human beings with all other living organisms.*
3. *To enlighten learners about the current status of wild life conservation in India in the light of guidelines from different relevant governing agencies vis-à-vis with adversity of poaching and bio piracy.*

COURSE OUT COME:

1. *This study would allow the learner to know about nature of animal Population, specific factors affecting specific factor affecting its growth and its impact on the population of other life forms.*
2. *Learners will grasp the concept of interdependence and interaction of physical, chemical and biological factors in the environment.*
3. *Learners would be inspired to choose career options in the field of wild life conservation, research, photography and ecotourism.*

Unit 1: Population ecology: (15 L)

1.1 : Population dynamics

1.1.1 : Population density
1.1.2 :Natality
1.1.3 :Mortality
1.1.4 :Fecundity
1.1.5 : Age structure
1.1.6 : Sex ratio
1.1.7 : Life tables
1.1.8 : Survivorship curves
1.1.9 : Population dispersal and distribution patterns
1.1.10 Niche concept

1.2 : Population growth regulation

1.2.1 : Intrinsic mechanism – Density dependent fluctuations and oscillations

1.2.2 : Extrinsic mechanism- Density independent, environmental and climate factors, population interactions

1.3 : Population growth pattern

1.3.1 : Sigmoid

1.3.2 : J Shaped

1.4 : Human census (India) – Concept, mechanism and significance

Unit:2 Ecosystem **(15L)**

2.1 : Concept of Ecosystems

2.1.1 **:** Ecosystem - Definition and components

2.1.2 **:** Impact of temperature on biota

2.1.3**:** Biogeochemical cycles (Water, Oxygen, Nitrogen, Sulphur)

2.1.4**:** Fresh water ecosystem – Lentic and Lotic

2.1.5 **:** Food chain and food web in ecosystem (Fresh water and Grassland).

2.1.6 **:** Ecological pyramids - energy, biomass and number.

2.1.7 **:** Animal interactions (commensalism, mutualism, predation, antibiosis, parasitism)

Unit:3 National Parks and Sanctuaries of India **(15L)**

3.1: Concept of Endangered and Critically Endangered species using examples of Indian Wildlife with respect to National Parks and Wild life Sanctuaries of India (Sanjay Gandhi National Park, Tadoba Tiger Reserve, Corbett National Park, Kaziranga National Park, Gir National Park, Silent Valley, Pirotan Island Marine Park, Keoladeo Ghana National Park, Bandipur Sanctuary)

3.2: Management strategies with special reference to Tiger and Rhinoceros in India

3.3: Ecotourism

3.4: Biopiracy

SEMESTER-II

PUSZOII21-262

Paper-II: Nutrition, Public health and hygiene, Pollution

OBJECTIVES:

1. To make learners understand the importance of balanced diet and essential nutrients of food at different stages of life.

2. To impart knowledge about source, quantum and need for conservation of fast depleting water resource and essentials of maintaining proper sanitation, hygiene and optimizing use of electronic gadgets.

3. To understand causes and ill effects of atmospheric pollution.

COURSE OUT COME:

1. *Healthy dietary habits would be inculcated in the life style of learners in order to prevent risk of developing health hazards in younger generation due to faulty eating habits.*
2. *Learners will understand the importance of water conservation and personal hygiene.*
3. *Learners will be more thoughtful in using the natural resources and may also guide their peers for the same.*

Unit 1: Nutrition and Health (15 L)

1.1 **:** Concept of balanced diet, dietary recommendations to a normal adult, infant, pregnant woman and aged.

1.2 **:** Malnutrition disorders – Anemia (B_{12} and Iron deficiency), Rickets, Marasmus, Goiter, Kwashiorkar (cause, symptoms, precaution and remedy).

1.3 **:** Constipation, piles, starvation, acidity, flatulence, peptic ulcers (cause, symptoms, precaution and remedy).

1.4 **:** Obesity (Definition and consequences), BMI calculation and its significance.

1.5 **:** Importance of fibres infood.

1.6 **:** Significance of breastfeeding.

1.7 **:** Swine flu (cause, symptoms, precaution andremedy).

1.8 **:** Covid-19(cause, symptoms, prevention and precaution)

Unit: 2 Public Health and Hygiene (15L)

2.1.1 **:** Definition of Health, the need for health education and health goal.

2.1.2 **:** Physical, psychological and Social health issues.

2.1.3 **:** WHO and its programmes - Polio, Small pox, Malaria and Leprosy (concept, brief accounts and outcome with respect to India).

2.1.4 : Ill effects of self-medication.

2.2 : Water and water supply

2.2.1 **:** Sources and properties of water.

2.2.2 **:** Purification of water, small scale, medium scale and large scale (rapid sand filters)

2.2.3 **:** Water footprint (concept, brief accounts and significance).

2.3 : Hygiene:

2.3.1 **:** Hygiene and health factors at home, personal hygiene, oral hygiene and sex hygiene.

2.4 : Radiation risk:

2.4.1 **:** Mobile Cell tower and electronic gadgets (data of recommended level, effects and precaution).

2.5 : Blood bank – Concept and significance

Unit: 3. Pollution (15L)

3.1 : Introduction

3.2 : Causes, effects and control measures of pollution

3.2.1**:** Air Pollution

3.2.2: Water Pollution

3.2.3: Soil Pollution

3.2.4: Solid waste pollution

3.2.5: Noise pollution

3.3: Case studies on pollution:

Bhopal Gas Tragedy, The Minamata disaster, Effect of air pollution on Taj Mahal, Acidification of Great Barrier reef, Diclofenac as a threat to Indian vultures

LEARNERS SPACE:

1. To protect wildlife from extinction now a day Satellite Technology is used in Sanctuaries and National Parks. How do they obtain images of their behaviour by using a way of modern wildlife

techniques?

2. Find ecological significance of every species of animal world.
3. What is meant by captive breeding?Where is it practiced?
4. What is Nephelometry? What is its use?
5. As a Nutritionist prepare guidelines to maintain physical fitness of your age.
6. Compare demography of any one developing and developed Nations,

PAPER: I and II
REFERENCES AND ADDITIONAL READING

1. Introduction to Ecology and Wildlife - University Text Book of Zoology, F.Y.B.Sc. Semester II Course 3. UniversityPress.
2. Ecology - Mohan P. Arora , Himalaya PublishingHouse
3. Field Biology and Ecology -- Alen H. Benton and William E. Werner ,Tata McGraw Hill ltd, NewDelhi
4. Ecology and Environment - Sharma P. D , RastogiPublication,Mumbai
5. Ecology : Principles and Applications - Chapman J.L , Cambridge University trust
6. Ecology - Subramaniam and Others, NarosaPublishingHouse.
7. Wildlife laws and its impact on tribes - Mona Purohit, Deep and deep Publication.
8. Economic Zoology, Biostats and Animal Behaviour - Shukla, Mathur, Upadhyay, Prasad. RastogiPublications.
9. Common Diseases, Health and Hygiene - University Text Book of Zoology, F.Y.B.Sc. Semester II Course 4. UniversityPress.
10. Common Medical Symptoms edited - P. J. Mehta National Inblisents and Distributions.
11. Parks Textbook of Preventive and Social Medicine K. ParkM/S BanarasidasBhanotJabalpar.
12. Human Physiology – Volume I – II C. C. Chatterjee, Medical Allied agency,Kolkatta.

13.Parasitology (Protozoology and Helminthoology) - K. D. Chatterjee, ChatterjeeMedialPublishers.

14.Nand's handbook of Forensic Medicine and Toxicology - ApurbaNandy, NCBApublication.

15.Essentials of Public Health and Sanitation- Part I and Part II. All India Institute of Local SelfGovernment.

16.Epidemiology and Management for Health Care for all. P.V. Sathe,A. P. Sathe, Popular Prakashan, Mumbai.

17.Textbook of Medical Parasitology- C. K. JayaramPaniker. JaypeeBrothers.

18. A Treatise on Hygiene and Public Health. -B. N. Ghosh. Calcutta Scientific PublishingCompany.

19. Clinical Dietetics and Nutrition - F. P. Antia and Philip, Oxford UniversityPress.

20. Nutrition: Principles and Application in Health Promotion - J. B. Lippincott Company.Philadelphia.

21.Food Nutrition and Health- Dr. ShashiGoyal, Pooja Gupta, S. Chand Publications. Food and Nutrition – Vol. I and II - Dr. Swaminathan ,BappcoPublication.

22.Dr.Parvish Pandya- A talk on Animal Behaviour https://youtu.be/hFSBx9F-fwg

Western Ghats https://youtu.be/mfSuc6C2mb0

24. Yoga at Home Yoga at Family for physical fitness https://youtu.be/2IXMHR07_A8

25. Human Nutrition and Health - You Tube: University of Surrey

SEMESTER II: Practical I (PSZOII21-P261)

1. Interpretation of the given graphs/ tables and comment on pattern of population nature:
   i. Survivorship curve
   ii. Life tables
   iii. Fecundity tables
   iv. Age structure
   v. Sex ratio

2. a) Calculation of Natality, Mortality, Population density from given data.
   b) Estimation of population density by capture recapture method.

3. Interpretation of Growth curves (Sigmoid and J shaped).

4. Estimation of hardness from given water sample. (tap water v/s well water).

5. Estimation of Free carbon dioxide (Free CO_2) from two different samples- aerated drinks (diluted) v/s tap water.

6. Identification and interpretation of aquatic and terrestrial (Grassland) food and food webs chains.

7. Construction of food chain/food web using given information/data.

8. a) Identification and interpretation of ecological pyramids of energy, biomass and number
   b) Construction of different types of pyramid from given data.

9. Study of the following:
   a) Endangered (Great Indian Bustard, Asiatic lion, Blackbuck, Olive Ridley sea turtle) and critically endangered species (Slender-billed vulture, Gharial, Malabar civet) of Indian wildlife and state reasons for their decline

   b) Study Biodiversity hotspots using world map (Western Ghats and Indo- Burma).

10. Study of sanctuaries, national parks, biosphere reserves in India with respect to its brand fauna as listed in theory)

SEMESTER II: Practical –II (PSZOII21-P262)

1. Qualitative test of heavy metals iron and lead.
2. Water Analysis- Physical properties
3. Milk adulterants (starch and glucose), methylene blue reduction Test (MBRT).
4. Food adulteration Test: Food Adulterants in Cheese, Butter, Jaggery, Ghee, Honey, Iodised Salt.
5. Study of Common medicines.
6. Study of causes and symptoms of anemia, acidity, obesity, constipation and goiter and kwashiorkor diseases
7. Study of Human parasites.
    1. Endoparasites - Protozoans (*Entamoeba, Plasmodium*), Helminths (*Ascaris, Wuchereria*),Ectoparasites (Head louse, tick) and Exoparasites (Bed bug, Mosquito).
8. Screening of anaemic/non-anaemic persons using CuSO4method.
9. ..First Aid – Demonstration Practical Training for teachers and students to be conducted by the experts from Red cross, Civil defence, Civic authorities by individual institute or cluster colleges in rotation.
9. BMI analysis - Measurement of Height/ Weight and calculation of BMI using formula, preparation and submission of report. (10 students/ group-50readings/group)

***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 the purpose of conducting practicals mentioned here-in-above.**

Note: There shall be at least one excursion/field trip.

Websites referred to change the syllabus

1.www.sgbau.ac.in Sant Gadgebaba Amravati University, Amravati, (M.S.)

2.bhu.ac.in Banaras Hindu University, Varanasi (U.P.)

3. nmu.ac.in Kavyatri Bahinabai North Maharashtra University, Jagaon(M.S.)

4.msubaroda.ac.in The Maharaja Sayajirao University, Vadodara (Gujrat

Pedagogy

As F.Y.B.Sc is the entry point for the students to undergraduate classes which acts like a guiding force for them to make up their mind in selecting a subject, they would wish to pursue their studies in future for carving their career in a particular field.

The syllabus has been with a view that it is most appropriate time when we transform our traditional closed classroom teaching learning practices to more of field and activity-based studies, the correct methodology for the study of natural sciences. It is recommended to orient the student about ecosystem, bio-diversity, wildlife conservation and management with the help of models, photographs, movies, documentaries, charts and use of ICT and then take learners to field to have realistic experiences. This will enable them to get true insight about endurance of animal life in relation to human activity inducing sentiment of love, care and protection in the young mind and heart leading to understand importance of co-existence and conservation of bio-diversity. An interaction with the officials of wildlife protection force should be allowed to get basic knowledge about the relevant acts through lectures which for creating awareness about these issues and also to make best use of the knowledge in their own interest as well as for the country. Instrumentation and animal biotechnology component would initiate academia- industry interface and should be edified in collaboration with expertise from relevant research institutes and establishments and entrepreneurs by inviting them as guest speakers or through industrial visits, excursions for practical experience about the principle, working and application of the instruments for commercial use. It is advisable to share topic related internet links to see videos on you tubes. Population ecology needs to be explained in context with sensors to enlighten pupils about the effect of diversity and dynamism of human population on socio-economic status of India. Expert from the field of nutrition and health can be invited to enlighten learners on the topics of nutritional value of food, balanced diet, ill –effects of eating junk food and aerated drinks medical professionals relevant NGO's may be engaged to educate students regarding myth, precautionary measures, immunization dries of common diseases, ill-effects of self-medication and stress, significance of BMI through series of programs. During medical emergencies it is of immense importance to provide first-aid assistance to the diseased within the golden period i.e. of few minutes. This enhances the possibility to save life, thus it is strongly re commended to form a consortium of colleges to first-aid technics for teachers and students both with the help of organizations like Red cross society, Health department of civic bodies, civil defense department and local self-government etc. They should be also made realize that healthy air, water and soil quality is important for existence of life on the earth.

SCHEME OF EXAMINATION (THEORY)

(a) Internal assessment of forty (40) marks per course per semester s will be conducted according to the format given below.

(b) External assessment of sixty (60) marks per course per semester will be conducted as per the following skeleton question paper pattern.

(c) One practical examination of fifty (50) marks per course each will 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

Time:2.5hours **Total marks:60**

EVALUATION PATTERN			
Evaluation	Type of Questions	Weightage	
Theory External **(60%)**	Answer in one or two sentences each/Definition/Give reason/Justify the statements	20%	12 marks
	Short answer questions	40%	24 marks
	Long answer questions	40%	24 marks
Practical (I + II)	Preparations, Presentation, Observation, Analysis, Results, Excursion / Survey, Viva and Journal	100%	100 marks
Theory Internal **(40%)**	One Class test (Objective/ Multiple Choice).	50%	20 marks
	Assignment/ Project/ Presentation/ Field Experience/Book or Research Paper Review.	37.5%	15 marks
	Active Participation, Level of Understanding of Students.	12.5%	05 marks

SEMESTER I: PAPER 1

Skeleton -Practical Examination Question Paper Pattern

Time: 2hrs **Marks: 50**

Q.1. From the given sample mount foraminiferan shells (three types) **(06 Marks)**

OR

Mounting of scales (placoid and cycloid/ctenoid) from fishes.

Q.2. Identify the fish species and comment on their habitat (a and b) **(06 Marks)**

Q.3. Identification (one specimen each) **(15 Marks)**

i. Types of corals
ii. Amphibians-breeding and parental care
iii. Adaptive radiation in reptiles
iv. Venomous and non-venomous snake
v. Types of beaks/ claws in birds

Q.4. Identify the mammal and comment on their feeding habits (a and b, c out of syllabus) (09 Marks)

Q.5. Field study report (Biodiversity) and viva on it. **(09 Marks)**

Q.6. Journal **(05 Marks)**

SEMESTER I: PAPER II

Skeleton -Practical Examination Question Paper Pattern

Time:2hrs **Marks: 50**

Q. 1 a) Dilute the given sample and estimate the OD using colorimeter. (four dilutions) **(10Marks)**

b) Calculate concentration from given OD by formula. (three concentrations) **(05Marks)**

OR

a) Prepare molar solutions(three) **(10 Marks)**

b) Find pH of water samples (three) and comment on their chemical nature. **(05 Marks)**

Q. 2. Perform experiment for separation of pigments by adsorption chromatography. **(08 Marks)**

OR

Perform experiment for separation of mixture of amino acids by paper chromatography

OR

Focus the given slide under 10 X and 45 X and show it to examiner.

OR

Perform Thin Layer Chromatography (TLC) for separation of lipids.

Q. 3. Prepare a frequency distribution table / Plot histogram / Pie diagram / diagra from the given data. **(06 Marks)**

Q. 4. Identification **(12 Marks)**
(Safety Symbols (two), parts of compound microscope, instrument (any one), transgenic animals, DNA fingerprinting)

Q.5. Viva **(04 Marks)**

Q. 6. Journal **(05 Marks)**

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Semester II Practical I

Practical Examination Question Paper Pattern

Time: 2hrs **Marks:50**

Q.1. Estimate Hardness from given water samples and compare the results. **(15Marks)**

OR

Estimate Free CO_2 from given samples and compares the results.

Q.2. Solve the given problems (using statistical approach wherever possible) based on (Any two) **(10Marks)**

Natality
Mortality
Sex Ratio
Fecundity
Population density

Q.3. Identify brand animals (Min. 4) and place them in their respective National parks/Sanctuaries on the given map quoting reasons for their decline. **(5 Marks)**

OR

Mark National parks and Sanctuaries on the map of India and mention the name of their brand animals stating reason for their decline. (Min. 4)

(5Marks)

OR

Identify endangered and critically endangered animals (photographs) one each and state their reason of decline **(5 Marks)**

Q.4. Study the given information and give answers on the basis of food chain/food web and ecological pyramids. **(10 Marks)**

OR

Prepare food chain/food web and ecological pyramid from the given data and give its significance. **(10 Marks)**

OR

Identify and interpret the given graph/growth curve/age structure and comment on the pattern of population dispersal. **(10Marks)**

OR

Determine Population density by capture and recapture method. **(10 Marks)**

Q.5. Journal and Viva voce (Based on practical component) **(10 Marks)**

Semester II Practical II

Skeleton -Practical Examination Question Paper Pattern

Time: 2hrs **Marks: 50**

Q.1. Analyse the given water sample and comment on its quality. **(10Marks)**

OR

Detect the presence of heavy metals in the given water sample.

Q.2. Analyse the given food sample and identify food adulterants (any 2samples). **(10Marks)**

OR

Detect adulterants present in the given milk sample (any two).

Q.3 Evaluate milk quality by Methylene Blue Reduction Test (MBRT).

OR

Comment on the medicinal use of the given sample.(two samples)

OR

Determine whether given blood sample is from anaemic/non-anaemic person using CuSO4 Method and suggest the appropriate diet **(05Marks)**

Q.4 Identification **(10Marks)**

a) One specimen of Protozoan Parasites.

b) One specimen of Helminth Parasites.

c) One specimen from Ectoparasite

d) One specimen from Endoparasite

e) One specimen from Exoparasite

Q5. Submission of report of Survey of nutritional diseases / Sound Pollution in their area / report of field visit and viva based on it. **(10Marks)**

Q6. Journal. **(05 Marks)**

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Academic Council date 10/02/2022 as per Item Number: 3.03

DOMBIVLI SHIKSHAN PRASARAK MANDAL'S,

K.V. PENDHARKAR COLLEGE OF ARTS, SCIENCE AND COMMERCE,

(AUTONOMOUS) DOMBIVLI (EAST), DIST. THANE

(Affiliated to University of Mumbai)

Faculty of Science

DEPARTMENT OF ZOOLOGY

(Programme: Bachelor of Science: B.Sc.)

SYLLABUS FOR

S. Y. B.Sc. Zoology (Semester III and IV)

Choice Based Credit System (CBCS)

(With effect from the Academic Year: 2022-2023)

Syllabus for S.Y.B.Sc.

Subject: ZOOLOGY

SEMESTER – III

COURSE CODE	UNIT	TOPIC	CREDITS	LECTURES/ WEEK
PUSZOIII22-361	I	Fundamentals of Genetics,	2	1
	II	Chromosomes and Heredity,		1
	III	Nucleic acids		1
PUSZOIII22-362	I	Study of Nutrition and Excretion	2	1
	II	Study Respiration and circulation,		1
	III	Control and coordination, Locomotion and Reproduction		1
PUSZOIII22-363	I	Common Human diseases and some common drugs	2	1
	II	Parasitology		1
	III	Economic Zoology		1
PUSZOIII22-P361, P362,363	Practical based on all three courses		03	**9**

SEMESTER – IV

COURSE CODE	UNIT	TOPIC	CREDITS	LECTURES/ WEEK
PUSZOIV22-461	I	Origin and evolution of Life,	2	1
	II	Population genetics and evolution,		1
	III	Scientific attitude, methodology, writing and ethics		1
PUSZOIV22-462	I	Cell Biology and Histology	2	1
	II	Endo membrane System		1
	III	Biomolecules		1
PUSZOIV22-463	I	Comparative Embryology,	2	1
	II	Aspects of Human Reproduction,		1
	III	Ethology		1
PUSZOIV22-P461,462,463		Practical based on all three courses	03	**9**

Syllabus for S.Y. B.

Sc

Course – ZOOLOGY

1. Syllabus Semester III & IV (Theory and Practical)

2. References and Additional Reading

3. Scheme of Examination and Paper Pattern (Theory and Practical)

4. Model Question bank

S. Y. B. Sc. ZOOLOGY UNIT WISE DISTRIBUTION					
Semester III			**Semester IV**		
Course 5 PUSZOIII22-361	**Course 6 PUSZOIII22-362**	**Course 7 PUSZOIII22-363**	**Course 8 PUSZOIV22-461**	**Course 9 PUSZOIV22-462**	**Course 10 PUSZOIV22-463**
Unit 1 Fundamentals ofGenetics	**Unit 1** Study of Nutrition & Excretion	Unit I Common Human disease and common drugs	**Unit 1** Origin & Evolution ofLife	Unit I Cell biology and Histology	**Unit 1** Comparative Embryology
Unit 2 Chromosome & Heredity	**Unit 2** Study of Respiration & circulation	**Unit 2** Parasitology	**Unit 2** Population Genetics & Evolution	**Unit 2** Endomembran eSystem	**Unit 3** Aspects of human Reproduction
Unit 3 Nucleic Acids	**Unit 3** Control and Coordination Locomotion & Reproduction	**Unit 3** Economic Zoology	**Unit 3** Scientific Attitude, Methodology, Writing & Ethics	**Unit 3** Biomolecule s	Unit 3 Ethology
Practical PUSZOIII22-P361	**Practical PUSZOIII22-P362**	**Practical PUSZOIII22-P363**	**Practical PUSZOIV22 -P461**	**Practical PUSZOI V22-P462**	**Practical PUSZOIV22-P463**

S.Y.B.Sc SYLLABUS

SEMESTER- III

Sr. No	PUSZOIII22-361 COURSE-V	No of lect allotted
	FUNDAMENTALS OF GENETICS	
	Unit 1: Fundamentals of Genetics	**15L**
	***Objectives* :** ➢ *To Introduce basic terms of genetics* ➢ *To study Mendelian principles of inheritance and other forms pattern of inheritance*	
.	**Desired *outcomes :*** ➢ *Understand and apply the principles of inheritance.* ➢ *Understand the concept of multiple alleles, linkage and crossingover.*	
1.1	**Introduction to genetics** ➢ Definition, scope and importance of genetics. ➢ Classical and Modern concept of Gene (Cistron, muton, recon). ➢ Brief explanation of the following terms: Allele, wild type and mutant alleles, locus, dominant and recessive traits, homozygous and heterozygous, genotype and phenotype, genome.	**2L**
1.2	**Mendelian Genetics** ➢ Mendelian Genetics**:** Monohybrid cross, Dihybrid cross, test cross, back cross, Mendel's laws of Inheritance, Mendelian traits in man. ➢ Exceptions to Mendelian Inheritance: Incomplete dominance, Co-dominance, Lethal alleles, Epistasis - Recessive, Double recessive, dominant and double dominant. ➢ Chromosome theory of inheritance. ➢ Pedigree analysis-Autosomal dominant and autosomal recessive, X- linked dominant, and X-linked recessive	**8L**
1.3	**Multiple Alleles and Multiple Genes** ➢ Concept of multiple alleles, Coat colour in rabbit, ABO and Rhblood group systems ➢ Polygenic inheritance with reference to skin colour and eye colourin	**3L**

	man. ➢ Concept of pleiotropy.	
1.4	**Linkage and Crossing Over** Linkage and crossing over, types of crossing over, cytological basisof crossing over.	**2L**
	Unit: 2: Chromosomes and Heredity	**15L**
	Learning objectives: ➢ *To familiarize the learners with the structure, types and classification of chromosomes.* ➢ *To introduce the concept of sex determination and its types, sex influenced and sex limited genes.*	
	Desired Outcomes: *Learners would understand the structure and types of chromosomes.* *Learners would understand mechanisms of sex determination.* *Learners would be able to correlate the disorders linked to a particular sex chromosome.*	
2.1	**Chromosomes** ➢ Types of chromosomes–Autosomes and Sex chromosomes ➢ Chromosome structure - Heterochromatin, Euchromatin ➢ Classification based on the position of centromere ➢ Endomitosis, Giant chromosomes- Polytene and Lamp brush chromosomes and significance of Balbiani rings.	**4L**
2.2	**Sex- determination** ➢ Chromosomal Mechanisms: XX-XO, XX-XY, ZZ-ZW. ➢ Sex determination in honey bees- Haplodiploidy, ➢ Sex determination in *Drosophila*-Genic balance theory, intersex, gynandromorphs. ➢ Parthenogenesis. ➢ Hormonal influence on sex determination-Freemartin and sexreversal. ➢ Role of environmental factors- Bonellia and Crocodile ➢ Barr bodies and Lyon hypothesis	**7L**

2.3	**Sex linked, sex influenced and sex limited inheritance.** ➢ X-Linked: Colourblindness, Haemophilia ➢ Y-linked: Hypertrichosis ➢ Sex-influenced genes ➢ Sex limited genes	**4L**
	Unit: 3 Nucleic acids	**15 L**
	***Objectives*:** *To introduce to the learners the classical experiments proving DNAas the genetic material.* *To make the learner understand the structure of nucleic acids andthe concept of central dogma of molecular biology.* *To familiarize the learner with the concept of gene regulation.*	
	Desired Outcomes: ➢ *Learner would understand the importance of nucleic acids as genetic material.*	
	➢ *The learners would understand and appreciate the regulation ofgene expressions.*	
3.1	**Genetic material** ➢ Griffith's transformation experiments, Avery-Macleod and McCarty, Hershey Chase experiment of Bacteriophage infection ➢ Chemical composition and structure of nucleic acids. ➢ Double helix nature of DNA, Solenoid model of DNA. ➢ Types of DNA – A, B, Z & H forms. ➢ DNA in Prokaryotes -chromosomal and plasmid. ➢ Extra nuclear DNA -mitochondria and chloroplast. ➢ RNA as a genetic material in viruses. ➢ Types of RNA: Structure and function.	**7L**
3.2	**Flow of genetic information in a Eukaryotic cell** ➢ DNA Replication ➢ Transcription of mRNA ➢ Translation ➢ Genetic code	**5L**

3.3	**Gene Expressions and regulation** ➢ One gene-one enzyme hypothesis /one polypeptide hypothesis ➢ Concept of operon ➢ Lac operon	**3L**

Sr. No	**PUSZOIII22-362 COURSE-VI**	**No of lect allotted**
	ANIMAL LIFE PROCESSES	
	Unit: 1 Life Processes- I	**15L**
	Objective : ➢ *To introduce the concepts of physiology* of nutrition,excretion and osmoregulation. ➢ *To expose the learners to various nutritional apparatus, excretory and osmoregulatory structures in different classes of organisms.*	
	Desired Outcome : ➢ *Learners would understand the increasing complexity ofnutritional, excretory and osmoregulatory physiology inevolutionary hierarchy.* ➢ *Learners would be able to correlate the habit and habitat with nutritional, excretory and osmoregulatory structures.*	
1.1	➢ Comparative study of Nutritional Apparatus (structure and function): Amoeba, Hydra, Earthworm, Cockroach, Bivalve,	5L
	Amphioxus, Pigeon, Ruminants.	
1.2	➢ Physiology of digestion in man	2L
1.3	➢ Comparative study of Excretory and Osmoregulatory structures and function a. Amoeba -contractile vacuoles b. Planaria -Flame cells c. Earthworm -Nephridia d. Cockroach-Malphigian tubules and green gland e. Bivalve -Organ of Bojanus	5L

1.4	➢ Categorization of animals based on principle nitrogenous excretory products	1L
1.5	➢ Structure of kidney, Uriniferous tubule and physiology of urine formation in man.	2L
	Unit: 2 Life Processes- II	15L
	Objective : ➢ To introduce the concepts of physiology of respiration and circulation ➢ To expose the learners to various respiratory and circulatory structures in different classes of organisms.	
	Desired Outcome: ➢ Learners would understand the increasing complexity of respiratory and circulatory physiology in evolutionary hierarchy. ➢ Learners would be able to correlate the habit and habitat with respiratory and circulatory structures.	
2.1	➢ Comparative study of Respiratory organs (structure and function) Earthworm, Spider, Rohu, Frog and Pigeon.	3L
2.2	➢ Accessory respiratory structures: Anabas /Clarius	1L
2.3	➢ Structure of lungs and physiology of respiration in man	2L
2.4	➢ Comparative study of circulation: Open and closed - single and double .	1L
2.5	➢ Types of circulating fluids- Water, coelomic fluid, haemolymph, lymph and blood.	2L
2.6	➢ Comparative study of Hearts (Structure and function) Earthworm, Cockroach, Shark, Frog, Crocodile and Pigeon.	4L
2.7	➢ Structure and mechanism of working of heart in man	2L
	Unit: 3 Life Processes- III	15L
	Objective : ➢ To introduce the concepts of physiology of control and coordination and locomotion and reproduction	
	➢ To expose the learners to various locomotory and reproductive structures in different classes of organisms	

	Desired Outcome: ➢ Learners would understand the process of control and coordination by nervous and endocrine regulation. ➢ Learners would be fascinated by various locomotory structures found in the animal kingdom. ➢ Learners would be acquainted with various reproductive strategies present in animals.	
3.1	Control and coordination ➢ Irritability –Paramoecium , Nerve net in Hydra, Nerve ring and nerve cord in earthworm ➢ Types of neurons on the basis of structure and function ➢ Conduction of nerve impulse: Resting potential, action potential and refractory period ➢ Synaptic transmission ➢ Endocrine regulation: Hormones as chemical messengers, feedback mechanisms	5L
3.2	Movement and Locomotion ➢ Locomotory organs -structures and functions a. Pseudopodia in Amoeba (sol gel theory), Cilia in Paramecium b. Wings and legs in Cockroach c. Tube feet in Starfish d. Fins of fish	4L
3.3	➢ Structure of Striated muscle fibre in human and Sliding filament theory	2L
3.4	Reproduction a. Asexual Reproduction- Fission, fragmentation, gemmule formation, budding b. Sexual reproduction i. Gametogenesis ii. Structure of male and female gametes in human iii. Types of fertilization iv. Oviparity, viviparity, ovi-viviparity	4L

	PUSZOIII22-363 COURSE-VII	
	Common Human Diseases and Common drugs, Parasitology, Economic Zoology	
	UNIT 1: Common Human Diseases and Common Drugs	(15L)
	Objective: ➢ To educate learners about causes, symptoms and impact of stress related disorders and infectious diseases. ➢ To understand the chemical nature of various drugs Desired Outcome: ➢ Learners will be able to promptly recognize stress related problems at initial stages and would be able to adopt relevant solutions which would lead to psychologically strong mind set promoting positive attitude important for academics ➢ Learners would be able to acquire knowledge of cause, symptoms and precautions of infectious diseases. ➢ Learners would be understand chemical nature of drug with action against the specific clinical condition	
1.1	Stress related disorders 1.1.1: Anxiety, insomnia, migraine, depression (cause, symptoms, precaution and remedy)	4L
1.2:	Communicable and non-communicable diseases and their common drugs	6L
	1.2.1: Typhoid, Hepatitis (A and B), AIDS,	
	1.2.2: Diseases of respiratory system- Causes, symptoms precautions & remedy of respiratory diseases- Asthma, Bronchitis, n-COVID-19, Prognosis for diseases.	
	1.2.3: Oral Cancer (Discuss cause/causative agents, symptoms, diagnostics, precaution /prevention and remedy)	
1.3	Introduction to some common drugs and their routes of administrations Definition and sources of drugs, Antibiotics and Antivirals and Antimalaria, Antiamoebic, Anti-helminthic and Antifungal drugs	5L
	Unit: 2 Parasitology	15L

	Objective: ➢ To acquaint learners with the concepts of parasitism, their relationship with environment. To make learners aware about the modes of transmission of parasites.	
	Desired Outcome: ➢ Learners would understand the general epidemiological aspects of parasites that affect humans and apply simple preventive measures for the same. Learners would comprehend the life cycle of specific parasites, the symptoms of the disease and its treatment.	
2.1	Introduction to Parasitology and types of parasites ➢ Definitions: parasitism, host, parasite, vector-biological and mechanical ➢ Types of parasites- Ectoparasites, Endoparasite and their subtypes ➢ Parasitic adaptations in Ectoparasites and Endoparasites Types of hosts: intermediate and definitive, reservoir	2L
2.2	Host-parasite relationship-Host specificity Definition, structural specificity, physiological specificity and ecological specificity.	2L
2.3	Life cycle, pathogenicity, control measures and treatment Entamoeba histolytica, Fasciola hepatica, Taenia solium, Wuchereria bancrofti	5L
2.4	Morphology, life cycle, pathogenicity, control measures and treatment Head louse (Pediculus humanus capitis), Mite (Sarcoptes scabei), Bed bug (Cimex lectularis)	2L
2.5	Parasitological significance Zoonosis- Bird flu, Anthrax, Rabies and Toxoplasmosis	4L
	Unit 3 Economic Zoology	15L
	Objective: ➢ To disseminate information on economic aspects of zoology like apiculture, vermiculture, dairy science. To encourage young learners for self-employment.	
	Desired Outcome: ➢ Learners would gain knowledge on animals useful to mankind and the	

	means to make the most of it. ➢ Learners would learn the modern techniques in animal husbandry. Learners would be pursuing entrepreneurship as careers	
3.1	APICULTURE	5L
3.1.1	Methods of bee keeping and management ➢ An introduction to different species of honey bees used in apiculture. ➢ Selection of flora and bees for apiculture. ➢ Advantages and disadvantages of traditional and modern methods of apiculture. ➢ Pests and Bee enemies- Wax moth, wasp, black ants, bee eaters , king crow and disease control Bee keeping industry- Present status and recent efforts to improve and boost the industry	
3.1.2	Economic importance ➢ Honey- Production, Chemical composition and economic importance ➢ Bees wax- Economic importance. Role of honey bees in pollination.	
3.2	VERMICULTURE	4L
3.2.1	Rearing methods, management and economic importance ➢ An introduction to different species of earthworms used in vermiculture. ➢ Methods of vermiculture. ➢ Maintenance and harvesting Economic importance: advantages of vermiculture, demands for worms; market for vermicompost and entrepreneurship.	
3.3	DAIRY SCIENCE	6L
3.3.1	Dairy development in India Role of dairy development in rural economy, employment opportunities	
3.3.2	Dairy Processing Filtration, cooling, chilling, clarification, pasteurization, freezing	
3.3.3	Milk and milk products	

	➢ Composition of milk ➢ Types of milk: ➢ Recombined milk, Soft curd milk, Skimmed and toned milk, Artificial milk ➢ Milk products	

	SEMESTER III
	Practical PUSZOIII22-P361 (Course V)
1	Extraction and detection of DNA
2	Extraction and detection of RNA.
3	Mounting of Barr bodies.
4	Study of polytene chromosome.
5	Study of mitosis- temporary squash preparation of Onion root tip
6	Detection of blood groups and Rh factor.
7	Problems in genetics a. Monohybrid/ Dihybrid cross b. X- linked inheritance c. Multiple alleles
8	Chromosome morphology: Metaphase spreadsheet (photograph to be provided)
9	Problems based on Pedigree analysis
10	Problems on molecular biology
	Practical PUSZOIII22-P362 (Course VI)
1	Urine analysis—Normal and abnormal constituents
2	Detection of ammonia in water excreted by fish
3	Detection of uric acid from excreta of Birds
4	Study of striated and non- striated muscle fibre
5	Study of nutritional Apparatus (Amoeba, Hydra, Earthworm, Pigeon, Ruminant stomach)
6	Study of respiratory structures: a. Gills of Bony fish and Cartilaginous fish. b. Lungs of Frog c. Lungs of Mammal. d. Accessory respiratory structure in Anabas (Labyrinthine organ) e. Air sacs of Pigeon.
7	Study of locomotory organs (*Amoeba*, *Unio*, Cockroach, Starfish, Fish, and Birds)
8	Study of hearts (Cockroach, Shark, Frog, *Calotes*, Crocodile, Mammal)
9	Study of permanent slides on topic of Reproduction a. Sponge gemmules

	b. Hydra budding c. T.S. of mammalian testis d. T.S. of mammalian ovary
	Practical PUSZOIII22-P363 (Course VII)
1	Extraction of Casein from Milk and its qualitative estimation
2	Study of Protozoan parasites: *a. Trypanosoma gambiense* *b. Giardia intestinalis* *c. Entamoeba histolytica,*
3	Study of Helminth parasites: *a) Ancylostoma duodenale* *b) Dracunculus medenensis* *c) Fasciola hepatica,*
4	Parasitic adaptations: Scolex and mature proglottid of Tapeworm
5	Study of Ectoparasites: a. Leech b. Tick c. Mite
6	BMI Analysis- Measurement of height/weight and calculation of BMI using formula, preparation of report.
7	First-aid: Demonstration practical training for teachers and students to be conducted by the experts from red cross, civil defense, civic authorities by Individual institutes or cluster colleges in rotation.
8	Anxiety test – Coglab software/ C A (Comprehensive anxiety by Sharma Bhardwaj and Bhargava, Mapan, Agra) Test
9	Project- Suggested topics on economic zoology (e.g Apiculture, sericulture/ lac culture / vermicompost Technique / Construction of artificial beehives /Animal husbandry/ aquaculture etc)

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 asenvisaged in the regulations of the relevant monitoring bodies. No new specimens, however, shall beprocured for the purpose of conducting practicals mentioned here-in-above.

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

Justification:

Paper-III Unit-I- Common Diseases and some common drugs:

It is essential for awareness to introduce Human diseases and certain drugs at UG level. Epidemic and pandemic spread of diseases becomes one of the reasons to setback economic growth of Nation.

Marks for Practical viva and certified Journal are given with separate weightage of 5 marks.

Learner's Space:

1. Prepare slogans on human parasites and control and treatment against parasitic diseases in English/Marathi/Hindi or in your mother tongue.
2. What are pandemic diseases?
3. What is the legislation implemented in checking pandemic condition. Explain it with suitable example.
4. Prepare a chart of types of various Human parasites, mode of infection, pathogenicity and precautionary measures.
5. Enlist the various parasites transmitted from pets. What are the precautions to be taken to avoid such infections?
6. Locate natural hive of Honeybees in wild habitat or in your vicinity using binocular from the safe distance. Identify the type of Honey bees depending on size and position of honey comb.
7. Prepare feasibility report of any one cattle farm as a guideline to emerging small scale cattle farmer.

   Define Lac-culture and Sericulture. Give its scope in various states of India.
8. Learn to prepare any other dairy products of your interest other than yogurt at your home. Give its constituents.
9. What are first generation and second generation antibiotics? Give examples.
10. What is ringworm infection? Find the prospective prognosis for the same.
11. If both parents have blood group 'A' what will be the possible blood group of their children.
12. Observe Drosophila and study various eye colours and wing patterns.

13. Conduct a survey in your class for the following traits and determined how many students in the class exhibit the phenotype:

Sr. No.	Trait	Do you have the trait (Yes/No)	Percentage of students showing similar traits
1	Tongue Rolling		
2	Attached earlobe		
3	Hitchhikers thumb		
4	Curly hair		
5	Widow's peak		

14. Arrange all the chromosomes of a normal person to prepared ideogram.
15. Compare the chromosomes in man and chimpanzees and note the identical chromosomes.
16. Organize a group activity of role played to understand protein synthesis by assigning the roles of DNA, mRNA, r RNA, tRNA, amino acids and peptide bonds.
17. Find out about more operon systems in human body.
18. Elucidate the causes and types of nephrolithiasis.
19. Review symbiotic digestion in animals other than ruminants.
20. Describe the role gastrointestinal hormones in the regulation of the secretions of the digestive glands and their role in digestion.
21. Discuss the disorders caused due to nutritional deficiencies.
22. Discuss the causes and general effects of the major respiratory disorders and diseases.
23. Review the three general pathway to generate ATP from food
24. Study a standard ECG and identify what cardiac function corresponds to each peak.
25. Find out the difference of the working of heart in space and earth.

Job oriented/Entrepreneurship development topics:

1. Common Human diseases and some common drugs: Medical Transcription.
2. Economic Zoology: Apiculture, Dairy industry and Vermiculture as self-employment programs.

Semester –III

REFERENCE BOOKS AND ADDITIONAL READING

COURSE-V (PUSZOIII22-361)

1. Principles of Genetics. Gardner, E.J., Simmons, M.J and Snustad, D.P. John Wileyand Sons
2. Concepts of Genetics. Klug, W.S., Cummings M.R., Spencer, C.A. BenjaminCummings.
3. Genetics- A Molecular Approach. Russell, P. J Benjamin Cummings.
4. Genetics: Analysis of Genes and Genomes. Daniel L., Hartl, Elizabeth W. JonesJones & Bartlett Publishers
5. Introduction to Genetic Analysis. Griffiths, A.J.F., Wessler. S.R., Lewontin, R.C. andCarroll, S.B. W. H. Freeman and Co.
6. Cell Biology Genetics, Molecular Biology Evolution and Ecology Verma P.S. andAgrawal P.K., 9th 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, Mc Graw 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

COURSE-VI (PUSZOIII22-362)

1. Vertebrate Zoology Volume I- Jordan and Verma , S. Chand and Co.
2. Invertebrate Zoology Volume II- Jordan and Verma , S. Chand and Co.
3. Invertebrate Zoology- Majupuria T. C., Nagin S.and Co.
4. Chordate Zoology- Dhami P. S. and Dhami J. K. , R. Chand and Co.
5. Invertebrate Zoology- Dhami P. S. and Dhami J. K., R. Chand and Co.
6. Introduction to Vertebrates- Moore Cambridge University- Low Priced Edition.
7. Zoology- Miller S. A. and Harley J. B., Tata McGraw Hill.
8. Modern Textbook of Zoology, Invertebrates, Kotpal R. L.

9. Biological Science, Taylor D.J., Stout G.W., Green N.P.O, Soper R.,CambridgeUniversity Press.

COURSE-VII (PUSZOIII22-363)

1. Biology of Insects- 1992 Saxena S. C. Oxford and IBH Publishing Co New Delhi.Bombay. Calcutta
2. A Text Book of Entomology- 1974Mathur V. K. and Upadhayay K Goel Printingpress, Barani.
3. Bee and Bee Keeping- Roger A. Morse, Conell University Press London
4. Vermiculture Technology - Clive A. Edwards, Norman Q. Arancon and RhondaSherman
5. Parasitology- Chatterjee K.D., Chatterjee Medical Publishers.
6. Medical Parasitology- Arora
7. Textbook of Medical Parasitology-. C.K Jayaram Paniker, Jaypee Brothers.
8. A text book of Parasitology- Kochhar S.K. Dominant Pub. & Dis, New Delhi.
9. Essentials of Parasitology- Gerald and Schmidt: Universal Bookstall, New Delhi.
10. Parasitology- Sharma P.N.and Ratnu L.N., Chand S & Co.Pvt.Ltd.
11. Introduction to Parasitology- Chandler and Read John Wiley & Sons
12. Economic Zoology- Biostatistics and Animal behaviour – S.Mathur, RastogiPublicatons.
13. Economic Zoology- Shukla G.S. & Upadhyay V.B., Rastogi Publications.
14. A handbook on Economic Zoology, S.Chand & Co.
15. Essentials of Medical Pharmacology- K D Tripathi., Jaypee brothers medical publications.

ICT Backup:

1. Google search engine.
2. Yahoo search engine
3. YouTube videos and animations
4. Department e-book library and video gallery

Pedagogy:

1. **Awareness Wall**

e.g. Cut-outs regarding the developments in the field of Wildlife, Environment, Social health etc. will be displayed.

2. **Teaching through Surveys:** Population surveys to study genetic traits (Widow's Peak, Free/Attached Earlobes, Curly Hair, Roller/Non-roller), BMI studies,
   Seasonal occurrence of diverse insects and avian fauna.
3. While taking lesson of drugs, it is expected that teachers shall emphasize upon avoidance of self-medication even though students are aware of the chemical nature & mode of action of drugs

MOOC units:

Sr. No.	**Course Code**	**Topic**	**MOOC unit**
1.	**PUSZOIII22-361**	**Genetics**	a. Useful genetic part –I: How our genes shape us? b. Useful genetic part –II: Genes and genetics c. Inheritance d. AP Biology part II: Genetics.
2.	**PUSZOIII22-362**	**Life Processes**	a. Anatomy: Cardiovascular, Urinary and respiratory system b. Anatomy: Human Neuroanatomy c. Anatomy: Gastrointestinal, Reproductive and endocrine system d. Human reproduction e. Respiration in the human body f. Sex and Human reproduction

SCHEME OF EXAMINATION (THEORY)

(a) Internal assessment of forty (40) marks per course per semester s will be conducted according to the format given below.

(b) External assessment of sixty (60) marks per course per semester will be conducted as per the following skeleton question paper pattern.

(c) One practical examination of fifty (50) marks per course each will 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

Time: 2.5hours **Total marks: 60**

EVALUATION PATTERN			
Evaluation	Type of Questions	Weightage	
Theory External **(60%)**	Answer in one or two sentences each/Definition/Give reason/Justify the statements	20%	12 marks
	Short answer questions	40%	24 marks
	Long answer questions	40%	24 marks
Practical (I /II/III)	Preparations, Presentation, Observation, Analysis, Results, Excursion / Survey, Viva and Journal	100%	50 marks

Theory Internal **(40%)**	One Class test (Objective/ Multiple Choice).	50%	20 marks
	Assignment/ Project/ Presentation/ Field Experience/Book or Research Paper Review.	37.5%	15 marks
	Active Participation, Level of Understanding of Students.	12.5%	05 marks

Passing Standard: 40% (Theory and Practical courses are separate areas of passing)

PRACTICAL

PUSZOIII22-361 (Course V)

Skeleton-Practical Examination Question Paper Pattern

Time: 2 hrs **Marks: 50**

Major Question 15 marks

Q1. Extraction and detection of DNA

OR

Q1. Extraction and detection of RNA

Minor Question 07 marks

Q2. Mounting of Barr bodies

OR

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

Q2. Detection of blood groups and Rh factor

Q3. Problems on Genetics and Molecular biology (Transcription /Genetic code)(01 problem each) 10 marks

Q4. Identification 08 marks

a. Chromosome morphology (2 Photograph)
b. Pedigree analysis

Q5. Viva 05 marks

Q6. Journal 05 marks

PRACTICAL

PUSZOIII22-362 (Course VI)

Skeleton-Practical Examination Question Paper Pattern

Time: 2 hrs **Marks: 50**

Major Question 15 marks

Q1. Urine analysis—Normal and abnormal constituents

Minor Question 10 marks

Q2. Detection of ammonia in water excreted by fish

OR

Q2. Detection of uric acid from excreta of Birds

Q3. Identification 15 marks

i. Nutritional apparatus
ii. Respiratory structures
iii. Locomotory organs
iv. Types of hearts
v. Permanent slides on reproduction

Q4. Viva 05 marks

Q5. Journal 05 marks

PRACTICAL

PUSZOIII22-363 (Course VII)

Skeleton -Practical Examination Question Paper Pattern

Time: 2 hrs **Marks: 50**

Major Question 12 marks

Q1. Extraction of Casein from Milk and its qualitative estimation

OR

Q1. Preparation of paneer from the given milk sample.

OR

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

Minor Question 08 marks

Q2. Life Cycle of Honey Bee and Bee Hive

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 marks

a. Disorder/ First aid
b. Protozoan parasites
c. Helminth parasites
d. Ectoparasites
e. Parasitic adaptations

Q4. Project submission and Viva based on project 10 marks

Q5. Journal 05 marks

	SEMESTER IV	
	PUSZOIV22-461 COURSE-VIII	
	Origin and evolution of Life, Population genetics, Scientific Research methodology	
	Unit 1 : Origin and evolution of Life	**15L**
	Objective : ➢ *To impart scientific knowledge to the learner about how lifeoriginated and evolved on our planet.*	
	Desired Outcomes : ➢ *Learner will gain insight about origin of life.* ➢ *Learner will know about the different theories of evolution.*	
1.1	**Introduction.** ➢ Origin of universe ➢ Chemical evolution - Miller-Urey experiment, Haldane and Oparin theory ➢ Origin of life ➢ Origin of eukaryotic cell.	**5L**
1.2	**Evidences in favour of organic evolution** ➢ Evidences from: Geographical distribution, Paleontology Anatomy, Embryology, Physiology and Genetics	**4L**
1.3	**Theories of organic evolution** ➢ Theory of Lamarck. ➢ Theory of Darwin and Neo Darwinism ➢ Mutation Theory ➢ Modern Synthetic theory ➢ Weismans germplasm theory ➢ Neutral theory of molecular evolution	**6L**
	Unit 2: Population genetics and evolution	**15L**
	Objective: ➢ *To develop learner's knowledge and understanding of genetic variability within a population and how the change in the genepool leads to*	

	evolution of species.	
	Desired Outcomes: ➢ *Learner would understand the forces that causeevolutionary changes in natural populations.* ➢ *Learner would comprehend the mechanisms of speciation* ➢ *Learner will be able to distinguish between microevolution, macroevolution and megaevolution*	
2.1	**Introduction to population genetics**	**1L**
	Definition	
2.1.1	**Brief explanation of the following terms:** Population, gene pool, Allele frequency, genotype frequency,phenotype frequency, microevolution	
2.2	**Population genetics**	**6L**
2.2.1	Hardy-Weinberg Law	
2.2.2	➢ Factors that disrupt Hardy Weinberg equilibrium- ➢ Mutation, ➢ Migration (Gene flow), ➢ Non-random mating (Inbreeding, inbreeding depression, Assortative mating-Positive and Negative, Disassortativemating), ➢ Genetic drift (Sampling error, fixation, Bottleneck effect andFounder effect) Natural Selection.	
2.2.3	**Patterns of Natural Selection** ➢ Stabilizing selection, ➢ Directional Selection (Examples: Peppered moth, Antibioticresistance in bacteria, Pesticide resistance) Disruptive selection	
2.3	**Evolutionary genetics** ➢ **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).	**8L**

	➢ Nature of genetic variations- Genetic polymorphism, Balanced polymorphism, Mechanisms that preserve balanced polymorphism- Heterozygote advantage and frequency dependent selection, ➢ Neutral variations. Geographic variation (Cline).	
2.3.1	➢ **Species Concept:** Biological species concept and evolutionary species concept	
2.3.2	**Speciation and Isolating mechanisms**: ➢ Definition and Modes of speciation (Allopatric, Sympatric ,Parapatric and Peripatric) ➢ Geographical isolation ➢ Reproductive isolation and its isolating mechanisms(Prezygotic and Postzygotic)	
2.3.3	**Macroevolution and Megaevolution :** ➢ Concept and Patterns of macroevolution (Stasis, Preadaptation /Exaptation, Mass extinctions, Adaptive radiation and Coevolution), Megaevolution	
	Unit 3: Scientific Attitude, Research methodology , writing and ethics	**15L**
	***Objective*:** *To inculcate scientific temperament in the learner.*	
	Desired outcome: ➢ *The learner will develop qualities such as critical thinking andanalysis.* ➢ *The learner will develop the skills of scientific communication.* ➢ *Learner will understand the ethical aspects of research*	
3.1	**Process of science: A dynamic approach to investigation**	**4L**
	The Scientific method Deductive reasoning and inductive reasoning, Criticalthinking, Role of chance in scientific discovery	
	Scientific Research Definition, difference between method and methodologycharacteristics, types	
	Steps in the Scientific Method	

	➢ Identification of research problem, Formulation of research hypothesis, Testing the hypothesis using experiments or surveys, Preparing research/study design including methodology and execution (Appropriate controls, sample size, technically sound, free from bias, repeat experiments forconsistency), Documentation of data, Data analysis and interpretation, Results and Conclusions	
	Dissemination of data ➢ Reporting results to scientific community (Publication in peer-reviewed journals, thesis, dissertation, reports, oral presentation, poster presentation)	
	Application of knowledge Basic research, Applied research, Translational research,Patent	
3.2	**Scientific writing**	**4L**
	Structure and components of a research paper ➢ (Preparation of manuscript for publication of research paper)- Title, Authors and their affiliations, Abstract, Keywords and Abbreviations, Introduction, Material and Methods, Results, Discussion, Conclusions, Acknowledgement, Bibliography; Figures, Tables and their legends	
3.3	**Writing a review paper**	**3L**
	Structure and components of research report: Report writing, Types of report	
	Computer application ➢ Plotting of graphs, Statistical analysis of data. Internet and its application in research-Literature survey, Online submission ofmanuscript for publication	
3.4	**Ethics**	**3L**
	Ethics in animal research The ethical and sensitive care and use of animals in research,teaching and testing, Approval from Institutional animal ethics Committee	
	Ethics in clinical research ➢ Approval from Clinical Research Ethics Committee	

	Informed consent	
	Approval from concerned/ appropriate authorities : ➢ National Biodiversity Authority ➢ State Biodiversity Board ➢ Forest Department	
	Conflict of interest	
3.5	**Plagiarism**	**1L**
	PUSZOIV22-462 COURSE-IX	
	Cell Biology & Histology and Biomolecules	
	Unit 1: Cell Biology and Histology	**15L**
	***Objective* :** ➢ *To study the structural and functional organization of cellwith an emphasis on nucleus, plasma membrane and cytoskeleton.*	
	***Desired outcome* :** *Learner would acquire insight of transport mechanismsfor maintenance and composition of cell*	
1.1	**Introduction to cell biology** ➢ Definition and scope ➢ Cell theory Generalized prokaryotic , eukaryotic cell: size, shape andstructure	**2L**
1.2	**Nucleus** ➢ Size, shape, number and position ➢ Structure and functions of interphase nucleus ➢ Ultrastructure of nuclear membrane and pore complex ➢ Nucleolus: general organization, chemical composition andfunctions ➢ Nuclear sap/ nuclear matrix ➢ Nucleocytoplasmic interactions	**4L**
1.3	**Plasma membrane** a. Fluid Mosaic Model b. Junctional complexes	**4L**

	c. Membrane receptors **d.** Modifications: Microvilli, Desmosomes and Plasmodesmata	
1.4	**Transport across membrane** **a.** Diffusion and Osmosis **b.** Transport: Passive and Active **c.** Endocytosis and Exocytosis	**3L**
1.5	**Histology: Overview of animal tissues, Vertical section of Skin**	**2L**
	Unit 2 Endomembrane System	**15L**
	***Objective* :** *To acquaint the learner with Ultrastructure of cell organellesand their functions.*	
	Desired outcome: ➢ *Learner would appreciate the intricacy of endomembranesystem.* ➢ *Learner would understand the interlinking of endomembrane System for functioning of cell.*	
2.1	**Endoplasmic reticulum** ➢ Discovery, occurrence and Types Ultrastructure and Functions	**3L**
2.2	**Golgi complex** ➢ Origin, occurrence and morphology Ultra structure and functions	**3L**
2.3	**Lysosomes** ➢ Origin, occurrence and polymorphism Ultrastructure and Functions	**3L**
2.4	**Mitochondria** ➢ Origin, occurrence and morphology ➢ Ultrastructure and functions ➢ Marker enzymes, Mitochondrial biogenesis, Semiautonomousnature of mitochondria	**6L**
	Unit 3: Biomolecules	**15L**
	***Objective* :**	

	➢ *To give learner insight into the structure of biomolecules,and their role in sustenance of life.* ***Desired outcome:*** ➢ *The learner will realize the importance of biomolecules andtheir clinical significance.*	
3.1	**Biomolecules** Concept of Micromolecules and Macromolecules**.**	1L
3.2	**Carbohydrates** ➢ Definition Classification, Properties and Isomerism,Glycosidic bond ➢ Structure of a. Monosaccharides- Glucose and Fructose b. Disaccharides - Lactose and Sucrose c. Polysaccharides - Cellulose, Starch, Glycogen and Chitin Biological role and their Clinical significance	4L
3.3	**Amino Acids and Proteins** ➢ Basic structure of amino acid, classification of amino acids ,Essential and Non-essential amino acids, Peptide bond ➢ Protein conformation : Primary, Secondary, Tertiary,Quaternary ➢ Types of proteins – Structural (Keratin, Collagen) andfunctional proteins (Hemoglobin) Biological role and their Clinical significance	5L
3.4	**Lipids** ➢ Definition, classification of lipids with examples, Ester linkage ➢ Physical and Chemical properties of lipids ➢ Saturated and Unsaturated fatty acids , Essential fatty acids ➢ Triacylglycerols, Phospholipids (Lecithin and Cephalin) andSteroids (Cholesterol). Biological role and their Clinical significance	5L
	PUSZOIV22-463 COURSE-X	
	Comparative Embryology, Aspects of Human Reproduction, E t h o l o g y	

	UNIT 1: Comparative Embryology	**15L**
	Objective: *To acquaint the learner with key concepts of embryology.*	
	➢ **Desired Outcomes:** ➢ *Learner will be able to understand and compare the differentpre-embryonic stages* ➢ *Learner will be able to appreciate the functional aspects of extra embryonic membranes and classify the different types of placentae.*	
1.1	Types of Eggs- Based on amount and distribution of yolk	2L
1.2	Structure and Types of Sperms	1L
1.3	Types of Cleavages.- Holoblastic and Meroblastic	1L
1.4	Types of Blastulae	1L
1.5	Gastrulation	2L
1.6	Coelom -Formation and types	2L
1.7	➢ Extra embryonic membranes Types of Placentae -Based on histology, morphology andimplantation	6L
	UNIT 2: Aspects of Human Reproduction	**15L**
	Objectives: ➢ *To acquaint the learners with different aspects of human reproduction.* ➢ *To make them aware of the causes of infertility, techniques* ➢ *to overcome infertility and the concept of birth control*	
	Desired Outcome: ➢ *Learners will able to understand human reproductivephysiology* ➢ *Learners will become familiar with advances in ART and Related ethical issues.*	
2.1	**Human Reproductive system and Hormonal regulation** ➢ Anatomy of human male and female reproductive system Hormonal regulation of Reproduction and Impact of age onreproduction-Menopause and Andropause	2L
2.2	**Contraception & birth control**	2L

	• Difference between contraception and birth control • Natural Methods: Abstinence , Rhythm method, Temperature method, cervical mucus or Billings method, Coitus interruptus,Lactation amenorrhea • Artificial methods **:** Barrier methods, Hormonal methods, Intrauterine contraceptives, Sterilization, Termination ,Abortion	
2.3	**Infertility Female infertility** ➢ **Causes -** Failure to ovulate; production of infertile eggs ; damage to oviducts (oviduct scarring and PID or Pelvic inflammatory disease, TB of oviduct), Uterus (T. B. of uterusand cervix) ➢ **Infertility associated disorders (**Endometriosis, Polycystic Ovarian syndrome (PCOS), POF (Primary ovarian failure) STDs (Gonorrhea, Chlamydia, Syphilis and Genital Herpes);Antibodies to sperm; Genetic causes-Recurrent abortions; Role of endocrine disruptors	4L
	Male infertility **Causes :** Testicular failure, infections of epididymis, seminal vesicles or prostate, hypogonadism, cryptorchidism , congenital abnormalities, Varicocele , Blockage, Azoospermia, Oligospermia, abnormal sperms, autoimmunity, ejaculatory disorders and Idiopathic infertility.	
2.5	**Treatment of Infertility** ➢ Removal /reduction of causative environmental factors ➢ Surgical treatment ➢ Hormonal treatment- Fertility drugs ➢ Assisted Reproductive Technology ➢ Sperm banks, cryopreservation of gametes and embryos ➢ Surrogacy	4L
2.6	**Techniques and Ethical considerations of ART** In vitro fertilization, Embryo transfer (ET), Intra-fallopiantransfer (IFT), Intrauterine transfer (IUT), Gamete intra- fallopian transfer (GIFT), intra-zygote transfer (ZIFT), Intracytoplasmic sperm injection (ICSI) with ejaculated sperm and sperm retrieved from testicular biopsies – Testicular sperm extraction (TESE), Pronuclear stage transfer (PROST).	3L

	Unit : 3 Ethology	15L
	Objective: ➢ *To equip learners with a sound knowledge of how animalsinteract with one another and their environment.* *To enable the learners to understand different behaviouralpatterns.*	
	Desired Outcome:	
	➢ Learners would gain an insight into different types of animal behaviour and their role in biological adaptations. ➢ Learners would be sensitized to the feelings instrumental in social behavior.	
3.1	**Introduction to Ethology** ➢ Definition, History and Scope of Ethology ➢ Animal behaviour - Innate and Learned behaviour ➢ Types of learning -Habituation, Imprinting and types of imprinting -filial and sexual, Classical conditioning, Instrumental learning and insight learning.	4L
3.2	**Aspects of animal behaviour** ➢ Communication in Bees and Ants ➢ Mimicry and colouration ➢ Role of hormones and pheromones in sexual behaviour ➢ Displacement activities, Ritualization ➢ Migration in fish, schooling behaviour ➢ Habitat selection, territorial behaviour, food selection and foraging behaviour in African ungulates	**6L**
3.3	**Social behaviour** ➢ Social behaviour in primates -Hanuman langur Elements of Socio-biology: Selfishness, cooperation, altruism,kinship and inclusive fitness	**5L**

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	SEMESTER IV
	Practical PUSZOIV22-461 (Course VIII)
1	Study of population density by Line transect method & Quadrant method and calculate differentdiversity indices. a) Index of Dominance. b) Index of frequency. c) Rarity Index. d) Shannon Index. e) Index of species diversity
2	Study of Prokaryotic cells (bacteria) by Crystal violet staining technique.
3	Study of Eukaryotic cells (WBCs) from blood smear by Leishman's stain.
4	Identification and study of fossils a. Arthropods : Trilobite b. Mollusca: Ammonite c. Aves : Archaeopteryx
5	Identification of a) Allopatric speciation (Cyprinodon species) b) Sympatric speciation.(hawthorn fly and apple maggot fly) c) Parapatric speciation. (Snail)
6	Bibliography/ Abstract writing.
7	Preparation of Power point presentation (Research Project & its presentation For interested students
	Practical PUSZOIV22-462 (Course IX)
1	Study of permeability of cell through plasma membrane (Osmosis in blood cells).
2	Measurement of cell diameter by occulometer (by using permanent slide)
3	Qualitative tests for carbohydrates (Molisch's test, Benedicts test, Barfoed's test, Anthrone test)
4	Qualitative tests for protein (Ninhydrin test, Biuret test, Millon's test, Xanthoproteic test)
5	Qualitative test for lipids (Solubility test, Sudan III test)

6	Study of rancidity of lipid by titrimetric method.
7	Ultra structure of cell organelles – (Electron micrographs) a. Nucleus b. Endoplasmic reticulum (Smooth and rough) c. Mitochondria. d. Golgi apparatus e. Lysosomes
8	Study of clinical disorders due to carbohydrates, proteins and lipids imbalance.(photograph to be provided / significance to given and disorder to be identified) a. Hyperglycemia, Hypoglycemia. b. Thalassemia, Kwashiorkor c. Obesity, Atherosclerosis
9	Study of mammalian histology: T.S. of Liver, Stomach and Intestine. V.S. of Tooth, Tongue and V.S. of skin
	Practical PUSZOIV22-463 (Course X)
1	Determination of blood pressure by Sphygmomanometer.
2	Detection of Creatinine in urine.
3	Determination of blood sugar by GOD and POD method
4	Study of bleeding time and clotting time.
5	Study of the following permanent slides, museum specimens and materials. a. Mammalian sperm and ovum. b. Egg types –Fish eggs, Frog eggs , Hen's egg. c. Cleavage, blastula and gastrula (Amphioxus, Frog and Bird).
6	Detection of pregnancy from given sample of urine using test-kit.
7	Study of birth control measures applicable to humans- IUD, Condoms and hormonal pills
8	Review writing based on programmes telecast by Doordarshan, Gyandarshan, UGC programmes.
9	Study of ethological aspects: a)Warning Colouration a) Instincts b) Imprinting

	c) Communication in animals: Chemical signals and sound signals Displacement activities in animals: Courtship and mating behavior in animals and ritualization
10	Study of natural ecosystem and field report of the visit

Note -The practicals may be conducted by using specimens authorized 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 asenvisaged in the regulations of the relevant monitoring bodies. No new specimens, however, shall beprocured for the purpose of conducting practicals mentioned here-in-above.

#There shall be at least one excursion/field

Justification:

Paper-II Unit-I- Cell Biology and Histology:

Histology is also given weightage to understand the aspects of tissue differentiation. As it is SYBSc topic, students will prepare better in TYBSc to study histological techniques like histopathology, histochemistry, Zoopharmacognosy and Micro techniques etc.

P-II Unit-III- Ethology

Study of Biodiversity and wild life has been covered in FYBSc class so in continuation with that behavioural study and it's techniques can be easily understood.

Marks for Practical viva and certified Journal are given with separate weightage of 5 marks.

In practical question of identification of spots, marks are justified with the number of sub-questions and it's explanation.

Titles of courses are modified suitably wherever possible to provide more specific titles.

Leaner's Space:

1. Study about precocial and altricial animals with suitable examples.
2. Observe any one pet in your area to learn about classical conditioning.

3. Find or record the any two examples using auditory signals used by animals as a means of communication.
4. Study anyone insect behaviour and present it in the class on overhead projector.
5. Explain territorial behaviour in Cats?
6. Visit the museums that have collection of various evidences of evolution like fossils, relics etc.
7. Study the latest trends in evolutionary evidences that are mentioned in the research journals.
8. Construct models to explain the origin of eukaryotic cells from prokaryotic cells.
9. Conduct general survey with reference to various genetic characters in your vicinity and confirm their distribution in the population.
10. Visit any ecosystem and enlist animals observed to – a) Put them in an appropriate schedule as per their ecological status. b) Prepare evolutionary tree
11. Describe various theories explaining formation of continents as they appear today.
12. Refer case studies of plagiarism and conflicts of interest in research.
13. Visit sites of INSA, ICMR, etc. to further understand ethical issues in animal and human trials.
14. Conduct a simple research survey and write a report.
15. Surf the internet to find out the details of research institutions in India and abroad.
16. Is nucleolus indispensible for the cell?
17. List examples of diffusion in our daily life.
18. Study the Na-K pump in detail.
19. Describes different types of sensory receptors found in our sensory organs with the help of electron micrograph.
20. Enlist the disorders caused due to defective cell organelles.
21. Draw chart diagrams to explain vesicle formation from Golgi apparatus.
22. Enlist the examples of Monosaccharides, disaccharides, oligosaccharides and Polysaccharides (atleast 10 examples of each)
23. What are different respiratory pigments other than Haemoglobin found in various animals?
24. D and L amino acid ratio is often used to determine the age of a person. Give reasons.
25. What will happen to you if you eat L-Glucose? Justify your answer.
26. Find out structure of steroids of plant origin and compare with that of animals
27. Enlist names of enzymes you have studied that require a vitamin as coenzyme.
28. Study eggs of different sizes and comment on their yolk contents.
29. Procure the half way incubated hen's eggs from hatcheries and open it to observe the blastodisc, yolk content and developmental stages of embryo with the help of your teachers.
30. What is fate map of the frog or chick embryo?

31. Among mammals only primates menstruate. Which fertility/reproductive cycle is seen in non-primate mammals? How is it different from the menstrual cycle?
32. Endocrine disrupting chemicals can seriously affect the health, including the reproductive abilities of Humans. Give examples of adverse effects of EDs on wild life.

Job oriented/Entrepreneurship development topics for Sem IV:

1. Population genetics and evolution: Health industry and population studies for socio-economic development.
2. Cell Biology and histology, Biomolecules: Introduction to Pathology and Histopathology courses.
3. Aspects of Human Reproduction: Prospects into Clinical trials studies and Fertility centers.
4. Ethology: Animal care and preservation of animals in captivity or training or conservation programs.

Semester IV

REFERENCE AND ADDITIONAL READING

COURSE-VIII (PUSZOIV22-461)

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, WileyEastern Ltd. Mumbai
8. Practical research planning and design 2nd edition- Paul D Leedy, MacmilanPublication

COURSE-IX (PUSZOIV22-462)

1. Cell Biology by Singh and Tomoar Rastogi Publication..
2. Cell and molecular Biology E.D.P De Robertis and E.M.R Robertis ,CBS Publishersand Distributors
3. The cell A molecular Approach Goeffrey M.Coper ASM Press Washington D.C.
4. A textbook of cytology 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 (6th ed) by the Insertus
8. Campbell Biology (9th Ed.)
    i. Principles of Biochemistry, 2005, 2nd and 3rd edn. Lehninger A.L. Nelson D.L. andCox 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, 9th 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, 26th 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
16. Inderbir Singh'S Textbook Of Human Histology With Colour Atlas And Practical Guide by Pushpalatha K (Author), Deepa Bhat (Author), Pushpa NB (Author), Jaypee Brothers Medical Publishers
17. Bailey's textbook of histology, Williams & Wilkins; 17th edition

COURSE-X (PUSZOIV22-463)

1. Developmental Biology- 5th Edition, Scot F. Gilbert, Sinauer Associates Inc.
2. Developmental Biology- Subramoniam T., Narosa Publishers.
3. Developmental Biology- Berril N.J., Tata Mc Graw –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 5th 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, SwasticPub, 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, Himalaya
25. Animal Behaviour- David Mc Farland
26. Animal Behaviour- Mohan Arora
27. Animal Behaviour- Reena Mathur
28. An introduction to Animal Behaviour- Dawkins
29. Animal Behaviour-Agarwal
30. Animal Behaviour- Tinberge

ICT Backup:

1. Google search engine.
2. Yahoo search engine
3. Youtube videos and animations
4. Department e-book library and video gallery
5. NCBI, EMBI, Pubmed, BLAST, FASTA,etc.

Pedagogy:

1. **Awareness Wall**
   e.g. Cut-outs regarding the developments in the field of Wildlife, Environment, Social health etc. will be displayed.
2. **Teaching through Surveys:** Population surveys to study genetic traits (Widow's Peak,Free/Attached Earlobes, Curly Hair, Roller/Non-roller), BMI studies, Seasonal occurrence of diverse insects and avian fauna.

3. **QR codes:** Are used for conveying syllabus related material with more convenience.

Cell Biology

Pathology

MOOC units:

Sr. No.	Course Code	Topic	MOOC unit
1.	PUSZOIV22-461	Origin and Evolution of Life	a. AP Biology- part 3: Evolution and Diversity b. Introduction to Human evolution
2.	PUSZOIV22-462	Cell Biology, Biomolecules	a. Essential Human biology cells and Tissues b. The cells Biology: Cytoskeleton and cell cycle c. The cells Biology: Signaling d. The cells Biology: Cell transport e. AP Biology- part1: The Cell
3.	PUSZOIV22-463	Animal Behaviour	a. Introduction to animal behaviour

SCHEME OF EXAMINATION (THEORY)

SCHEME OF EXAMINATION (THEORY)

(d) Internal assessment of forty (40) marks per course per semester s will be conducted according to the format given below.

(e) External assessment of sixty (60) marks per course per semester will be conducted as per the following skeleton question paper pattern.

(f) One practical examination of fifty (50) marks per course each will be conducted at the end of every semester.

SKELETON- EXAMINATION PATTERN FOR THE ABOVE SYLLABUS

SKELETON- EXAMINATION PATTERN FOR THE ABOVE SYLLABUS

All Questions are compulsory Figures to the right indicate full marks

Time: 2.5hours **Total marks:60**

EVALUATION PATTERN			
Evaluation	Type of Questions	Weightage	
Theory External **(60%)**	Answer in one or two sentences each/Definition/Give reason/Justify the statements	20%	12 marks
	Short answer questions	40%	24 marks
	Long answer questions	40%	24 marks
Practical (I /II/III)	Preparations, Presentation, Observation, Analysis, Results, Excursion / Survey,	100%	50 marks

	Viva and Journal		
Theory Internal **(40%)**	One Class test (Objective/ Multiple Choice).	50%	20 marks
	Assignment/ Project/ Presentation/ Field Experience/Book or Research Paper Review.	37.5%	15 marks
	Active Participation, Level of Understanding of Students.	12.5%	05 marks

Passing Standard: 40% (Theory and Practical courses are separate areas of passing)

PRACTICAL

PUSZOIV22-461 (Course VIII)

Skeleton -Practical Examination Question Paper

Patter

Time: 2 hrs **Marks: 50**

Major Question 12 marks

Q1. Study Population density by Line transect or Quadrant method and calculate biodiversity indices (any 2)

Minor Question 08 marks

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 marks

a. Fossils

b. Speciation

Q4. From the given article prepare the bibliography/ abstract 06 marks

Q5. Power point presentation 06 marks

Q6. Viva 05 marks

Q7. Journal 05 marks

PRACTICAL

PUSZOIV22-462 (Course IX)

Skeleton -Practical Examination Question Paper Pattern

Time: 2 hrs **Marks: 50**

Major Question 15 marks

Q1. Study of permeability of cell through plasma membrane (Osmosis in blood cells).

OR

Q1. Measurement of cell diameter by Occulometer (by using permanent slide)

Minor Question 10 marks

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

OR

Q2. Qualitative tests for proteins (Ninhydrin test, Biuret test, Millon's test, Xanthoproteictest)

OR

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

OR

Q2. Study of rancidity of lipids by titrimetric method

Q3. Identify and describe as per instructions 15 marks

1. Ultra structure of cell organelles/ Histological slides (a, b & c)
2. Clinical disorders (d & e)

Q4. Viva 05 marks

Q5. Journal 05 mark

PRACTICAL

PUSZOIV22-464 (Course X)

Skeleton -Practical Examination Question Paper Pattern

Time: 2 hrs **Marks: 50**

Major Question **12 marks**

Q1. Detection of Creatinine in urine

OR

Q1. Determination of blood sugar by GOD and POD method

Minor Question **08 marks**

Q2. Detection of pregnancy using given sample of urine

OR

Q2. Determination of blood pressure by using spyghmomanometer

OR

Q2. Study of bleeding time and clotting time

Q3. Identifiy and describe as per instructions **15 marks**

1. Permanent slides/ Photographs (Embryology) (a,b)
2. Ethology (c,d)
3. Birth control device (e)

Q4. Field Report and viva based on it. **10 marks**

Q5. Journal **05 marks**

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END OF S.Y.B.Sc. SYLLABUS

Syllabus for T. Y. B. Sc. Course: ZOOLOGY
Credit Based Semester and Grading System - with a Choice for Additional Credits
(To be implemented from the Academic Year 2018-2019)

SEMESTER-V					
THEORY					
COURSE NO.	**COURSE CODE**	**UNIT**	**TOPICS**	**CREDITS**	**LECTURES/ WEEK**
11	USZO501	I	Principles of Taxonomy	2.5	1
		II	Kingdom: Animalia I		1
		III	Kingdom: Animalia II		1
		IV	Type study: *Sepia*		1
12	USZO502	I	Basic Haematology	2.5	1
		II	Applied Haematology		1
		III	Basic Immunology		1
		IV	Applied Immunology		1
13	USZO503	I	Mammalian Histology	2.5	1
		II	Toxicology		1
		III	General Pathology		1
		IV	Biostatistics		1
14	USZO504	I	Integumentary system and derivatives	2.5	1
		II	Human Osteology		1
		III	Muscles of long bones of Human limbs		1
		IV	Developmental biology of Chick		1
				10	**16**
PRACTICAL					
USZOP05	Practicals based on all four courses			**06**	**16**
Total Number of Credits and Workload				**16**	**32**
Research Project					
USZOR07	Additional Credits (Choice Based / Optional)			**1**	**No Workload for Teachers**

Syllabus for T. Y. B. Sc. Course: ZOOLOGY
Credit Based Semester and Grading System - with a Choice for Additional Credits
(To be implemented from the Academic Year 2018-2019)

SEMESTER-VI					
THEORY					
COURSE NO.	**COURSE CODE**	**UNIT**	**TOPICS**	**CREDITS**	**LECTURES/ WEEK**
15	USZO601	I	Phylum Chordata: Protochordata and Group Euchordata I	2.5	1
		II	Group Euchordata II		1
		III	Group Euchordata III		1
		IV	Type study: Shark		1
16	USZO602	I	Enzymology	2.5	1
		II	Homeostasis		1
		III	Endocrinology		1
		IV	Animal Tissue Culture		1
17	USZO603	I	Molecular Biology	2.5	1
		II	Genetic Engineering		1
		III	Human Genetics		1
		IV	Bioinformatics		1
18	USZO604	I	Environment management	2.5	1
		II	Wildlife management		1
		III	Bioprospecting and Zoopharmacognosy		1
		IV	Zoogeography		1
				10	**16**
PRACTICAL					
USZOP06	Practicals based on all four courses			**06**	**16**
Total Number of Credits and Workload				**16**	**32**
Research Project					
USZOR08	Additional Credits (Choice Based / Optional)			**1**	**No Workload for Teachers**

T. Y. B. Sc. Zoology: Semester V (Theory)
Course Code: USZO501:
Taxonomy - Invertebrates and Type Study
Course 11

Unit I: Principles of Taxonomy **(15L)**

Objective:

- *To introduce the principles of taxonomy and modern system of classification in animal kingdom with evolution point of view.*

Desired outcome:

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

1.1: Levels of Organization:

1.1.1: Unicellularity, colonization of cells, multicellularity

1.1.2: Levels of Organization: Acellular, Cellular, Tissue level, Organ level and 'Organ-system' level

1.2: Symmetry

1.2.1: Basic concept and definition

1.2.2: Types:

a. Asymmetry: e.g. *Amoeba*
b. Radial symmetry: e.g. Starfish
c. Bi-lateral symmetry: e.g. Invertebrate – Planaria
Vertebrate – Man

1.2.3: Evolutionary significance of symmetry

1.3: Coelom

1.3.1: Basic concept and definition

1.3.2: Formation of coelom

1.3.3: Types:

a. Acoelomate: Platyhelminthes e.g. Liverfluke
b. Pseudocoelomate: Nematoda e.g. Roundworm
c. Coelomate: e.g. Frog

1.3.4: Evolutionary significance of coelom

1.4: Metamerism

1.4.1: Basic concept and definition

1.4.2: Types:

a. Pseudometamerism: e.g. Tapeworm

b. Truemetamerism:
   i. Homonomous – Annelida e.g. *Nereis*
   ii. Heteronomous – Cephalization – Insecta e.g. Dragonfly
   Cephalothorax – Crustacean e.g. Lobster

1.4.3: Evolutionary significance of metamerism

1.5: Taxonomy

1.5.1: Basic concept, definition and objectives

1.5.2: Linnaean Hierarchy, Binomial Nomenclature

1.5.3: Six Kingdom classification:
General characters of each Kingdom with examples:
- Kingdom Archaebacteria
- Kingdom Eubacteria
- Kingdom Protista
- Kingdom Fungi
- Kingdom Plantae
- Kingdom Animalia

1.6: Kingdom Protista: Animal like Protists: Protozoa

1.6.1: General characters of Protozoa

1.6.2: Classification of Protozoa with distinguishing features and suitable examples:
- Phylum Sarcomastigophora
  - Class Sarcodina e.g. *Amoeba*
  - Class Mastigophora e.g. *Trypanosoma*
- Phylum Ciliophora
  - Class Ciliata e.g. *Opalina*
  - Class Phyllopharyngea e.g. *Dysteria*
- Phylum Sporozoa
  - Class Aconoidasida e.g. *Plasmodium*
  - Class Conoidasida e.g. *Toxoplasma*

Unit II: Kingdom Animalia I **(15L)**

Objective:
- *To comprehend the general characters and classification of Kingdom Animalia from Porifera to Nematoda and specific characters of organisms belonging to these phyla.*

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

2.1: Phylum Porifera
a. General characters
b. Classification up to class with distinguishing features and suitable examples:
   - Class Calcarea e.g. *Leucosolenia (Branched sponge)*

- Class Hexactinellida e.g. *Hyalonema* (Glass-rope sponge)
- Class Demospongia e.g. *Euspongia* (Bath sponge)

2.2: Phylum Cnidaria

a. General characters
b. Classification up to class with distinguishing features and examples
   - Class Hydrozoa e.g. *Hydra*
   - Class Scyphozoa e.g. *Aurelia* (Jelly fish)
   - Class Anthozoa e.g. *Meandrina* (Maze Coral)

2.3: Phylum Platyhelminthes

a. General characters
b. Classification up to class with distinguishing features and examples
   - Class Turbellaria e.g. *Dugesia* (Planaria)
   - Class Trematoda e.g. *Schistosoma* (Blood-fluke)
   - Class Cestoda e.g. *Taenia* (Tapeworm)
c. Morphology, life cycle and pathogenicity of *Fasciola hepatica.*

2.4: Phylum Nematoda

a. General characters
b. Classification up to class with distinguishing features and examples
   - Class: Aphasmida / Adenophorea e.g. *Trichinella* (Trichina worm)
   - Class: Phasmida / Secernentea e.g. *Ascaris* (Roundworm)

Unit III: Kingdom Animalia II **(15L)**

Objective:

- *To introduce basic concepts of classification up to class in animal kingdom from phylum Annelida to Hemichordata and to familiarize with their characters.*

Desired outcome:

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

3.1: Phylum Annelida

3.1.1: General characters

3.1.2: Classification up to class with distinguishing features and examples
   - Class Polychaeta e.g. *Neries* (Clamworm)
   - Class Oligochaeta e.g. *Pheretima* (Earthworm)
   - Class Hirudinea e.g. *Hirudinaria* (Leech)

3.2: Phylum Arthropoda

3.2.1: General characters

3.2.2: Classification up to class with distinguishing features and examples
   - Subphylum Chelicerata
     - Class Arachnida e.g. *Hottentotta* (Scorpion)
     - Class Merostomata e.g. *Limulus* (Horse-shoe crab)
     - Class Pycnogonida e.g. *Nymphon* (Sea spider)

- Subphylum Crustacea
  - Class Malacostraca e.g. *Scylla* (Crab)
  - Class Maxillipoda e.g. *Balanus* (Barnacle)
- Subphylum Uniramia
  - Class Chilopoda e.g. *Scolopendra* (Centipede)
  - Class Diplopoda e.g. *Xenobolus* (Millipede)
  - Class Insecta e.g. *Attacus* (Moth)

3.3: Phylum Mollusca

3.3.1: General characters of the Phylum

3.3.2: Classification up to class with distinguishing features and examples

- Class Aplacophora e.g. *Chaetoderma* (Glisten worm solenogaster)
- Class Polyplycophora e.g. *Chiton* (Coat-of-mail shells)
- Class Monoplacophora e.g. *Neopilina*
- Class Gastropoda e.g. *Nerita* (Nerit)
- Class Pelecypoda e.g. *Solen* (Razor clam)
- Class Scaphopoda e.g. *Dentalium* (Tusk shell)
- Class Cephalopoda e.g. *Nautilus* (Pearly nautilus)

3.4: Phylum Echinodermata

3.4.1 General characters

3.4.2 Classification up to class with distinguishing features and examples

- Class Asteroidea e.g. *Protoreaster* (Starfish)
- Class Ophiuroidea e.g. *Ophiothrix* (Brittle star)
- Class Echinoidea e.g. *Clypeaster* (Sand dollar)
- Class Holothuroidea e.g. *Cucumaria* (Sea cucumber)
- Class Crinoidea e.g. *Antedon* (Sealily)

3.5 Minor phyla

3.5.1: General characters along with examples of

- Phylum Acanthocephala e.g. *Moniliformis*
- Phylum Onychophora e.g. *Peripatus* (Velvet worm)
- Phylum Chaetognatha e.g. *Sagitta* (Arrow worm)

3.5.2: *Peripatus*, a connecting link – Affinities with Phylum Annelida, Arthropoda and Mollusca.

3.6 Phylum Hemichordata

3.6.1: General characters, classification with distinguishing features and examples

- Class Enteropneusta e.g. *Balanoglossus* (Acorn worm)
- Class Pterobranchia e.g. *Rhabdopleura*
- Class Planctosphaeroidea e.g. *Planctosphera*

3.7 Basic concepts of phylogeny: Phylogenetic tree of invertebrates

Unit IV: Type study: *Sepia* **(15L)**

Objective

- *To acquaint learners with the details of Sepia as a representative of invertebrate animals.*

***Desired* outcome**

- *Learners will get an idea of general characteristics and details of invertebrate animal systems.*

4.1: General characters and classification, Habit and habitat, External characters, mantle cavity, locomotion, economic importance

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

Course Code: USZO502:
Haematology and Immunology
Course 12

Unit I: Basic Haematology **(15L)**

Objectives:

- *To introduce to the learner the composition of blood, haemorrhage and haematopoiesis*
- *To acquaint the learner with the physiology of blood clotting and clinical aspects of haematology,*

Desired outcome:

- *The learner shall comprehend basic haematology.*
- *The learner will be able to identify various components of haemostatic systems*

1.1: Composition of plasma: Water, respiratory gases, dissolved salts, plasma proteins, nutrients, enzymes, hormones, nitrogenous waste products

1.2: Haematopoiesis: Erythropoiesis, leucopoiesis and thrombopoiesis

1.3: Erythrocytes: Structure and functions, abnormalities in structure, total count, variation in number; ESR; types of anaemia

1.4: Haemoglobin: Structure, formation and degradation; variants of haemoglobin (foetal, adult), abnormalities in haemoglobin (Sickle cell and Thalassemia)

1.5: Leucocytes: Types and functions, total count and variation in number; leukaemia and its types

1.6: Thrombocytes: Structure, factors and mechanism of clotting, failure of clotting mechanism

1.7: Blood volume: Total quantity and regulation; haemorrhage

Unit II: Applied Haematology **(15L)**

Objective:

- *To introduce to the learner the basics of applied haematology and to impart knowledge of diagnostic techniques used in pathology.*

Desired outcome:

- *The learner will be familiar with the terminology used and diagnostic tests performed in a pathological laboratory.*
- *The learner shall be acquainted with diagnostic approaches in haematological disorders.*
- *The learner will be better equipped for further pathological course or working in a diagnostic laboratory.*

2.1: Introduction and scope of Applied Haematology: Clinical, microbiological, oncological and forensic haematology

2.2: Clinical significance of Diagnostic Techniques

2.2.1: Microscopic examination of blood:

- Blood cancer (lymphoma, myeloma),
- Infectious diseases (malaria, leishmaniasis),
- Haemoglobinopathies (sickle cell anaemia, thalassemia)

2.2.2: Coagulopathies: Haemophilia and purpura

2.2.3: Biochemical examination of blood:

- Liver function tests: AST, ALT, LDH, Alkaline phosphatase , Total and direct bilirubin
- Kidney function test: Serum creatinine, Blood Urea Nitrogen (BUN)
- Carbohydrate metabolism tests: Blood sugar, Glucose tolerance test, Glycosylated haemoglobin test
- Other biochemical tests: Blood hormones - TSH, FSH, LH.

Unit III: Basic Immunology **(15L)**

Objective:

- *To introduce the topic of immunology by emphasizing the basic concepts to build a strong foundation and to give an overview of the immune system that plays an important role in disease resistance.*

Desired outcome:

- *The learner shall comprehend the types of immunity and the components of immune system.*
- *The learner will realize the significant role of immune system in giving resistance against diseases.*

3.1: Overview of Immunology

3.1.1: Concept of immunity

3.1.2: Innate immunity – Definition, factors affecting innate immunity, Mechanisms of innate immunity – First line of defence – physical and chemical barriers; Second line of defence- phagocytosis, inflammatory responses and fever

3.1.3: Adaptive or Acquired immunity, Antibody mediated and cell mediated immunity; Active Acquired immunity – Natural and Artificial; Passive Acquired immunity – Natural and Artificial

3.2: Cells and Organs of immune system

3.2.1: Cells of immune system – B cells, T cells and null cells, macrophages, dendritic cells and mast cells

3.2.2: Organs of immune system

- Primary: Thymus and bone marrow
- Secondary: Lymph nodes and spleen

3.3: Antigens: Definition and properties; haptens

3.4: Antibodies: Definition, basic structure, classes of antibodies – IgG, IgA, IgM, IgD and IgE

3.5: Antigen processing and presentation

3.5.1: Endogenous antigens – cytosolic pathways

3.5.2: Exogenous antigens – endocytic pathways

Unit IV: Applied Immunology **(15L)**

Objectives:

- *To introduce immunopathology to the learner*
- *To introduce the concept of vaccines and vaccination.*
- *To familiarise the learner to immunological perspectives of organ transplantation.*

Desired outcome:

- *The learner shall understand immunopathology and the principles and applications of vaccines.*
- *The learner will develop basic understanding of immunology of organ transplantation.*

4.1: Antigen-Antibody interaction

4.1.1**:** General features of antigen-antibody interaction

4.1.2**:** Precipitation reaction – Definition, characteristics and mechanism.

- Precipitation in gels (slide test)
- Radial immunodiffusion (Mancini method)
- Double immunodiffusion (Ouchterlony method)

4.1.3**:** Immunoelectrophoresis – Counter-current and Laurel's Rocket electrophoresis

4.1.4**:** Agglutination reaction definition, characteristics and mechanism.

- Haemagglutination (slide and micro-tray agglutination)
- Passive agglutination
- Coomb's test

4.1.5**:** Immunoassay- ELISA

4.2: Vaccines and Vaccination

4.2.1**:** Principles of vaccines – active and passive immunization, Routes of vaccine administration

4.2.2**:** Classification of vaccines:

- Live attenuated
- Whole-Killed or inactivated
- Sub-unit vaccines: Toxoids, Protein vaccines, Viral-like particles, DNA vaccines

4.2.3**:** Adjuvants used for human vaccines:

- Virosomes and Liposomes
- Saponins

- Water-in-oil emulsions

4.2.4**:** Vaccines against human pathogens:

- Polio
- Hepatitis A and B
- Tuberculosis (BCG)

4.3: Transplantation Immunology: Introduction to transplantation; Types of grafts; Immunologic basis of graft rejection: MHC compatibility in organ transplantation, Lymphocyte and Antibody mediated graft rejection; Precautionary measures against graft rejection

Course Code: USZO503:
Histology, Toxicology, Pathology and Biostatistics
Course 13

Unit I: Mammalian Histology **(15L)**

Objectives:

- *To familiarize the learner with the cellular architecture of the various organs in the body.*
- *To make the learner understand the need and importance of different types of tissues in the vital organs and their functions.*

Desired outcome:

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

1.1: Vertical section (V.S.) of skin: Layers and cells of epidermis; papillary and reticular layers of dermis; sweat glands, sebaceous glands and skin receptors

1.2: Digestive System

1.2.1: Vertical section (V.S.) of tooth; hard tissue – dentine and enamel; soft tissue – dentinal pulp and periodontal ligaments

1.2.2: Transverse section (T.S.) of tongue – mucosal papillae and taste buds

1.2.3: Alimentary canal – Transverse section (T.S.) of stomach, small intestine, large intestine of mammal.

1.2.4: Glands associated with digestive system – Transverse section (T.S.) of salivary glands, liver.

Unit II: Toxicology **(15 L)**

Objectives:

- *To introduce the learner to the principles of toxicology with particular emphasis on toxic responses to chemical exposures, nature and effect of toxicity and toxicity testing.*
- *It also intends to develop amongst students an introductory understanding of regulatory affairs in toxicology.*

Desired outcome:

- *The course will prepare learner to develop broad understanding of the different areas of toxicology.*
- *It will also develop critical thinking and assist students in preparation for employment in pharmaceutical industry and related areas.*

2.1: Basic toxicology

2.1.1: Introduction to toxicology – brief history, different areas of toxicology, principles and scope of toxicology

2.1.2: Toxins and Toxicants – Phytotoxins (caffeine, nicotine), Mycotoxins (aflatoxins),

Zootoxins (cnidarian toxin, bee venom, scorpion venom, snake venom)

2.1.3: Characteristics of Exposure – Duration of exposure, Frequency of exposure, Site of exposure and Routes of exposure

2.1.4: Types of Toxicity – Acute toxicity, Sub-acute toxicity, Sub-chronic toxicity and Chronictoxicity

2.1.5: Concept of LD_{50}, LC_{50}, ED_{50}

2.1.6: Dose Response relationship – Individual / Graded dose response, Quantal dose response, shape of dose response curves, Therapeutic index, Margin of safety

2.1.7: Dose translation from animals to human – Concept of extrapolation of dose, NOAEL (No Observed Adverse Effect Level), Safety factor, ADI (Acceptable Daily Intake)

2.1.8: Target organ toxicity:
Hepatotoxicity: susceptibility of the liver, types of liver injury, examples of hepatotoxicants;
Neurotoxicity: vulnerability of nervous system, examples of neurotoxicants;
Nephrotoxicity: susceptibility of kidney, examples of nephrotoxicants

2.2: Regulatory toxicology

2.2.1: OECD guidelines for testing of chemicals (an overview)

2.2.2: CPCSEA guidelines for animal testing centre, ethical issues in animal studies

2.2.3: Animal models used in regulatory toxicology studies

2.2.4: Alternative methods in toxicology (*in vitro* tests)

Unit III: General Pathology **(15L)**

Objectives:

- *To introduce the learner to basics of general pathology.*
- *To impart knowledge of retrogressive, necrotic, pathological conditions in the body.*
- *To explain repair mechanism of the body.*

Desired outcome:

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

3.1: General Pathology: Introduction and scope

3.2: Cell injury: Mechanisms of cell injury: ischemic, hypoxic, free radical mediated and chemical

3.3: Retrogressive changes: Definition, cloudy swelling, degeneration: fatty, mucoid and amyloid (causes and effects)

Course Code: USZO504:
Anatomy and Developmental Biology
Course 14

Unit I: Integumentary system and derivatives **(15L)**

Objective:

- *To introduce the learner to understand different integumentary structures and derivatives in the vertebrates and to acquaint learners with special derivatives of integument.*

Desired outcome:

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

1.1: Basic structure of integument: Epidermis and dermis

1.2: Epidermal derivatives of Vertebrates

1.2.1: Hair, hoof, horn, claw, teeth, beak and epidermal scales (small scales, large scales, modified scales – spine)

1.2.2: Glands – types (mucous, serous, ceruminous, poison, uropygial and salt gland) and functions

1.2.3: Type of feathers

1.3: Dermal derivatives of Vertebrates: Scales in fish; scutes in reptiles and birds; dermal scales in mammals – Armadillo, Antler – Caribou

1.4: Special derivatives of integument: Wart in toad, rattle in snake, whale bone in baleen whale, kneepads in camel.

Unit II: Human Osteology **(15L)**

Objective:

- *To introduce the learner to different bones of human skeleton and theirfunctional importance.*

Desired outcome:

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

2.1: Introduction: Bone structure (Histology), physical properties, chemical composition and general functions of bones.
Cartilage: General structure, functions

2.2: Axial skeleton

2.2.1: Skull: General characteristics of skull bones - Cranial and facial bones

2.2.2: Vertebral column: General characteristics of a vertebra, structure of different types of vertebrae (cervical, thoracic, lumbar, sacrum and coccyx)

2.2.3: Ribs and sternum: General skeleton of ribs and sternum

2.2.4: Hyoid bone: Structure and function.

2.3: Appendicular skeleton
2.3.1: Pectoral girdle and bones of forelimbs

2.3.2: Pelvic girdle and bones of hind limbs

Unit III: Muscles of long bones of Human limbs **(15L)**

Objectives:
- *To study long limb muscles involved in body movements.*
- *To identify various arrangements of the long limb muscles and to relate the arrangement with contraction and motion.*
- *To study muscle injuries and syndromes.*

Desired outcome:
- *Learner will be able to understand the types of long limb muscles, its arrangement and their role in body movements.*

3.1: Introduction and types of long limb muscles
3.1.1: Flexors, Extensor, Rotator, Abductors, Adductors

3.2: Muscles of forelimbs
3.2.1: Muscles that move the arm (Humerus) –*Triceps brachii, Biceps brachii, brachialis* and *brachioradialis*

3.2.2: Muscles that move the forearm (Radius-ulna) –*Flexor carpi radialis, Flexor carpi ulnaris* and *Extensor carpi ulnaris*

3.2.3: Muscles that move the wrist, hand and fingers –*Flexor digitorium superficialis, Extensor carpi radialis* and *Extensor digitorum*

3.3: Muscles of hindlimbs
3.3.1: Muscles that move the thigh (Femur) – Sartorius, Adductor group, Quadriceps group (*Rectus femoris, Vastus lateralis, Vastus medialis*), Hamstring group (*Biceps femoris, Semimembranosus, Semitendinosus*)

3.3.2: Muscles that move the lower leg (tibia-fibula) –*Fibularis longus, Gastrocnemius, Tibialis anterior, Soleus, Extensor digitorum longus* and *Fibularis tertius*

3.3.3: Muscles that move the ankle, foot and toes - *Tibialis anterior, Extensor digitorum, Longus* and *Fibularis* muscles

Unit IV: Developmental biology of Chick **(15L)**

Objective:

- *To introduce the learner to the basics of developmental biology with reference to chick as a model and also familiarize with experiments related to it.*

Desired outcome:

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

4.1: Introduction to Developmental Biology: Basic concept and principles of developmental biology - morphogenesis, organogenesis, fate maps, cell adhesion, cell affinity and cell differentiation.

4.2: Development of Chick embryo

4.2.1: Structure of Hen's egg, physico-chemical nature and forms of yolk- granular, platelets and spheres; fertilization, cleavage, blastulation, gastrulation

4.2.2: Structure of chick embryo – 18hours, 24 hours, 33 hours, 48 hours and 72 hours

4.2.3: Extra embryonic membranes

4.2.4: Organizer: Introduction, Spemann Mangold experiment, Hensen's node as an organizer.

Practical Syllabus for Semester V
Course code: USZOP05; Course 11

1. Classification of phyla up to class and study of the general characters up to class.

Kingdom Protista – Animal-like Protists: Protozoa

A. Phylum: Sarcomastigophora
- Class Sarcodina e.g. *Amoeba*
- Class Mastigophora e.g. *Euglena*

B. Phylum: Ciliophora
- Class Ciliata e.g. *Paramoecium*
- Class Phyllopharyngea e.g. *Dysteria*

C. Phylum: Sporozoa,
- Class Aconoidasida e.g. *Eimeria*
- Class Conoidasida e.g. *Sarcocystis*

Kingdom Animalia

D. Phylum: Porifera
- Class Calcarea e.g. *Scypha* (Little vase sponge)
- Class Hexactinellida e.g. *Hyalonemma* (Glass-rope sponge)
- Class Demospongia e.g. *Spongilla* (Freshwater sponge)

E. Phylum Cnidaria
- Class Hydrozoa e.g. *Vellela* (By-the-wind sailor or purple sail)
- Class Scyphozoa e.g. *Rhizostoma* (Barrel jellyfish)
- Class Anthozoa e.g. *Corallium* (Coral)

F. Phylum Platyhelminthes
- Class Turbellaria e.g. *Dugesia* (Planaria)
- Class Trematoda e.g. *Fasciola* (Liverfluke)
- Class Cestoda e.g. *Taenia* (Tapeworm)

G. Phylum Nematoda
- Class Aphasmida / Adenophorea e.g. *Trichinella* (Trichina worm)
- Class Phasmida / Secernentea e.g. *Ascaris* (Roundworm)

H. Phylum Annelida
- Class Polychaeta e.g. *Arenicola* (Lugworm)
- Class Oligochaeta e.g. *Tubifex* (Sludge worm)
- Class Hirudinea e.g. *Pontobdella* (Marine leech)

I. Phylum Arthropoda

Subphylum Chelicerata
- Class Arachnida e.g. *Hotentotta* (Scorpion)
- Class Merostomata e.g. *Limulus* (Horseshoe crab)
- Class Pycnogonida e.g. *Nymphon* (Sea spider)

Subphylum Crustacea

- Class Malacostraca e.g. *Panulirus* (Lobster)
- Class Maxillipoda e.g. Cyclops (Copepods)

Subphylum Uniramia

- Class Chilopoda e.g. *Scolopendra* (Centipedes)
- Class Diplopoda e.g. *Xenobolus* (Millipedes)
- Class Insecta e.g. *Attacus* (Moth)

J. Phylum Mollusca

- Class Aplacophora e.g. *Chaetoderma* (Glisten worm solenogaster)
- Class Polyplacophora e.g. *Tonicella* (Lined Chiton)
- Class Monoplacophora e.g. *Neopilina*
- Class Gastropoda e.g. *Turbo* (Turban shell)
- Class Pelycypoda e.g. *Donax* (Bean clam or wedge shell)
- Class Scaphopoda e.g. *Dentalium* (Tusk shell)
- Class Cephalopoda e.g. *Octopus*

K. Phylum Echinodermata

- Class Asteroidea e.g. *Asterias* (Starfish)
- Class Ophiuroidea e.g. *Ophiothrix* (Brittle star)
- Class Echinoidea e.g. *Echinus* (Sea urchin)
- Class Holothuroidea e.g. *Cucumaria* (Sea cucumber)
- Class Crinoidea e.g. *Crinoid* (Sea lily)

L. Phylum Hemichordata

- Class Enteropneusta e.g. *Saccoglossus*
- Class Pterobranchia e.g. *Rhabdopleura*
- Class Planctosphaeroidea e.g. *Planctosphaera*

2. Minor Phyla

Acoelomate

M. Phylum Acanthocephala e.g. *Echinorhynchus*

Coelomate

N. Phylum Chaetognatha e.g. *Sagitta*

O. Phylum Onychophora e.g. *Peripatus* (Velvet worm)

3. Study of Sepia with the help of diagram/Photograph/Simulation whichever possible. No animal shall be dissected.

a) Digestive system,
b) Reproductive system
c) Nervous system
d) Jaws
e) Radula
f) Chromatophores
g) Spermatophores
h) Statocyst

Course code: USZOP05; Course 12

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

Course code: USZOP05;Course 13

1. Study of mammalian tissues: V.S. of Tooth, T.S. of Stomach, T.S. of small intestine, T.S. of Liver.
2. Microtomy: Tissue preservation and fixation, dehydration, infiltration, paraffin embedding and block preparation, sectioning, staining.
3. Identification of diseases or conditions (from slides or pictures): Vitiligo, Psoriasis, Bed sores, Necrosis, Oedema
4. To study the effect of CCl_4 on the level of enzyme activity in liver on aspartate and alanine amino transferase, alkaline phosphatase (*in vitro* approach).
5. Study and interpretation of abnormal pathological reports: Blood (CBC), Urine (Routine) and Stool (Routine).
6. Following biostatistics practicals will be done using data analysis tool of Microsoft Excel (DEMONSTRATION in regular practicals) & manually:
   a. Problems based on Z test
   b. Problems based on t test
   c. Problems based on Chi square test
   d. Correlation, regression analysis – demonstration only.
   e. Problems based on ANOVA – demonstration only.

(Learner is expected to identify appropriate test for the given problem)

Course code: USZOP05; Course 14

1. Study of integumentary systems – V. S. of Skin of Shark, Frog, *Calotes*, Pigeon and Human
2. Study of Human Axial Skeleton – Skull and Vertebral column
3. Study of Human Appendicular Skeleton – Pectoral and pelvic girdle with limb bones
4. Study of muscles of forelimbs – *Biceps brachii, Brachialis, Brachio radialis, Triceps brachii, Flexor carpi radialis, Flexor carpi ulnaris* and *Extensor carpi ulnaris*
5. Study of muscles of hind limbs – Sartorius, Adductor group, Quadriceps group
6. *Rectus femoris, Vastus lateralis, Vastus medialis, Hamstring* group (*Biceps femoris, Semimembranosus, Semitendinosus*), *Fibularis longus, Gastrocnemius*
7. *Tibialis anterior, Soleus, Extensor digitorum longus, Fibularis tertius*
8. Study of ontogeny of chick embryo using permanent slides – 18 hours, 24 hours, 33 hours, 48 hours and 72 hours.
9. Prepare temporary mounting of chick embryo up to 48 hours of incubation.

References and Additional Reading for Semester V

Course 11:

REFERENCES

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

ADDITIONAL READING

- https://www.earthlife.net/inverts/an-phyla.html
- http://www.biologydiscussion.com/invertebrate-zoology/invertebrates-phyla/study-notes-on-invertebrates-phyla/28077
- http://www.asfa.k12.al.us/ourpages/auto/2014/4/23/64232119/invertebrate-animal-phyla-notes.pdf
- http://www.biology-pages.info/I/Invertebrates.html
- https://portals.iucn.org/library/sites/library/files/documents/2012-064.pdf
- http://instruction2.mtsac.edu/mcooper/Biology%202/Labs/Protistalab1.pdf
- http://www.faculty.ucr.edu/~legneref/invertebrate/inverteb.htm
- http://www.cbv.ns.ca/mchs/diversity/ProtozoansPage1.html
- http://bioweb.uwlax.edu/bio203/s2009/maiers_andr/Classification.htm
- https://www.earthlife.net/inverts/annelida.html
- https://manoa.hawaii.edu/exploringourfluidearth/biological/invertebrates/worms-phyla-platyhelmintes-nematoda-and-annelida
- http://www.fossilmuseum.net/Tree_of_Life/PhylumAnnelida.htm

- http://www.austincc.edu/sziser/Biol%201413/LectureNotes/lnexamIII/Phylum%20Annelida.pdf
- http://animaldiversity.org/accounts/Annelida/classification/
- http://faculty.college-prep.org/~bernie/sciproject/project/Kingdoms/Animal%20Kingdom%20-%205/Local%20copy/classification/arthropoda.html
- http://bio.rutgers.edu/~gb102/lab_2/309am-arthro.html
- http://www.auburn.edu/academic/classes/biol/1030/boyd/lect10-14outline.htm
- http://www.fossilmuseum.net/Tree_of_Life/PhylumArthropoda.htm
- http://www.geo.arizona.edu/geo3xx/geo308/FoldersOnServer/2003/3Mollusca.htm
- http://www.fossilmuseum.net/Tree_of_Life/PhylumMollusca.htm
- http://www.geo.arizona.edu/geo3xx/geo308/FoldersOnServer/2003/Lab7EchinoArthro.htm
- https://www.earthlife.net/inverts/echinodermata.htmla
- http://www.uky.edu/OtherOrgs/KPS/paleoclass/pages/wimbergechinodermata.htm
- http://www.fossilmuseum.net/Tree_of_Life/Phylum-Echinodermata.htm

Course 12
REFERENCES

- Human Physiology - Volume 1; C.C. Chatterjee
- Essentials of Haematology; Shirish M. Kawthalkar; Jaypee Brothers
- Williams Hematology; Kenneth Kaushansky, Marshall A. Lichtman, E. Beutler, Thomas J. Kipps, Josef Prchal, Uri Seligsohn
- Essential Haematology; Victor Hoffbrand, Paul Moss, John Pettit
- Rapid Review of Hematology; Ramadas Nayak; Jaypee Brothers
- Precise Haematology; Usha Rusia, Meera Sikka, Renu Saxena; Wiley India
- Short Textbook of Haematology; Shah B.S.; C.B.S. Publisher and Distributor
- Practical Zoology; Second Edition; Dr. K.C. Ghose & Dr. B. Manna; New Central Book Agency Pvt. Ltd., Kolkata; 1999
- Mechanisms of Body Functions; Second Edition; Dexter M. Easton; Prentice-Hall of India Pvt. Ltd., New Delhi; 1978
- A Text book of Practical Physiology; First Edition; V.G. Ranade; A.V.G. Prakashan, Pune; 1968
- Principles of Anatomy & Physiology; Thirteenth Edition; Gerard J. Tortora & Bryan Derrickson; Biological Science Textbooks, Inc.; 2012
- Biochemistry; Fourth Edition; U. Satyanarayana & U. Chakrapani; Elsevier; 2013
- Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006
- Medical Biochemistry; Fourth Edition; John Baynes & Marek Dominiczak; Saunders (Elsevier); 2014
- Harrison's Hematology and Oncology; 3rd Edition (Harrison's Specialty);Dan Longo; McGraw-Hill
- Essentials of Haematology; Second Edition; Kawthalkar Shirish M.; Jaypee; 2013
- Medical Biochemistry by C. Jaypee; 2012
- Essentials in Hematology and Clinical Pathology; Nayak, Ramadas
- Clinical Pathology and Hematology; Maheshwari, Nanda; Jaypee
- Practical Hematology; Dacie J V; Churchill Livingstone; 2006
- Lecture Notes: Haematology; Hatton, Chris S. R. Hughes-Jones, Nevin C. Hay, Deborah; Wiley-Blackwell

- ABC series : ABC of Clinical Haematology; Provan; Drew Publisher: BMJBooks
- Principles of Anatomy & Physiology; Thirteenth Edition; Gerard J. Tortora & Bryan Derrickson; Biological Science Textbooks, Inc.; 2012
- Biochemistry; Fourth Edition; U. Satyanarayana & U. Chakrapani; Elsevier; 2013
- Immunology - Introductory Textbook; Shetty N.; New Age International; 2005
- Immunology - Essential and Fundamental; Pathak S., & Palan U.; Science Publishers; 2005
- Immunology: A textbook; Rao C. V.; Alpha Science Int'l Ltd.; 2005
- Ananthanarayan and Paniker's textbook of Microbiology; C. J. Paniker (Ed.); Ananthanarayan R.; Orient Blackswan; 2005
- Textbook of Immunology; Haleem Khan, Rajendra Sagar, Sadguna
- Prescott's Microbiology; Ninth Edition; Joanne M. Willey, Linda M. Sherwood &
- Christopher J. Woolverton; McGraw-Hill Education; 2014
- Immunology; Third Edition; Janis Kuby; W.H. Freeman; 1997
- Kuby Immunology; Sixth Edition; Thomas J. Kindt, Richard A. Goldsby, Barbara Osborne & Janis Kuby; W.H. Freeman; 2007
- Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006
- Medical Biochemistry; Fourth Edition; John Baynes & Marek Dominiczak; Saunders (Elsevier); 2014
- Cellular and Molecular immunology; Abbas A. K., Lichtman A. H. &Pillai S.; Elsevier Health Sciences; 2014
- Roitt's Essential Immunology – Vol. 20; Delves P. J., Martin S. J., Burton D. R., & Roitt I. M.; John Wiley & Sons; 2011
- The Elements of Immunology; Khan F.H.; Pearson Education, India; 2009
- Kuby Immunology; Sixth Edition; Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne & Janis Kuby; W.H. Freeman; 2007
- Janeway's Immunobiology; Murphy K. & Weaver C.; Garland Science; 2016
- Fundamental Immunology; Paul W. E.; Philadelphia: Lippincott-Raven; 1999
- Immunology - Introductory Textbook; Shetty N.; New Age International; 2005
- Prescott's Microbiology; Ninth Edition; Joanne M. Willey, Linda M. Sherwood & Christopher J. Woolverton; McGraw-Hill Education; 2014
- Medical Biochemistry; Fourth Edition; John Baynes & Marek Dominiczak; Saunders (Elsevier); 2014
- Lehninger's Principles of Biochemistry; David Lee Nelson, A. L. Lehninger, Michael M Cox; W.H. Freeman, New York; 2008
- Biochemistry; 5th ed.; J M Berg, J L Tymoczko and Lubert Stryer; W.H. Freeman, New York; 2002
- Biochemistry; 2nd edition; Donald Voet and Judith G Voet; J. Wiley and Sons, New York; 1995

ADDITIONAL READING:

- Biology – A Global Approach; Tenth Edition (Global Edition); Campbell, Reece, Urry, Cain, Wasserman, Minorsky & Jackson; Pearson Education Ltd., England; 2015
- Biology; Seventh Edition; Neil A. Campbell & Jane B. Reece; Pearson Education, Inc.; 2005
- Biology; Student Edition; Kenneth R. Miller & Joseph S. Levine; Prentice Hall; 2007
- Biology: Eleventh Revised Edition; Sylvia S. Mader & Michael Windelspecht;
- McGraw-Hill Education; 2012

- Biology – Concepts & Applications; Sixth Edition; Cecie Starr; Brooks/ Cole; 2005
- The Emperor of All Maladies: A biography of Cancer; Siddhartha Mukherjee; Scribner, New York; 2010
- Molecular Cell Biology; Fifth edition; Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, S. Lawrence Zipursky & James Darnell; W.H. Freeman & Company, New York; 2004
- 'India facing shortage of life-saving albumin serum'; written by Abantika Ghosh, New Delhi; The Indian Express, October 16, 2014, 2:25 am
- Articles on "Blood groups"; (1)The Indian Express, August 15, 2012/ Times of India, August 16, 2012; (2)Times of India, September 11, 2014
- 'Nanoparticle vaccine shows potential as immunotherapy to fight multiple cancer types'; UT Southwestern Medical Center; Science Daily, April 24 2017; https://www.sciencedaily.com/
- Textbook of Biochemistry with clinical correlations; Fourth Edition: Edited by Thomas M.Devlin; Wiley-Liss Publication.
- Biochemistry; Third Edition: Pamela C. Champe, Richard A. Harvey, Denise R. Ferrier; Indian Edition by JP Publication.

Course 13
REFERENCES

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

B.C. Decker, Inc., Hamilton; 2008
- Fundamentals of Biostatistics; Second Edition; Veer Bala Rastogi; Ane Books Pvt. Ltd., New Delhi; 2009 (Reprint 2010)
- Fundamentals of Biostatistics; Second Revised Edition; Irfan Ali Khan and Atiya Khanum; Ukaaz Publications, Hyderabad; 2004
- Instant Medical Biostatistics; Dr. Ranjan Das and Dr.Papri N. Das; Ane Books Pvt. Ltd., New Delhi; 2009
- Primer of Biostatistics; Fifth Edition; Stanton A. Glantz; McGraw-Hill Companies, Inc.; 2002
- Basic Biostatistics – Statistics for Public Health Practice; Second Edition; B. Burt Gerstman; Jones and Bartlett Learning Burlington; 2015
- Biostatistics – A Guide to Design, Analysis, and Discovery; Second Edition; Ronald N. Forthofer, Eun Sul Lee and Mike Hernandez; Elsevier, Inc., (Academic Press), USA; 2007
- Statistics in Biology and Psychology; Sixth Edition; Debajyoti Das and Arati Das; Academic Publishers, Kolkata

ADDITIONAL READING:

- Biology – A Global Approach; Tenth Edition (Global Edition); Campbell, Reece, Urry, Cain, Wasserman, Minorsky & Jackson; Pearson Education Ltd., England; 2015
- Biology; Seventh Edition; Neil A. Campbell & Jane B. Reece; Pearson Education, Inc.; 2005
- Biology; Student Edition; Kenneth R. Miller & Joseph S. Levine; Prentice Hall; 2007
- Biology: Eleventh Revised Edition; Sylvia S. Mader & Michael Windelspecht; McGraw-Hill Education; 2012
- Biology – Concepts & Applications; Sixth Edition; Cecie Starr; Brooks/ Cole; 2005
- Prescott's Microbiology; Ninth Edition; Joanne M. Willey, Linda M. Sherwood & Christopher J. Woolverton; McGraw-Hill Education; 2014
- Disease & Medicine in India – A Historical Overview; Deepak Kumar; Tulika Books, India; 2012

Course 14

REFERENCES

- Comparative Anatomy of the Vertebrates; Ninth Edition; Kent, G.C. and Carr R.K.; The McGraw-Hill Companies; 2000
- Text book of Chordates; Saras publication
- Modern text book of Zoology; Prof. R.L. Kotpal
- Integumentary system and its derivatives; Samuel D. Hodge
- Atlas of Human Anatomy – Vol I; R.D. Sinelnikov; Mr. Publishers Moscow
- A Guide of Osteology (for medical students); Prakash Kendra, Lucknow
- Text Book of Comparative Anatomy and Physiology; Tortora
- Human Osteology – Tim D White
- Text Book of Human Osteology – Singh Inderbir
- Mechanisms of Body Functions; Second Edition; Dexter M. Easton; Prentice-Hall of India Pvt. Ltd., New Delhi; 1978
- Human Anatomy – John W. Hole, Jr., Karen A. Koos, Publisher: W. C. Brown Publisher, USA.
- Principles of Anatomy and Physiology – Gerard T. Tortora and Sandra Reynolds Grabowski. Publisher: Harpers Collins College Publishers (7th Edition).

- Developmental biology – Gilbert
- Development of Chick – Patten
- Developmental Biology – Wolpert
- Text book of Embryology – N. Arumugam
- Chicken Development – Embryology; W.H. Freeman & B. Bracegirdle
- Practical Zoology; Second Edition; Dr. K.C. Ghose & Dr. B. Manna; New Central Book Agency Pvt. Ltd. , Kolkata; 1999

ADDITIONAL READING

- Comparative Anatomy of Vertebrates by Sumitra Saxena and R. K. Saxena
- Comparative Anatomy of Vertebrates by S. K. Kulshrestha
- Vertebrates: Comparative Anatomy, Function, Evolution by Kenneth Kardong
- Comparative Anatomy of the Vertebrates by George C Kent and Robert K. Carr
- Comparative Anatomy of Vertebrates by Robert Wiedersheim
- Illustrations of Comparative Anatomy, Vertebrate and Invertebrate – For The Use of Students In The Museum Of Zoology And Comparative Anatomy
- Human Osteology, 3rd Edition by Tim D. White, Michael T. Black and Pieter A. Folkens.
- Hand Book of Osteology, 13th Edition by S. Poddar and Ajay Bhagat
- The Anatomy and Biology of the Human Skeleton by D. Gentry Steele
- Atlas of Chick Development – By Ruth Bellairs and Mark Osmond
- Laboratory embryology of the chick by Lloyd Eugene Downs
- Vertebrate Embryology: A Laboratory Manual - Richard M. Eakin
- Molecular Embryology: Methods and Protocols by Paul T. Sharpe, Ivor
- Dictionary of Developmental Biology and Embryology by Frank J. Dye

T.Y.B.Sc. Zoology: Semester VI (Theory)
Course Code: USZO601:
Taxonomy – Chordates and Type Study
Course 15

Unit I: Phylum Chordata: Protochordata and Group Euchordata I **(15L)**

Objective:

- *To introduce basic concepts of modern Chordate classification with evolution point of view and to understand the concept of taxonomy in higher animal kingdom.*

Desired outcome:

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

1.1: General characters, Difference between non-chordates and chordates

Origin of chordates: Annelids as ancestors, Arachnids as ancestors and affinities with Echinodermata

1.2: **Protochordata**

1.2.1: General characters of Group Protochordata

1.2.2: Distinguishing characters of Subphylum Urochordata and Cephalochordata

1.2.3: Subphylum Urochordata

- Class Ascidiacea e.g. *Herdmania*
- Class Thaliacea e.g. *Salpa*
- Class Larvacea e.g. *Oikopleura*

1.2.4: Subphylum Cephalochordata

- Class Leptocardii e.g. *Branchiostoma* (*Amphioxus*)

1.3: Euchordata I

Group Euchordata: General characters

- Subphylum Vertebrata: General characters
- Division Agnatha and Gnathostomata: Distinguishing characters.

General characters with examples of:

- Class Ostracodermii e.g. *Cephalaspis*
- Class Cyclostomata e.g. *Petromyzon* (Lamprey)

Unit II: Group Euchordata II **(15L)**

2.2.1: Division: Gnathostomata

- Superclass: Pisces and Tetrapoda
- Superclass – Pisces: Distinguishing characters
  - Class Placodermi e.g. *Climatius*
  - Class Chondrichthyes e.g. *Rhinobatos* (Guitar fish)
  - Class Osteichthyes e.g. *Exocetus* (Flying fish)

Unit IV: Type study: Shark **(15L)**

Objective:

- *To study in depth one vertebrate animal type i. e. general characteristics and salient features of animal type - shark.*

Desired outcome:

- *Learners will get an idea of vertebrate animal life after studying one representative animal Shark.*

4.1: Habit & habitat, distribution, external characters, classification and economic importance.

4.2: Skin, exoskeleton, endoskeleton and systems

a) Digestive system
b) Respiratory system
c) Blood vascular system
d) Nervous system and receptor organs
e) Urinogenital system, copulation, fertilization and development

Course Code: USZO602:
Physiology and Tissue Culture
Course 16

Unit I: Enzymology **(15L)**

Objective:

- *To introduce to the learner the fundamental concepts of enzyme biochemistry and to enable the learner realize applications of enzymes in basic and applied sciences.*

Desired outcome:

- *The learner shall understand fundamentals of enzyme structure, action and kinetics.*
- *The learner shall appreciate the enzyme assay procedures and the therapeutic applications of enzymes.*

1.1: Introduction and Nomenclature: Definition; concept of activation energy; nomenclature and classification (based on IUB – Enzyme Commission) of enzymes; chemical nature of enzyme, co-factors and co-enzymes.

1.2: Enzyme Action and Kinetics: Mechanism; Factors affecting enzyme activity – substrate, pH and temperature. Derivation of Michaelis-Menten equation and Lineweaver-Burk plot; Concept and significance of K_m, V_{max} and K_{cat}.

1.3: Enzyme Inhibition: Competitive and non-competitive inhibitors and their kinetics; therapeutic applications of enzyme inhibitors.

1.4: Regulation of Enzyme Activity: Allosteric regulation and regulation by covalent modification of enzymes; Isozymes (LDH)

1.5: **Industrial applications of enzymes**: Food and detergents

Unit II: Homeostasis **(15L)**

Objective:

- *To introduce to the learner the concept of homeostasis-thermoregulation and osmoregulation*

Desired outcome:

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

2.1: Homeostasis

2.1.1: External and internal environment; Acclimation and acclimatization.

2.1.2: Body clock – Circadian & Diurnal rhythm.

2.2: Thermoregulation

2.2.1: Endothermy and ectothermy

2.2.2: Temperature balance: Heat production – shivering and non-shivering thermogenesis; Brown fat, Mechanisms of heat loss.

2.2.3: Adaptive response to temperature - daily torpor, hibernation, aestivation

2.3: Osmotic and Ionic Regulation

2.3.1: Living in hypo-osmotic, hyper-osmotic andterrestrial environment – Water absorption, salt water ingestion and salt excretion, Salt glands, Metabolic water

2.3.2: Role of kidney in ionic regulation

Unit III: Endocrinology **(15L)**

Objective:

- *To introduce to the learner the details of endocrine glands and its disorders.*

Desired outcome:

- *The learner shall understand the types and secretions of endocrine glands and their functions.*

3.1: General organization of mammalian endocrine system

3.2: Hormones: Classification, properties, mechanism of hormone action.

3.3: Histology, functions and disorders of the following endocrine glands:

- Pituitary
- Thyroid
- Parathyroid
- Pancreas
- Adrenal

Unit IV: Animal Tissue Culture **(15L)**

Objective:

- To *introduce to the learner the fundamental concepts of tissue culture and guide them progressively to certain areas of animal tissue culture.*

Desired outcome:

- *The learner shall understand the significance of tissue culture as a tool in specialized areas of research*
- *The learner will appreciate its applications in various industries.*

4.1: Aseptic techniques

4.1.1**:** Sterilization – basic principles of sterilization, importance of sterility in cell culture

4.1.2**:** Sterile handling – swabbing, capping, flaming, handling bottles and flasks, pipetting, pouring.

4.2: Culture media

4.2.1: Types of media – Natural and Artificial media

4.2.2: Balanced Salt Solutions

4.2.3: Complete Media – amino acids, vitamins, salts, glucose, oxygen supplements, hormones and growth factors, antibiotics

4.2.4: Factors influencing cell culture – surface tension and foaming, viscosity, temperature, osmolality, pH, CO_2, bicarbonate and O_2

4.3: Advantages of tissue culture – control of the environment, *in vitro* modelling of *in vivo* conditions

4.4: Limitations of tissue culture

4.5: Culture techniques

4.5.1: Preparation of cells/ organs for culture

4.5.2**:** Cover slip, Flask and Tube culture

4.5.3: Primary and established cell lines

4.5.4: Hybridoma technology

Course Code: USZO603:
Genetics and Bioinformatics
Course 17

Unit I: Molecular Biology **(15 L)**

Objectives:

- *To introduce learner to chemical and molecular processes that affect genetic material.*
- *To make learner understand the concept of DNA damage and repair, and how gene control is necessary for cell survival.*

Desired outcome:

- *Learner shall get an insight into the intricacies of chemical and molecular processes that affect genetic material.*
- *The course shall prepare learner to recognize the significance of molecular biology as a basis for the study of other areas of biology and biochemistry.*
- *Learner shall also understand related areas in relatively new fields of genetic engineering and biotechnology.*

1.1: Types of mutation

1.1.1: Point mutations – substitution, deletion and insertion mutations

Substitution mutations – silent (same-sense), missense and nonsense mutations, transition and transversion

Deletion and Insertion mutations – frameshift mutations

1.1.2: Trinucleotide repeat expansions – fragile X syndrome, Huntington disease

1.1.3: Spontaneous mutation – tautomeric shifts, spontaneous lesions

1.2: Induced mutations

1.2.1: Physical agents:

- Ionizing radiation (X-rays, α, β and γ rays)
- Non-ionizing radiation (UV light)

1.2.2: Chemical agents:

- Base analogs (5-bromouracil)
- Intercalating agents (ethidium bromide)
- Deaminating agents (nitrous acid)
- Hydroxylating agents (hydroxylamine)
- Alkylating agents (mustard gas)
- Aflatoxin (aflatoxin B_1)

1.3: Preventative and repair mechanisms for DNA damage

1.3.1: Mechanisms that prevent DNA damage – superoxide dismutase and catalase

1.3.2: Mechanisms that repair damaged DNA – direct DNA repair (alkyl transferases, photoreactivation, excision repair)

1.3.3:Postreplication repair – recombination repair, mismatch repair, SOS repair

1.4: Eukaryotic gene expression

1.4.1: Regulatory protein domains– zinc fingers, helix-turn-helix domain and leucine zipper

1.4.2**:** DNA methylation

Unit II: Genetic Engineering **(15 L)**

Objective:

- *To introduce learner to a set of techniques to modify an organism's genome to produce improved or novel genes and organisms.*

Desired outcome:

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

2.1: Tools in Genetic Engineering

2.1.1: Enzymes involved in Genetic Engineering: Introduction, nomenclature and types of restriction enzymes with examples, Ligases – *E. coli* DNA ligase, T4 DNA ligase, polynucleotide kinase, phosphatases, DNA polymerases, reverse transcriptase, terminal transferase

2.1.2: Vectors for gene cloning: General properties, advantages and disadvantages of cloning vectors - plasmid vectors (pBR322), phage vectors (λ Phage), cosmid vectors (c2XB)

2.1.3**:** Cloning techniques: Cloning after restriction digestion – blunt and cohesive end ligation, creation of restriction sites using linkers and adapters, cloning after homopolymer tailing, cDNA synthesis (Reverse transcription), genomic and cDNA libraries

2.2: Techniques in Genetic Engineering

2.2.1**:** PCR techniques: Principle of polymerase chain reaction (PCR), Applications of PCR

2.2.2**:** Sequencing techniques: DNA sequencing: Maxam-Gilbert method, Sanger's method Protein sequencing: Sanger's method, Edman's method Applications of sequencing techniques

2.2.3**:** Detection techniques: Blotting techniques – Southern blotting, Northern blotting and Western blotting Applications of blotting techniques

Unit III: Human Genetics **(15L)**

Objective:

- *To introduce learner with genetic alterations in human genome and their diagnosis.*

Desired outcome:

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

3.1: Non-disjunction during mitosis and meiosis

3.1.1**:** Chromosomal Aberrations: Structural: Deletion: types, effects and disorders;
Translocation: types: Robertsonian and non-Robertsonian disorders;
Inversion: types, effects and significance;
Duplication and their evolutionary significance (multigene families)
Numerical: Aneuploidy and Polyploidy (Autopolyploidy and Allopolyploidy)

3.2: Genetic Disorders

3.2.1**:** Inborn Errors of Metabolism: Phenylketonuria, G-6-PD deficiency, Alkaptonuria, Albinism

3.2.2**:** Single gene mutation: Cystic fibrosis

3.2.3**:** Multifactorial: Breast Cancer

3.2.4**:** Uniparental Disomy: Angelman Syndrome and Prader-Willi Syndrome

3.3: Diagnosis

3.3.1**:** Prenatal Diagnosis: Amniocentesis and Chorionic villus sampling, Banding techniques (G, C, Q), FISH, Protein truncation test (PTT),

3.3.2**:** Genetic counselling

Unit IV: Bioinformatics **(15L)**

Objective:

- *To introduce learner to bioinformatics – a computational approach to learning the structure and organization of genomes, phylogeny and metabolism.*

Desired outcome:

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

4.1: Introduction

4.1.1**:** Introduction to Bioinformatics and Bioinformatics web resource (NCBI, EBI, OMIM, PubMed)

4.1.2**:** Applications of Bioinformatics

4.2: Databases – Tools and their uses

4.2.1**:** Biological databases;
Primary sequence databases: Nucleic acid sequence databases **(**GenBank, EMBL-EBI, DDBJ) Protein sequence databases (UniProtKB, PIR)
Secondary sequence databases
Derived databases - PROSITE, BLOCKS**,**
Structure databases and bibliographic databases

4.3: Sequence alignment methods

4.3.1**:** BLAST, FASTA

Course Code: USZO604:
Environmental Biology and Zoopharmacognosy
Course 18

Unit I: Environment management **(15L)**

Objective:

- *Learner should understand different factors affecting the environment and various methods to improve environmental stewardship.*

Desired outcome:

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

1.1: Natural resources and their Classification

1.1.1: Forest resources, water resources (surface and ground) and mineral resources

1.1.2: Energy resources: renewable (solar, tidal, wind, biofuel) and non-renewable resources (coal, petroleum oil, natural gas).

1.2: Exploitation and Modification of Natural Resources: Impact on climate, flora and fauna

1.3: Waste Management

1.3.1: Technologies in solid waste management:

a) Traditional methods for solid waste management: Composting, Incineration, Landfill Recycling, Windrow composting

b) Modern methods for solid waste management: Anaerobic digestion, ethanol production, biodrying, pyrolysis, Upflow anaerobic sludge blanket (UASB) technology, waste autoclave

1.3.2: e-waste and hazardous waste (biological, chemical, medical and nuclear) management

1.4: Water management

1.4.1: Rainwater harvesting: Definition ways of harvesting, components, model of rain water harvesting: Rural and Urban, Advantages and disadvantages

1.4.2: Watershed management: Definition, need and objectives, classification (mini, micro, mili, sub-watershed, macro-watershed), Watershed management practices: Contour, gully control, stone bunds. Growing greenery and integrated watershed approach (IWA).

1.4.3: Case study: Ice-stupa artificial glaciers by Sonam Wangchuk

1.4.4: Effluent treatment, recycling plants, control and treatment of sewage water.

1.5: Acts and Rules of Environment Management

1.5.1: Environment Protection Act – 1986, Air (Prevention and Control of Pollution) Act – 1981, Water (Prevention and Control of Pollution) Act – 1974

1.5.2: Hazardous Wastes (Management and Handling) Rules – 1989

1.5.3: EIA (Environmental Impact Assessment)

1.5.4: Role of Central and State Government (Pollution Control Board) and NGOs

Unit II: Wildlife Management **(15L)**

Objectives:

- *To sensitize learner regarding the various threats to the wildlife*
- *To introduce learner various ways that can help in the protection, conservation, management, and enhancement of wildlife populations and habitat.*

Desired outcome:

- *Learner will be able to understand various methods for wildlife conservation.*
- *Learner will be able to apply knowledge to overcome the issues related to wildlife conservation and management.*

2.1: Habit, Habitat, Territory and Niche of Wild Animals: Herbivores, carnivores, solitary, social (flock, pod, community), pack and herd, types of habitats and territories, niche concept

2.2: Threats to Wildlife

2.2.1: Poaching and hunting, deforestation, encroachment, competition (intra-specific and inter-specific), overgrazing and climate change, diseases (zoonosis and reverse zoonosis)

2.2.2: Tourism and human animal conflict

2.3: Wildlife Conservation

2.3.1: Techniques and methods used for wildlife census: Aerial counts, camera trap, line transect census and track surveys, capture mark recapture method, wildlife radio telemetry

2.3.2: Forest management, policies and Acts: Harvesting Trees, Thinning harvest, Clearcut Harvest, Shelterwood harvest, Seed tree harvest, Group selection harvest, Single-tree selection harvest, Prescribed burning, Reforestation

2.3.3: Forest policy 1894, 1952, 1988; The Indian Forest Act, 1927; Forest (Conservation) Act, 1980.

Unit III: Bioprospecting and Zoopharmacognosy **(15L)**

Objectives:

- *To introduce the learner to the concepts of bioprospecting and zoopharmacognosy.*
- *Learner will be made aware of the process of discovery and commercialization of new products based on biological resources.*
- *To introduce learner with various ethological aspects by which non-human animals apparently self-medicate themselves.*

Desired outcome:

- *Learner will understand the paradigms of discovery and commercialization of biological resources and knowledge gained by self-medication by animals.*

3.1: Bioprospecting

3.1.1: Traditional and modern bioprospecting, economic value of bioprospecting

3.1.2: Bioprospecting and conservation, advantages and disadvantages

3.2: Zoopharmacognosy

3.2.1: Definition and types

3.2.2: Self-medication and its mechanism

3.2.3: Methods of self-medication through:

a) Ingestion- ants and mammals
b) Geophagy- invertebrates and birds
c) Absorption and adsorption

3.2.4: Applications – Social and trans-generational aspects of insects, birds and mammals

3.2.5: Contribution to human medicines

Unit IV: Zoogeography **(15L)**

Objectives:

- *To introduce learner to the geographic distribution (present and past) of animal species.*
- *To introduce learner to various ways by which animals distributed.*

Desired outcome:

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

4.1: Introduction: Plate tectonics and continental drift theory

4.2: Animal Distribution and Barriers

4.2.1: Patterns of animal distribution – continuous, discontinuous, isolation and bipolarity

4.2.2: Barriers of distribution –Topographic, climatic, vegetative, large water masses, land mass, lack of salinity and special characteristic habit (homing instinct).

4.2.3: Means of dispersal – land bridges, natural rafts and drift wood, favouring gales, migration by host, accidental transportation and by human agencies

4.3: Zoogeographical Realms: Palearctic, Ethiopian, Oriental, Australian, Neotropical, Nearctic and Antarctic

Practical Syllabus for Semester VI
Course code: USZOP06: COURSE 15

1. Group Protochordata

- Subphylum Urochordata
  - Class Larvacea e.g. *Oikopleura* (Sea squirt)
  - Class Ascidiacea e.g. *Ciona* (Transparent Sea squirt)
  - Class Thaliacea e.g. *Salpa* (Common salp)

- Subphylum Cephalochordata
  - Class Leptocardii e.g. *Branchiostoma* (*Amphioxus*)

- Subphylum Vertebrata: Division Agnatha
  - Class Ostracodermi e.g. *Pharyngolepis*
  - Class Cyclostomata e.g. *Petromyzon* (Lamprey)

2. Division Gnathostomata

- Superclass Pisces:
  - Class Placodermi e.g. *Bothriolepis*
  - Class Chondrichthyes e.g. *Rhinobates* (Guitar fish), *Chimaera* (Rabbitfish or ghost shark)
  - Class Osteichthyes e.g. *Protopterus, Clarius* (Catfish)
- Superclass Tetrapoda:
  - Class Amphibia e.g. *Alytes* (Midwife toad) and *Triton* (Salamander)
  - Class Reptilia e.g. *Varanus* (Monitor lizard) and *Crocodylus* (Crocodile)

3. Class Aves: Examples: *Eudyptes* (Penguin), *Phoenicopterus* (Flamingo) and *Gyps* (Vulture)

4. Class Mammalia: Examples: *Dasyurus* (Quoll), *Petaurista* (Flying squirrel) and *Macaca* (Monkey).

5. Study of Shark with the help of diagram / Photograph / Simulation whichever possible. No animal shall be dissected.

a) Digestive system
b) Heart and Aortic arches
c) Urinogenital System
d) Endoskeleton of shark:
   i. Axial – Skull and vertebral column
   ii. Appendicular – Pelvic and pectoral fins, pelvic and pectoral girdle

6. Visit to fish market / Aquarium / Zoo/ National Park / Local Gardens and available niche / / Sanctuaries / and such other places in Maharashtra and / or India and / or abroad to observe chordates and prepare a report.

Course code: USZOP06: COURSE 16

1. Effect of varying pH on activity of enzyme Acid Phosphatase
2. Effect of varying enzyme concentration on activity of enzyme Acid Phosphatase
3. Effect of varying substrate concentration on activity of enzyme Acid Phosphatase
4. Effect of inhibitor on the activity of enzyme Acid Phosphatase
5. Separation of LDH isozymes by agarose / polyacrylamide gel electrophoresis
6. Histology of glands: T.S. of pituitary, thyroid, parathyroid, pancreas, adrenal.
7. Instruments for tissue culture- Autoclave, Millipore filter, CO_2 incubator, Laminar air-flow. (Principle & use)
8. Packaging of glassware for tissue culture.
9. Aseptic transfer techniques.
10. Trypsinization and vital staining using Trypan blue stain.

Course code: USZOP06: COURSE 17

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

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

Course code: USZOP06: Course 18

1. Estimation of phosphates from sample water.
2. Estimation of BOD from sample water.
3. Estimation of COD from sample water.
4. Estimation of Nitrates from sample water.
5. Estimation of acidity and alkalinity of sample water by methyl orange and phenolphthalein indicator.
6. Comparative study of sound intensity in different places by Decibel meter.
7. Study of bioprospecting:
   a. Tumour suppression compounds e.g. Sponge
   b. Skin erythema treatment from gel
8. Study of Zoopharmacognosy in ants, cats, elephants and dogs.
9. Indicate the distribution of fauna in the world map w.r.t. to its realm and comment on the pattern of distribution.
   a. Palearctic: Giant Panda and Japanese Macaque
   b. Ethiopian: Common ostrich and African bush elephant
   c. Oriental: Indian one-horned Rhinoceros and Gharial
   d. Australian: Platypus and Red Kangaroo
   e. Neotropical: Guanaco and South American Tapir
   f. Nearctic: Virginia opossum and Sea otter
   g. Antarctic: Emperor Penguin and Antarctic Minke Whale
10. Long Excursion (Study tour / Visit) to Zoo / Sanctuary / National park / Research institute and submit a report.

References and Additional Reading for Semester VI

Course 15

REFERENCES

- Modern text book of Zoology – Vertebrates; Professor R.L. Kotpal; Rastogipublication; Third Edition 2012.
- Vertebrate Zoology for Degree students; V. K. Agarwal; S. Chand Publication; 2012.
- Fundamentals of Zoology, Dr. K. C. Ghosh and Dr. B. Manna, New Central book Agency (P) Ltd.
- Chordate Zoology Volume II, Prof. N. Arumogam. Saras Publication.
- Chordate Anatomy Mohan P. Arora, Himalaya Publishing House, First edition.
- Chordate Zoology, E. L. Jordan, P.S. Verma, S. Chand & Company Ltd.
- The life of Vertebrates; J.Z. Young; ELBS - Oxford University Press; Third edition, 2006
- Textbook of chordate Zoology, Vol. II, G.S. Sandhu, H. Bhaskar; Campus Book International, First edition, 2005.
- Introduction to Zoology – Vol II: K. K. Chaki, G. Kundu and S. Sarkar, New Crystal Book Agency.
- URL for search on net: https://www.amazon.com/Protozoology-Susheel-Vilas-Nikam/dp/9350300044
- Chordate Zoology by E. L. Jordan and P. S. Verma, edition,2009, Chand publications
- Chordate Zoology by P. S. Verma, edition,2009, Chand publications
- Modern Textbook of Zoology Vertebrates by R.L. Kotpal, edition Jan 2015, Rastogi publications
- Practical Zoology: Vertebrate, by S. S. Lal, 2015
- A Textbook of Invertebrate Zoology & Cell Biology, by V. S. Kanwate, A. N. Kulkarni et al. ed. Alka Prakashan
- The Animal Kingdom: An Elementary Textbook in Zoology; Specially Classified and Arranged for the Use of Science Classes, Schools and Colleges (Classic Reprint), by Ellis A. Davidson, Sept. 2015, Publisher: Forgotten Book.

ADDITIONAL READING

- http://faculty.college-prep.org/~bernie/sciproject/project/Kingdoms/Animal%20Kingdom%20-%205/Local%20copy/classification/chordata.html
- http://www.ucmp.berkeley.edu/chordata/chordata.html
- http://animaldiversity.org/accounts/Chordata/
- https://www.earthlife.net/inverts/chordata.html
- http://www.nhc.ed.ac.uk/index.php?page=493.450
- https://manoa.hawaii.edu/exploringourfluidearth/biological/invertebrates/phylum-chordata
- http://www.nhptv.org/wild/chordata.asp
- https://www.shapeoflife.org/phylum-chordata-advanced

Course 16

REFERENCES

- Comparative Animal Physiology; Knut Schmidt Nielson; Cambridge Press
- Comparative Animal Physiology; Prosser and Brown
- Comparative Animal Physiology; William S Hoar

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

ADDITIONAL READING:

- A textbook of Enzymes: Shailendra Singh; Campus Book International, New Delhi 2007.
- Biochemical Adaptation: Mechanism and Process in Physiological Evolution: Peter W. Hochachka& George N. Somero, Oxford University Press.
- Comparative Animal Physiology: P. C. Withers, Thomson Publishing Co.
- Mammalian Endocrinology: Ashoke Kumar Boral. New Central Book Agency Ltd
- Endocrinology-Hormones and Human Health: Prakash S. Lohar, MJP Publishers, Chennai. 2005
- Biotechnology-an introduction: Second Edition: S. Ignacimuthu, S. J, Narosa Publications.
- Animal Biotechnology: R. Sasidhara, MJP Publishers, Chennai. 2006

Course 17
REFERENCES

- Genetics – The continuity of life; Daniel Fairbanks and Ralph Andersen; Brooks/ Cole Publishing Company; 1999
- Introduction to Molecular Biology; Peter Paolella; Tata McGraw Hill; 2010
- Molecular Biology; David Freifelder; Narosa Publishing House; 2008
- Genetics; Robert Weaver and Philip Hedrick; McGraw Hill; 2001
- iGenetics – A Molecular Approach; Third Edition; Peter J. Russell; Pearson Education, Inc. (Benjamin Cummings), San Francisco; 2010
- Molecular Biology – Academic Cell Update; Update Edition; David Clark; Elsevier, Inc.; 2010
- Genetics; M.W. Farnsworth; Harper and Row Publishers, Inc., USA; 1978
- Principles of Genetics; Eighth Edition; Gardner, Simmons and Snustad; John Wiley and Sons (Asia) Pte. Ltd., Singapore; 2002

- The Science of Genetics – An Introduction to Heredity; Fourth Edition; George W. Burns; Macmillan Publishing Co., Inc., New York; 1980
- Molecular Biology – Bios Instant Notes; Fourth Edition; Alexander McLennan, Andy Bates, Phil Turner & Mike White; Garland Science; 2013
- https://www.ncbi.nlm.nih.gov/books/
- Current Protocols in Molecular Biology; Frederick M. Ausubel, Roger Brent, Robert E. Kingston, David D. Moore, Seidman J. G., John A. Smith and Kevin Struhl; John Wiley& Son, Inc.; 2003
- Introduction to Proteomics; Daniel C. Liebler; Humana Press; 2002
- Molecular cloning; Joseph Sambrook, David William Russell; Third Edition; CSHL Press; 2001
- Gene Cloning – An Introduction; Brown .T.A; Fourth Edition; Wiley-Blackwell; 2011
- Recombinant DNA - Genes and Genomes- A short course; 3rd Edition; Watson, J.D., Myers, R.M., Caudy A., Witkowski, J.K.; Freeman and Co. NY; 2007
- Principles Of Gene Manipulation & Genomics; Primrose SB and R. Twyman; Blackwell Science Publications; 2006
- Methods In Enzymology, Vol 152; Berger SI, Kimmer AR; Academic Press; 1987
- Genomes 3; Third Edition; T.A.Brown; Garland Science Publishing; 2007
- Molecular Biotechnology - Principles and applications of recombinant DNA; Glick, B.R. and Pasternak, J. J.; ASM press, Washington; 2010
- Microbiology; Fifth Edition; Pelczar, M.J. et al; Tata McGraw-Hill Co., New Delhi; 2001
- Introduction to Protein Structure; Second Edition; Branden C. and Tooze J.; Garlan Publishing; 1999
- Proteins; Second Edition; Creighton T.E.; W.H. Freeman; 1993
- Proteomics - Protein Sequence to Function; Pennington, S.R and M.J. Dunn; Viva Books; 2002
- Genetic engineering – Principles and Practice; Sandhya Mitra; Macmillan India Ltd., New Delhi
- Biotechnology – Fundamentals and Applications; Third Enlarged Edition; S.S. Purohit; Student Edition, Jodhpur; 2005
- Biotechnology – Expanding Horizons; B.D.Singh; Kalyani Publishers, Ludhiana
- A textbook of Biotechnology; R.C.Dubey; S.Chand and Company Ltd., New Delhi
- Cell and Molecular Biology; Eighth Edition; E.D.P. De Robertis, E.M.F. De Robertis Jr.; Info-Med Ltd.; 1988
- Genetics (Bios Instant Notes); Third Edition; G.I. Hickey, H.L. Fletcher and P. Winter; Taylor and Francis Group, New York; 2007
- Genetics – A Conceptual Approach; Third Edition; Benjamin A. Pierce; W.H. Freeman and Company, New York; 2008
- New Clinical Genetics; Second Edition; Andrew Read and Dian Donnai; Scion Publishing Ltd., UK; 2011
- Genetics; Third Edition; Robert F. Weaver and Philip W. Hedrick; Wm. C. Brown Publishers (The McGraw-Hill Companies, Inc.); 1997
- Human Molecular Genetics; Fourth Edition; Tom Strachan and Andrew Read; Garland Science, USA; 2011
- Genetics; M.W. Farnsworth; Harper and Row Publishers, Inc., USA; 1978
- Human Genetics – An Overview; Alice Marcus; Narosa Publishing House; 2010
- The Science of Genetics – An Introduction to Heredity; Fourth Edition; George W. Burns; Macmillan Publishing Co., Inc., New York; 1980

Course 18

REFERENCES

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

ADDITIONAL READING

- Environmental Management: Principles and Practice by Christopher J. Barrow -
- Introduction to Environmental Management by Mary K. Theodore and Louis Theodore
- Effective Environmental Management: Principles and Case Studies by Rory Sullivan and Hugh Wyndham
- Solid Waste Management: Principles and Practice by Ramesha Chandrappa, Diganta Bhusan Das
- Solid Waste Management: An Indian Perspective by M. S. Bhatt and Asheref Illiyan
- Solid Waste Management by Subhash Anand
- Watershed Management by Vijay P. Singh and Ram Narayan Yadava
- Watershed Management by J. V. S. Murty
- Water Resources, Conservation and Management by S.N. Chatterjee
- Watershed Management – By Madan Mohan Das, Mimi Das Saikia
- Concepts in Wildlife Management by B. B. Hosetti
- Wildlife Management Practices by James Durell

- Wildlife: management and conservation by M. M. Ranga
- Ecological Census Techniques: A Handbook By William J. Sutherland - 2006
- CRC Handbook of Census Methods for Terrestrial Vertebrates by Davis
- Selecting Wildlife Census by R. F. H. Collinson
- Forest Measurements: Fifth Edition by Thomas Eugene Avery and Harold E. Burkhart
- Techniques for wildlife investigations and management by Clait E. Braun, Wildlife Society
- Zoopharmacognosy by Jesse Russell, Ronald Cohn
- News Feature: Animals that self-medicate by Joel Shurkin
- Zoopharmacognosy and Herbal Pharmacology by Thomas H. Ingraham
- How Animals Heal Themselves: Self-Selection: Self-Selection: Giving Animals the Choice to Select Their Own Natural Medicines: Ingraham Applied Zoopharmacognosy by Caroline Ingraham
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4267359/
- Zoopharmacognosy: The Use of Medicinal Plants by Animals by Eloy Rodriguez and Richard Wrangham https://link.springer.com/chapter/10.1007/978-1-4899-1783-6_4
- http://www.calmercreatures.co.uk/zoopharmacognosy-dogs/
- Zoopharmacognosy, The Self-Medication Behavior Of Animals by Eraldo Medeiros Costa-Neto http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.940.6592&rep=rep1&type=pdf

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

N.B:

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

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

1) A Committee for the Purpose of Care and Supervision of Experimental Animals (CPCSEA) and
2) A Dissection Monitoring Committee (DMC) to ensure that no dissections are done.

Composition of DMC shall be as follows:

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

Use of animals for any experiment /dissection /mounting is banned. Simulations, authorized permanent specimens/slides, charts, models and other innovative methods are encouraged.

Scheme of Examination (Theory and Practical)

(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 (THEORY)

Time: 3 hours **Total marks: 100**

Q1	Based on Unit 1	20 marks
Q.2.	Based on Unit 2	20 marks
Q.3.	Based on Unit 3	20 marks
Q.4.	Based on Unit 4	20 marks
Q.5.	Based on all four Units	20 marks

***Internal option scheme shall be followed from time to time as per university guidelines for T. Y. B. Sc.**

T. Y. B.Sc. Zoology: Semester V (Practical)
Course Code: USZOP05: Course 11

Skeleton of Practical Examination Question Paper

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1	Sepia: Sketch and label _____ system. (Digestive / Reproductive system / Nervous system) **OR** Identify and Describe: a, b & c (Jaws / Radula / Chromatophores / Spermatophores / Statocyst) **OR** Perform virtual dissection of _____ system.	09
Q.2.	Identify and classify giving reasons: a) Protozoa / Porifera / Cnidaria b) Platyhelminthes / Nematoda c) Annelida / Arthropoda d) Mollusca / Echinodermata	12
Q.3	Identify, classify and describe a) Acanthocephala/ Chaetognatha / Onychophora b) Hemichordata c) Observe the animal* (photo/existing preserved specimen) and identify phylum giving reasons. *A suitable animal which is not prescribed in the syllabus	09
Q.4	Field report – Submission and Discussion	10
Q.5	Viva voce	05
Q.6	Journal	05

T. Y. B.Sc. Zoology: Semester V (Practical)
Course Code: USZOP05: Course 12

Skeleton of Practical Examination Question Paper

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1 Enumerate erythrocytes in the given sample and comment on clinical condition. 15

OR

Q.1 Enumerate leucocytes in the given sample and comment on clinical condition.

OR

Q.1 Present a report on differential count of leucocytes and comment on clinical condition.

Q.2 Estimate total plasma proteins by Folin's method. 10

OR

Q.2 Estimate serum/plasma total triglycerides by Phosphovanillin method.

Q.3 Estimate haemoglobin by Sahli's acid haematin method. 10

OR

Q.3 Record Erythrocyte Sedimentation Rate by Westergren / Wintrobe method.

OR

Q.3 Determine serum LDH by colorimetric/spectrophotometric method.

Q.4 Perform Latex agglutination test – Rheumatoid Arthritis. 05

OR

Q.4 Record bleeding/clotting time and comment on clinical significance.

Q.5 Viva voce 05

Q.6 Journal 05

T.Y.B.Sc. Zoology: Semester V (Practical)
Course Code: USZOP05: Course 14

Skeleton Question Paper for Practical Examination

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1	Make a temporary mounting of chick embryo (up to 48 hours)	10
Q.2	Identify and describe a) and b) Based on integumentary system c) and d) Based on forelimb muscle e) and f) Based on hindlimbs muscle g) and h) Based on osteology – human axial skeleton i) Based on osteology – human appendicular skeleton j) Chick embryo up to 72 hours	30
Q.3	Viva-voce	05
Q.4	Journal	05

T. Y. B.Sc. Zoology: Semester VI (Practical)
Course Code: USZOP06: Course 15

Skeleton of Practical Examination Question Paper

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1	Identify, classify giving reasons a) Urochordata / Cephalochordata / Ostachodermi / Cyclostomata b) Observe the animal* (photo/existing preserved specimen) and state its class giving reasons. * The animal should be other than prescribed in the syllabus	06
Q.2.	Identify, classify and describe a) Pisces b) Amphibia c) Reptilia d) Aves e) Mammalia	15
Q.3	Study of shark with the help of Specimen / Photograph / Simulation (Digestive system / Urinogenital system / Heart and aortic arches)	06
Q.4	Identify, sketch and label / Identify and describe marked portion in given diagram Skull or vertebra of shark / Fin of shark (Pectoral / Pelvic) / Girdle of shark (Pectoral / Pelvic)	03
Q.5	Field report – Submission and Discussion	10
Q. 6	Viva Voce	05
Q.7	Journal	05

T. Y. B.Sc. Zoology: Semester VI (Practical)
Course Code: USZOP06: Course 16

Skeleton of Practical Examination Question Paper

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1 Demonstrate the effect of _____ on the activity of acid phosphatase (Substrate concentration / pH variation / Enzyme concentration / Inhibitor concentration) 15

OR

Q.1 Perform trypsinization and show the isolated cells using suitable vital stain.

Q.2 Separate LDH isozymes from the given sample by agarose / polyacrylamide gel electrophoresis 10

OR

Q.2 Demonstrate the packaging of glassware for tissue culture (any 3)

OR

Q.2 Demonstrate the technique of aseptic transfer.

Q.3 Identify and describe a, b, c, d, e 15

a to d: Slides / Photographs of T.S of Pituitary, thyroid, parathyroid, pancreas, adrenal (any 4)

e: Any one instrument – Autoclave, Millipore filter, CO_2 incubator, Laminar air-flow.

Q.4 Viva voce 05

Q.5 Journal 05

T. Y. B.Sc. Zoology: Semester VI (Practical)
Course Code: USZOP06: Course 17

Skeleton of Practical Examination Question Paper

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1	Isolation & Estimation of RNA by Orcinol method. **OR** Isolation & Estimation of DNA by Diphenylamine method.	15
Q.2	Separation of Genomic DNA by Agarose gel electrophoresis. **OR** Colorimetric estimation of proteins from given sample by Folin's method.	09
Q.3	Problems (two) based on Restriction endonucleases. **OR** Calculation of mitotic index from the photograph or stained preparation of onion root tip or cancer cells. **OR**	08
Q.3a	Analyse the given syndrome and comment on numerical and/or structural variations in chromosomes.	04
Q.3b	Interpretation of a genetic formula.	04
Q.4	Demonstrate the use of bioinformatics tool: BLAST for nucleotide sequence comparison. **OR** Databases at NCBI for querying a nucleotide/protein sequence with the help of suitable operator. **OR** PubMed for downloading a research paper of interest with the help of suitable operator.	08
Q.5	Viva voce	05
Q.6	Journal	05

T.Y. B.Sc. Zoology: Semester VI (Practical)
Course Code: USZOP06: Course 18

Skeleton Question Paper for Practical Examination

Time: 9.30 am. To 2.30 pm. **Total Marks: 50**

Q.1	Estimation of BOD / COD / nitrates from the given water sample	10
Q.2	Estimation of phosphates / acidity / alkalinity of sample water.	08
Q.3	Identification a) Based on bioprospecting (*Sponge / Aloe ferox / Aloe vera*) b) Zoopharmacognosy (any one – ants, cats, elephants and dogs)	06
Q.4	Identify the given animals (any 2) with respect to their realms and comment.	06
Q.5	Study tour Visit Report – Submission and Discussion.	10
Q.7	Journal	05
Q.6	Viva voce	05

Research Project (Optional)

There shall be a component of Research Project which will be optional, catering to the needs of advanced learners and the students desirous of perceiving higher studies and / or career in research. Since research component is optional, its credits are in addition to the credits otherwise allotted to B. Sc. program in Zoology. The credits of Research Project shall therefore be considered as additional credits performance of which shall be separately evaluated. Needless to say that the marks / GPA / grade obtained by the student in the Research Project shall appear separately in the marksheet or shall be certified separately by the University in both the semesters viz. Semester V and Semester VI. These marks / GPA / grade points shall not be added to the total / grand total and shall not be considered for class / GPA / grade / merit / rank of the University. Research Project shall be evaluated at practical examination by the examiners in both the semesters, by dividing the candidates equally for each examiner irrespective of practicals based on Course 11, 12, 13, 14 / 15, 16, 17, 18. The students may seek guidance from a mentor who could be a teacher from his college or any other college or from the industry though it is not mandatory since Research Project done by the student independently shall also be assessed. Assessment will be based on file in Semester and hard bound dissertation in Semester VI submitted by the student and viva voce conducted by the examiner, details of which shall be as follows:

In semester V the students will submit an outline / scheme of the project proposal to be evaluated by the external examiner as per the following criteria:

Title	**Marks**
Literature Search / Survey	06 marks
Objectives, Purpose and Rationale	06 marks
Materials and Methods	06 marks
Expected outcome / Hypothesis	05 marks
Bibliography	05 marks
Work plan	06 marks
Relevance	06 marks
Viva voce based on the proposal	10 marks
Total	**50 marks**

Actual execution / practical work of this project to be done only in semester VI. Evaluation of which will be done by any external examiner during practical examination for Semester VI. The external examiner will evaluate the 'Dissertation' carrying 30 marks as per the evaluation criteria given below:

Title	**Marks**
Abstract / Synopsis	05 marks
Materials and Methods	05 marks
Observations	05 marks
Interpretation of Results	05 marks
Conclusion and Discussion	05 marks
Relevance of work	05 marks
Total	**30 marks**

The external examiner will evaluate the 'Power point presentation' carrying 20 marks as per the evaluation criteria given below:

Title	Marks
Content of the presentation	05 marks
Quality of the presentation	05 marks
Presentation skills	05 marks
Viva /Question- Answer session	05 marks
Total	**30 marks**

The credits of Research Projects which are additional, may be transferred to other programs and post graduation program wherever applicable and permitted by the ordinances and if desired by the student.