AC/14.8.19/RS 1

SIES College of Arts, Science & Commerce

RISE WITH EDUCATION

Sion (West), Mumbai – 400022

(Autonomous)

Faculty: Science

Program: S.Y.B.Sc.

Subject: ZOOLOGY

Academic Year: 2019 – 2020

Credit Based Semester and Grading System approved by Board of Studies in Zoology to be brought into effect from June 2019

S. Y. B. Sc. Zoology Syllabus (Autonomous)

Semester III and Semester IV

(Credit Based Semester and Grading System, with effect from academic year 2019-20)

Preamble

"I cannot teach anybody anything, I can only make them think."– Socrates

With the institution entitled for Academic Autonomy, thus entails for academic freedom. This opens an avenue to refashion and refine the curriculum, which is one of the hallmarks of academic excellence. This syllabus is an attempt to appreciate Zoology in its fundamental and applied forms. This syllabus is also designed to inculcate an interdisciplinary approach amongst students by making them explore the world of Biochemistry, Biophysics and Bioinformatics. It is a syllabus designed to provide a must-have knowledge that will open the doors for scientific discovery in students.

Some of highlights of this syllabus include:

- ✓ *Origin and Evolution and Development Biology will help students understand how the processes and mechanisms related to Evolution are phenomena connected to Developmental Biology.*
- ✓ *Molecules and Life, Metabolism and Energy reveal the intricate chemical reactions which sustain life, and thereby will help students appreciate the fact that the same principles/ laws govern the physical and the living worlds.*
- ✓ *Economic Zoology (Entomology and Animal Husbandry) that may inspire the entrepreneur in students.*
- ✓ *Research methodology nurturing deep thinking, an inclination for scientific investigation and developing analytical skills. Also, acquainting students with the ethics in engaging science-related issues for the welfare of the society.*
- ✓ *Biotechnology and Bioinformatics – involving tools and techniques besides the application of computers, to keep pace in this technologically-driven world.*

This syllabus is a collective and constructive effort of the professors of Zoology at SIES College, Sion (West) and other board members from outside the institution. The comments and recommendations of the contributors and reviewers have been carefully considered and implemented wherever feasible. It was approved by the Board of Studies in the meeting held on 27th April 2019 at the institution's department of Zoology.

Through implementation of this syllabus, we expect students to recognize the links between the various aspects/ topics of the subject that is crucial in gaining a better understanding and in application of the subject. In conclusion, we hope this syllabus will encourage and maximize learning among students to develop open, inquiring minds.

Dr. Satish Sarfare
Chairman,
Board of Studies in the subject of Zoology

S. Y. B. Sc. Zoology Syllabus (Autonomous)
Credit Based Semester and Grading System
(With effect from academic year 2019-20)

Grid of Syllabus – Semester III

Theory				
Paper Code	**Unit No.**	**Unit Name**	**Credits**	**Lectures/week**
SIUSZO31	1	Wonders of Animal Kingdom – Invertebrate Life	2	1
	2	Developmental Biology		1
	3	Origin of Life and Evolution		1
SIUSZO32	1	Molecules and Life	2	1
	2	Metabolism and Energy		1
	3	Genetics		1
SIUSZO33	1	Introduction to Parasitology and Protozoan Parasites	2	1
	2	Economic Entomology		1
	3	Animal Husbandry – Vermiculture, Poultry, Goat farming		1
Practical				
SIUSZOP31	Based on SIUSZO31 (Practical I)		1	3
SIUSZOP32	Based on SIUSZO32 (Practical II)		1	3
SIUSZOP33	Based on SIUSZO33 (Practical III)		1	3
Total			**9**	**18**

Grid of Syllabus – Semester IV

Theory				
Paper Code	**Unit No.**	**Unit Name**	**Credits**	**Lectures/week**
SIUSZO41	1	Wonders of Animal Kingdom – Chordate Life	2	1
	2	Cellular Organization		1
	3	Basic Concepts in Research		1
SIUSZO42	1	Molecular Biology	2	1
	2	Biotechnology		1
	3	Bioinformatics		1
SIUSZO43	1	Helminth Parasitology	2	1
	2	Fishery Science		1
	3	Animal Husbandry –Sheep farming, Cattle farming, Dairy Science		1
Practical				
SIUSZOP41	Based on SIUSZO41(Practical I)		1	3
SIUSZOP42	Based on SIUSZO42 (Practical II)		1	3
SIUSZOP43	Based on SIUSZO43 (Practical III)		1	3
Total			**9**	**18**

Semester III – Theory

Paper Code: SIUSZO31
Invertebrate life, Developmental Biology, Evolution

Learning Objectives

- *To do an introductory survey of the diversity of animal life to understand that part of the world around us composed of animals. Also, to gain an insight on the evolutionary sequence of life from simpler to more complex ones.*
- *To acquaint the learner with key concepts of embryology, amazing processes Occur at the initial stages of the development that lead to formation of complex life form.*
- *To study evolutionary aspects to appreciate the phenomenon of how life made its way through the apparently lifeless conditions existing on the primitive earth, and to understand the importance of natural forces that have given a form and function to the present living world.*

Unit1: Wonders of Animal Kingdom – Invertebrate Life 15 Lectures

1.1 **Unicellular, Multicellular and Acoelomate/ Pseudocoelomate life**

1.1.1 Protozoa: Skeleton, reproduction, bioluminescence
1.1.2 Porifera: Canal systems, spicules, reproduction and regeneration
1.1.3 Coelenterata: Polymorphism; Coral reefs –Types and theories of formation
1.1.4 Platyhelminthes and Nemathelminthes: Parasitic adaptations

1.2 **Coelomate life**
1.2.1 Annelida: Metamerism and reproduction
1.2.2 Arthropoda: Crustacean larvae and metamorphosis in insects
1.2.3 Mollusca: Shell and torsion
1.2.4 Echinodermata: Water vascular system and echinoderm larvae

Unit2: Developmental Biology 15 Lectures
2.1 Acquisition of multicellularity – Signaling in *Dictyostelium*
2.2 Fertilization and parthenogenesis
2.3 Eggs and Cleavage
2.3.1 Types of eggs
2.3.2 Types of cleavage
2.4 Blastulation: Types of blastula with examples: amphibian, avian and mammalian
2.5 Gastrulation: epiboly, emboly, invagination, involution and infiltration
2.6 Fate of three germ layers and coelom formation
2.7 Maternal genes, segmentation genes, Homeotic genes in early development in *Drosophila*
2.8 Aging

Unit3: Origin of Life and Evolution 15 Lectures
3.1 Origin of Life
3.1.1 Origin of universe
3.1.2 Chemical evolution: Haldane and Oparin theory, Miller-Urey experiment

3.1.3 Origin of eukaryotic cell
3.2 Theories of Organic Evolution
3.2.1 Theory of Lamarck
3.2.2 Theory of Darwin and Neo-Darwinism
3.2.3 Mutation Theory
3.2.4 Modern Synthetic theory
3.2.5 Weismann's Germplasm theory
3.2.6 Neutral theory of Molecular evolution
3.3 Evolution
3.3.1 Genetic basis of evolution: Reproduction and significance of Meiosis;
3.3.2 Population Genetics: Gene pool, gene frequencies, Hardy-Weinberg equilibrium
3.3.3 Variations as raw material for Evolution; types of Variations, Mutation and Recombination
3.3.4 Elemental forces of Evolution: Migration (Gene flow),Mutation, Natural Selection and Genetic drift
3.3.5 Speciation: Modes of speciation; Types of isolation and isolating mechanisms
3.3.6 Concept of Macroevolution and Megaevolution

References:

Wonders of Animal Kingdom – Invertebrate Life

- Biological science, 3rd edition – D.J. Taylor, N. P. O. Green, G. W. Stout. Cambridge University press, Low priced edition.
- Zoology – S. A. Miller and J. B. Harley, Tata McGraw hill
- Biology – Silvia S. Maddor, W.C.B. Publications
- Modern text book of Zoology – Invertebrates; Eleventh Edition; Professor R.L. Kotpal; Rastogi publication
- 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.
- Invertebrate Zoology for Degree students; V. K. Agarwal; S.Chand Publication; 2012
- Invertebrate Zoology - Vol 1; Parker and Haswell
- Biology of Invertebrates; Fourth Edition; J.A.Pechnik; Tata McGraw Hill
- A textbook of Zoology; T.J.Parker&W.A.Haswell; MacMillan
- Invertebrate Zoology; Bares; Saunders
- Practical Zoology; Second Edition; Dr. K.C. Ghose& Dr. B. Manna; New Central Book Agency Pvt. Ltd. , Kolkata; 1999
- Text book of Invertebrates; N.C.Nair, S. Leelavathy, N. SoundaraPandian, T. Murugan, N. Arumugam; Saras Publication
- Invertebrate Zoology – A functional evolutionary approach; Seventh Edition; Edward E. Ruppert, Richard S. Fox & Robert D. Barnes; Cengage Learning India Ptv. Ltd.; 2004
- Invertebrate Zoology Volume II- Jordan and Verma; S. Chand and Co.
- Invertebrate Zoology- Majupuria T. C., NaginS.and Co.
- Invertebrate Zoology- Dhami P. S. and Dhami J. K., R. Chand and Co.
- Modern Textbook of Zoology, Invertebrates, Kotpal R. L.

Developmental Biology

- Developmental biology; Gilbert
- Developmental biology; Patten
- Developmental biology; Wolpert
- Text book of embryology; N. Arumugam
- Chicken Development – Embryology; W.H. Freeman & B. Bracegirdle

Origin of Life and Evolution

- Theory of Evolution- Smith, Cambridge Press, and Low price Ed.
- Evolution - Strickberger, CBS publication
- Evolution- P.S.Verma and Agarwal
- Introduction to Evolution by Moody
- Biology. E. P. Solomon, L. R. Berg, D. W. Martin, Thompson Brooks/Cole
- Biology -The Unity and Diversity of Life**.** C. Starr, R. Taggart, C. Evers, L. Starr, Brooks/Cole Cengage learning International Edition

Paper Code: SIUSZO32
Biochemistry and Genetics

- *To give learner insight into the structure of Organic and Inorganic molecules, and their role in sustenance of life.*
- *To give the learner a brief highlight of all the metabolic process of the body and the use of metabolic outcome ATP in the Growth and propagation of life.*
- *To understand the Non-Mendelian genetics - the chromosomes, and the role of genetics in sex determination and sex-linked inheritance, multiple alleles, linkage and, crossing over.*

Unit1: Molecules and Life **15 Lectures**

1.1 Water: The basic molecule of life

1.1.1 Molecular structure of Water: Tetrahedral geometry, hydrogen bonds and flickering clusters, macromolecular association

1.1.2 Physical and chemical properties of water in relation to life processes:

1.1.3 Density, specific heat, heat of vapourisation, heat of fusion, surface tension, hydrogen bonds with solutes, interaction with non-polar compounds, water as a reactant

1.1.4 Dissociation of water and ion product of water (K_w)

1.2 Acids, bases and buffers

1.2.1 pH, pH scale – Use of pH paper, Universal indicator and pH meter,

1.2.2 Dissociation of strong electrolytes

1.2.3 Acids and bases, dissociation of weak acids and weak bases, dissociation constant pK_a, Henderson-Hasselbalch equation; Titration curves of weak acids

1.2.4 Buffers and physiological buffers in biological systems

Unit 2: Metabolism and Energy **15 Lectures**

2.1 Concepts of Thermodynamics

2.1.1 An overview of Carbohydrate metabolism
Significant pathways of Carbohydrate metabolism

2.1.2 An overview of Lipid metabolism

2.1.3 An overview of Protein metabolism

2.1.3.1 Amino acid pool, essential and non-essential amino acids
2.1.3.2 Metabolism of amino acids – Transamination, deamination (Oxidative and Non-oxidative)
2.1.4 Ornithine cycle

Unit 3: Genetics **15 Lectures**

3.1 Sex determination
3.1.1 Methods of sex determination:
Chromosomal mechanisms – XX-XO, XX-XY and ZZ-ZW
Sex determination in honey bees: Haplodiploidy
Sex determination in Drosophila: Genic balance theory
3.1.2 Barr body and Lyon hypothesis of X chromosome inactivation
3.1.3 Environmental mechanism
3.2 Inheritance related to sex
3.2.1 Inheritance of X-linked genes
3.2.2 Inheritance of Y-linked genes
3.2.3 Inheritance of Z-linked genes
3.2.4 Sex limited genes
3.2.5 Sex influenced genes
3.3 Multiple Alleles:
3.3.1 Concept, definition, characters and symbolism
3.3.2 Coat colour in rabbit, eye colour and vestigial wing alleles in Drosophila
3.3.3 Inheritance of ABO blood groups and Rh factor in humans
3.4 Quantitative or Polygenic inheritance:
3.4.1 Concept, definition and characteristics
3.4.2 Skin colour, eye colour and height in humans, Milk gene in cow, Meat gene in Poultry
3.5 Linkage
3.5.1 Concept
3.5.2 Coupling and repulsion hypothesis
3.5.3 Chromosome theory of linkage and arrangement of linked genes
3.5.4 Types: Complete and incomplete
3.5.5 Linkage groups
3.6 Crossing over
3.6.1 Concept
3.6.2 Cytological evidence for crossing over
3.6.3 Mechanism, Types and factors affecting crossing over
Significance

References:

Molecules and Life / Metabolism and Energy

- Medical Biochemistry; Fourth Edition; John Baynes & Marek Dominiczak; Saunders (Elsevier); 2014
- Biochemistry; Fourth Edition; U. Satyanarayana & U. Chakrapani; Elsevier; 2013
- Biochemistry; Fifth Edition; Reginald H. Garrett & Charles M. Grisham; Brooks/ Cole (Cengage Learning); 2013

- Biochemistry; Fifth Edition; Reginald H. Garrett & Charles M. Grisham; Brooks/ Cole (Cengage Learning); 2013
- Biochemistry, Dushyant Kumar Sharma, 2010, Narosa Publishing house Pvt. Ltd.
- Fundamentals of Biochemistry, Dr AC Deb, 1983, New Central Book Agency Ltd.
- A Textbook of Biochemistry, 9thPP edition, Dr. Rama Rao A.V.S.S and Dr A Suryalakshmi.
- Biochemistry-G Zubay , Addison Wesley, 1983
- Biochemistry, L Stryer, 3rd/4th/5th ed, 1989 , Freeman and Co. NY
- Harper's Biochemistry,1996, 26thPP edition, Murray R.K. Granner D.K. Mayes P.A. Rodwell V.M. Hall international USA
- Outline of Biochemistry, 1976, E.E. Conn and P.K. Stumpf. John Wiley and Sons USA
- Principles of Biochemistry, 2005, 2ndPP and 3rdPP edn. Lehninger A.L. Nelson D.L. and Cox M.M
- Concepts in Biochemistry – Rodney Boyer
- Introduction to Practicals in Biochemistry – David Plummer

Genetics

- Genetics – Winchester Oxford IBH publication
- Principle of genetics - W. Sinnott, L.C. Dunn and Theodosius Dobzhansky, McGraw hill publication.
- Principles of Genetics. Gardner, E.J., Simmons, M.J and Snustad, D.P. John Wiley and Sons
- Concepts of Genetics. Klug, W.S., Cummings M.R., Spencer, C.A. Benjamin Cummings.
- Genetics- A Molecular Approach. Russell, P. J Benjamin Cummings.
- Genetics: Analysis of Genes and Genomes. Daniel L., Hartl, Elizabeth W. Jones Jones& Bartlett Publishers
- Introduction to Genetic Analysis. Griffiths, A.J.F., Wessler. S.R., Lewontin, R.C. and Carroll, S.B. W. H. Freeman and Co.
- Principles of Genetics – Eight edition- Eldon john Gardner, Michael J. Simmons, D. Peter Snustad
- Genetics- Weaver, Hedrick, third edition, McGraw Hill Education
- Genetics A Mendelian approach; Peter J.Russel, Pearson Benjamin Cummings
- Genetics A conceptual approach, Benjamin A. Pierce, Southwestern University, W.H. Freeman and company, New York
- Genetics, Third Edition, Monroe W. Strickberger
- 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
- Genetics – the continuity of life – Daniel Fairbanks and Anderson

Paper Code: SIUSZO33

Parasitology, Entomology and Economic Zoology

Learner's objective

- *To acquaint learners with the concepts of parasitism, their relationship with environment, make them aware about the modes of transmission of parasites.*
- *To acquaint the learner with general morphological, Anatomical and behavioral properties of the insects.*
- *To disseminate information on economic aspects of zoology like apiculture, vermiculture, dairy science.*
- *To encourage young learners for self-employment.*

Unit1: Introduction to Parasitology and Protozoan parasites 15 Lectures

1.1 Types of parasites and hosts

1.1.1 Parasites: ectoparasites, endoparasites, monogenetic, digenetic, temporary, permanent, extracellular parasites, intracellular parasites, facultative, accidental

1.1.2 Hosts: definitive, intermediate, paratenic, reservoir

1.1.3 Host-parasite relationship: Host specificity –

- Structural specificity
- Physiological specificity
- Ecological specificity

1.1.4 Protozoan parasites: Morphology, mode of infection, life cycle, pathogenicity, prophylaxis and treatment of–

- *Entamoeba histolytica*
- *Plasmodium vivax*
- *Trypanosoma gambiense*
- *Leishmania donovani*

Unit 2: Economic Entomology 15 Lectures

2.1 Honeybee: Social life and communication, life history, apiculture, economic importance

2.2 Lac insect: Life cycle, lac culture, composition and uses of lac

2.3 Silk moth: Life history, sericulture, economic importance

2.4 Life history and control measures of –

2.4.1 *Schistocera gregaria*

2.4.2 Aphids

2.4.3 *Sitophilus oryzae*

2.4.4 *Tribolium confusum*

2.5 Methods of insect control:

2.5.1 Chemical control–Synthetic and natural chemicals

2.5.2 Biological control(biotic controllers of insects) –*Bacillus thureingensis*, Entomophagus insects, Parasitic insects, insectivorous birds

Unit 3: Animal Husbandry – Vermiculture, Poultry, Goat farming 15 Lectures

3.1 Vermiculture

3.1.1 An introduction to different species of earthworms used in vermiculture

3.1.2 Methods of vermiculture

3.1.3 Maintenance and harvesting

3.1.4 Vermicompost

3.1.5 Economic importance of vermiculture

3.2 Poultry

3.2.1 Definition, nomenclature and breeds of fowl

3.2.2 Housing and equipments, brooding and rearing

3.2.3 Raising broilers

3.2.4 Factors affecting size of eggs, abnormal eggs, hatching of eggs

3.2.5 Poultry diseases – Coccidiosis, Avian flu

3.3 Goat farming

3.3.1 Importance of goat farming

3.3.2 Indigenous breeds and exotic breeds

3.3.3 Nutrition, prevention and treatment of diseases

3.3.4 Recent techniques to improve production

References

Introduction to Parasitology and Protozoan parasites

- Parasitology- K .D. Chatterjee Chatterjee Medical Publication, Kolkata
- Medical Parasitology A CD and T K. Dey Allied agency, Kolkata
- Animal Parasitism Clark P R Prentice Hall of India, New Delhi
- Textbook of Medical Parasitology-. C.K Jayaram Paniker, Jaypee Brothers
- A text book of Parasitology- Kochhar S.K. Dominant Pub. & Dis, New Delhi
- Essentials of Parasitology- Gerald and Schmidt: Universal Bookstall, New Delhi
- Parasitology- Sharma P.N.and Ratnu L.N., Chand S & Co. Pvt. Ltd.
- Introduction to Parasitology- Chandler and Read John Wiley & Sons
- Medical Parasitology- Arora

Entomology

- Handbook of Economic Zoology - Jawad A and Sina SPS. Chand and Co., New Delhi
- Destructive and Useful Insects Flint Tata Mcgraw Hill, New Delhi
- Biology of Insects- 1992 Saxena S. C. Oxford and IBH Publishing Co New Delhi, Bombay, Calcutta
- A Text Book of Entomology- 1974 Mathur V. K. and Upadhayay, K .Goel Printing press, Barani
- Bee and Bee Keeping- Roger A. Morse, Conell University Press London
- Imm's General Text book of Entomology – Vol. I & II; Richards O.W. & Davis R.F., B.I. Pul; Indian edition, New Delhi; 1993
- Principals of Insect Morphology; Snodgrass R.E.; Indian Reprint, SBS Pub., New Delhi; 1994
- Structure & functions of Insects; Third Edition; Chapman R.F.; ELBS, London; 1983
- Entomology; Gillott; Cedric Plenum Press, New York; 1980
- The Science of Entomology; Romoser W.S.; Second edition, Macmillan Co., New York; 1981

- General Entomology; Mani M.S.; Reprint Oxford – IBH, India; 1998
- An Introduction to Entomology; Srivastava R.D. & Singh R.P.; Concept Pub. New Delhi; 1997
- General & Applied Entomology; Nayar K.K., T.N. Anantkrishanan & B.V. David; Tata McGraw Hill Pub., New Delhi; 1983
- Insects; Mani M.S.; Reprint NBT Pub., New Delhi; 2006
- Applied Entomology; P.G. Fenemore & Alka Prakash; Wiley Eastern Ltd., 1992
- Entomology; M.S. Nalina Sundari& R. Santhi; MJP Publishers, Chennai; 2008
- Fundamentals of Entomology; Richard J. Elzinga; Prentice-Hall of India Ptv. Ltd., New Delhi; 1978
- General & Applied Entomology; Second Edition; V.A. Little; Harper & Row Publishers, Inc; 1967

Animal Husbandry – Vermiculture, Poultry, Goat farming

- Vermiculture Technology - Clive A. Edwards, Norman Q. Arancon and Rhonda Sherman
- A Handbook on Animal Husbandry ICAR Publication
- Live Stock and Poultry Production-Harbans Singh and Earl N More Prentice Hall of India, New Delhi
- A Textbook of Animal Husbandry - GC. Banerjee Oxford and IBH Publishing Co

Practical I (SIUSZOP31) based on SIUSZO31

1) Mounting of foraminiferan shells from sand
2) Observation of Binary fission and Conjugation in Paramoecium (Permanent Slides)
3) Observation of V. S. of Grantia and L. S. of Leucosolenia
4) Observation of Polymorphism: Obelia Colony and medusa, Physalia, Vellela, Porpita
5) Observation of Corals: Fungia, Madrepora, Meandrina [Brain Coral], Tubipora and Sea Fan.
6) Observation of Liverfluke: T. S. and its Larvae
7) Observation of Heteronereis and Trochophore Larva
8) Study of Crustacean Larvae: Nauplius, Cypris, Zoea, Megalopa, Alima, Mysis and Phyllosoma
9) Study of Metamorphosis in insect:
   a) Juvenile and adult of Lepisma
   Life history of
   b) House fly
   c) Mosquito (Culex or Anopheles)
   d) Beetle
   e) Butterfly
10) Study of shells in
   Mollusca:Chiton,Dentalium,Trochus,Placuna,Solen,Sepia,Nautilus,Sinistral and Dextral Shells
11) Study of Echinoderm larvae: Bipinnaria, Ohiopleuteus, Echinopleuteus, Auricularia, Doliolaria
12) Embryology:

a) Study of different types of eggs: Isolecithal, Mesolecithal, Telolecithal
b) Study of blastulae: Amphioxus, Frog, Mammal
c) Study of Gastrulae: Frog, Primitive streak, Section of primitive streak of chick embryo

13) Identification of:

a) Allopatric speciation (Cyprinodon species)
b) Sympatric speciation (hawthorn fly and apple maggot fly)
c) Parapatric speciation (Snail)

Practical II (SIUSZOP32) based on SIUSZO32

1) Study of pH meter: Principle and Working.
2) Preparation of buffer of different pH using Henderson-Hasselbalch equation
3) Preparation of titration curve for strong acid and strong base with the help of pH meter
4) Determination of pKa for weak acid
5) Study of Colorimeter:
   a) Principle and working
   b) Selection of best filter
   c) Determination of concentration using colorimeter
6) Estimation of the Blood glucose level using glucometer and using glucose estimation kit [GOD/POD method]
7) Mounting of Barr body
8) Problems in Genetics

Practical III (SIUSZOP33) based on SIUSZO33

1) Identification of Protozoan parasites: Entamoeba, Plasmodium, Trypanosoma, Leishmania
2) Economic entomology:
   a) Study of life cycle of honey bee and bee hive
   b) Mountings of honeybee –Mouth parts, Legs of honeybee, Sting apparatus
   c) Life cycle of Silk Moth
   d) Study of Harmful insect–Locust/Grasshopper, Aphids, Rice weevil, Flour beetle, Entomophagus insect –Dragonfly, Parasitic Insect – Ichneumon wasp.

3) Animal husbandry: Poultry – Layers (Leghorn),Broiler, Goat – Jamnapuri, Surti
4) Colorimetric estimation of protein in two different varieties of hen eggs (Country/ Farm) – Biuret or Folin – Lowry method (Std. graph to be provided or Concentration of the Std. to be given).
5) Colorimetric estimation of total lipids in the yolk of two different varieties of hen eggs(Country/Farm)–$FeCl_3$method.(Std. graph to be provided or Concentration of the Std. to be given)

Semester IV – Theory
Paper Code: SIUSZO41
Chordate life, Cell biology and Scientific research

Learning objectives

- *To do an introductory survey of the diversity of Chordate animal life, to understand that part of the world around us composed of animals. Also, to gain an insight on the evolutionary sequence of in vertebrate life from simpler to more complex ones, to which man himself belongs.*
- *To understand the basic functional unit of life the "cell", its structure, types and the general processes that occur inside the cell*
- *To develop scientific temperament, qualities such as critical thinking and analysis.*
- *To develop the skills of scientific communication, understand the ethical aspects of research*

Unit1: Wonders of Animal Kingdom – Chordate life 15 Lectures

1.1 Protochordata: Retrogressive metamorphosis in ascidians

1.2 Vertebrata

1.2.1 Pisces: Origin and evolution, Swim bladder, breeding and parental care

1.2.2 Amphibia: Origin and evolution, Neoteny and parental care in amphibians

1.2.3 Reptilia: Origin and evolution, Adaptive radiation in reptiles, Venomous and non-venomous snakes

1.2.4 Aves: Origin and evolution, Migration in birds

1.2.5 Mammalia: Origin and evolution, Egg laying mammals and marsupials, Aquatic mammals

Unit 2: Cellular Organization 15 Lectures

2.1 Plasma membrane

2.1.1 Structure and function

2.1.2 Importance of membrane fluidity and asymmetry

2.1.3 Membrane transport,passivediffusion,facilitatedtransport,activetransport, exocytosis and endocytosis

2.2 Cytoplasmic membrane system

2.2.1 Structure and functions of –Endoplasmic reticulum(smooth[SER] and rough[RER])

2.2.2 Structure and functions of Golgi complex

2.2.3 Structure and functions of Lysosomes (primary and secondary lysosomes)

2.3 Mitochondria

2.3.1 Structural organization

2.3.2 Chemical energy and ATP, Krebs cycle, electron transport system and oxidative phosphorylation

2.4 Nucleus

2.4.1 Structure of nucleus and nucleolus, nuclear pore and pore complex

2.4.2 Organization of chromatin and chromosomes

2.4.3 Giant chromosomes: Polytene and lamp brush chromosomes

Unit3: Basic Concepts in Research 15 Lectures

3.1 Science: A process of inquiry – a dynamic approach to investigation

3.1.1 Making observations, Forming and Testing hypothesis, Deductive and Inductive reasoning

3.1.2 Any case study in scientific inquiry (for example – Investigating coat colouration in mouse populations)
3.1.3 Experimental variables and Controls: experimental tests, controlled experiments, identifying important variables
3.2 Relevance of research: basic research, applied research, translational research
3.3 Research methodology: Scientific approach and attitude
3.4 Scientific writing: Writing a research article
3.4.1 Primacy of the research question, structure and components of research paper, common mistakes seen in manuscripts submitted to a journal
3.4.2 Writing an abstract, selection of keywords, citing references or bibliography (Numeric, Harvard and American Psychological Association **[**APA] style)
3.5 Peer review
3.5.1 Fundamental principle of high quality scientific publication
3.5.2 Systematic approach for critiquing a manuscript: reviewing the manuscript, writing your critique, writing your comments
3.6 Research ethics
3.6.1 Significance and compliance, conflict of interest, plagiarism
3.6.2 Overview of ethics in animal research or preclinical trials, Institutional Animal Ethics Committee (IAEC), Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) guidelines
3.6.3 Overview of ethics in clinical trials, Institutional Ethics Committee (IEC), Indian Council of Medical Research (ICMR) and International Conference on Harmonisation – Good Clinical Practice (ICH-GCP) guidelines

References:

Wonders of Animal Kingdom – Chordate life

- Vertebrate Zoology Volume I- Jordan and Verma S. Chand and Co.
- Chordate Zoology- Dhami P. S. and Dhami J. K. R. Chand and Co.
- Introduction to Vertebrates- Moore Cambridge University- Low Priced Edition.
- Zoology- Miller S. A. and Harley J. B., Tata McGraw Hill.
- Biological Science, Taylor D.J., Stout G.W., Green N.P.O, Soper R., Cambridge University Press.

Cellular Organization

- Cell Biology Genetics, Molecular Biology Evolution and Ecology; Verma P.S. and Agrawal P.K., 9thPP edition, S. Chand Publication, New Delhi.
- Cell Biology by Singh and Tomoar Rastogi Publication..
- Cell and molecular Biology E.D.P De Robertis and E.M.R Robertis ,CBS Publishers and Distributors
- The cell:A molecular Approach - GoeffreyM.Coper ASM Press Washington D.C.
- A textbook of cytology- SuruchiTyagi Dominant Publishers and Distributors NewDelhi.
- Cell Biology Pawar C.B. Himalaya publication
- Cell and Molecular Biology – DeRoberties
- Cell Biology – Gerald Karp

Basic Concepts in Research

- Research basics – Spickard James

- Research methods – McBurney, Donald
- Research design and methods – a process approach – Bordens, Kenneth
- Science Research Writing – For non-native speakers of English – Glasman, Hilary
- Research Methodology, Methods and Techniques- by C.R. Kothari, Wiley Eastern Ltd. Mumbai
- Practical research planning and design 2ndPP edition- Paul D Leedy, Macmilan Publication

Paper Code: SIUSZO42
Molecular biology, Biotechnology and Bioinformatics

Learning Objectives

- *To develop an interest to learn the chemical language of life i.e., the molecular basis of life.*
- *To keep pace with technology that merges biological concepts, for its application for the betterment of human life through the study of Biotechnology.*
- *To understand the role of computer in the field of biology and explore the Available databases of the nucleotides and protein sequences.*

Unit1: Molecular Biology **15 Lectures**

1.1 Central dogma of Molecular Biology
1.2 Transcription in prokaryotes: Initiation, elongation, termination of m-RNA, *E.coli* RNA polymerase
1.3 Differences in transcription in prokaryotes and eukaryotes
1.4 Posttranscriptional modifications: Capping, tailing, splicing (intron and exon)
1.5 Genetic code: Properties, salient features, Wobble hypothesis, Base ambiguity symbols, Single letter code
1.6 Structureandchemicalcompositionofprokaryoticandeukaryoticribosomes
1.7 Cloverleaf model of t-RNA, Aminoacylation of t-RNA, activation of t-RNA, recognition of t-RNA
1.8 Translation in prokaryotes: Chain initiation, chain elongation, chain termination
1.9 Differences in translation in prokaryotes and eukaryotes
1.10 Posttranslational modifications
1.11 DNA methylation

Unit 2: Biotechnology **15 Lectures**

2.1 Tools in recombinant DNA technology
2.1.1 Molecular tools: Restriction enzymes, DNA ligases
2.1.2 Cells and organisms as tools for recombinant DNA technology – Brief idea, Properties and types of Vectors–plasmids (pBR322), bacteriophage & cosmid vectors.
2.1.3 Gene libraries and construction of gene library: c-DNA synthesis(reverse transcription)
2.2 Applications of Biotechnology in:
2.2.1 Agriculture –Golden rice, Herbicide resistance, Nitrogen fixation, Bt toxin
2.2.2 Therapeutics/Clinical: Hepatitis B vaccine, Stem Cell therapy, Monoclonal antibodies
2.2.3 Environment: Use of microbes in Bioremediation of Heavy Metals.

Unit 3: Bioinformatics **15 Lectures**

3.1 Basics of computing and concept of database
3.2 Genomics: DNA sequencing by Sanger's Method
3.3 Introduction to Human Genome project
3.4 Introduction to Proteomics :
Protein sequence analysis (Homologous, Analogous, orthologous and paralogous sequences)
3.5 Biological databases:
Primary sequence databases: Nucleic acid sequence databases (GenBank, EMBL-EBI, DDBJ)
Protein sequence databases (UniProt, KB, PIR, PDB)
3.6 Bioinformatics web resource (NCBI, OMIM, PubMed)
3.7 Applications of Bioinformatics

Molecular Biology

- Molecular Biology – Bios Instant Notes; Fourth Edition; Alexander McLennan, Andy Bates, Phil Turner & Mike White; Garland Science; 2013
- DNA & Biotechnology; Third Edition; Molly Fitzgerald-Hayes & Frieda Reichsman; Academic Press; 2009
- Cell and molecular biology Gupta P.K, Rastogi Publication, India.
- Molecular Biology of the cell (6^{th}PP ed) by the InsertusCampbell Biology (9^{th}PP Ed.)
- 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

Biotechnology

- 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; Third Edition; Joseph Sambrook & David William Russell; CSHL Press; 2001
- Gene Cloning – An Introduction; Fourth Edition; Brown T.A.; Wiley-Blackwell; 2011
- Recombinant DNA – Genes and Genomes : A short course; Third Edition; Watson J.D., Myers R.M., Caudy A., Witkowski J.K.; Freeman and Co., NY; 2007

- Principles Of Gene Manipulation & Genomics; S.B.Primrose & R.M.Twyman; Blackwell Science Publications; 2006
- Methods In Enzymology, Vol 152;Berger Sl, 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.; Garland 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
- Molecular Biology – Bios Instant Notes; Fourth Edition; Alexander McLennan, Andy Bates, Phil Turner & Mike White; Garland Science; 2013
- Concepts in Biochemistry; Third Edition; Rodney Boyer; John Wiley & Sons, Inc.; 2006
- Molecular Biotechnology – Principles & Applications of Recombinant DNA; Fourth Edition; Bernard R. Glick, Jack J. Pasternak & Cheryl L. Patten; American Society for Microbiology, Washington DC; 2010
- DNA & Biotechnology; Third Edition; Molly Fitzgerald-Hayes & Frieda Reichsman; Academic Press; 2009

Bioinformatics

- Bioinformatics - Concepts, Skills, and Applications; S.C. Rastogi & others; CBS Publishing; 2003
- Bioinformatics - A practical guide to analysis of Genes & Proteins; Andreas D Baxevanis& B. F. Francis; John Wiley; 2000
- Introduction to Bioinformatics; First Edition; T.K. Attwood, D.J. Parry-Smith; Pearson Education, Eleventh Reprint; 2005
- Bioinformatics; First Edition; C.S.V. Murthy; Himalaya Publishing House; 2003
- Bioinformatics - Sequence and Genome analysis; David W. Mount; Cold spring harbor laboratory press; 2004
- Basic Bioinformatics; S. Ignacimuthu, s.j.; Narosa Publishing House; 1995
- An Introduction to Bioinformatics Algorithms; Neil C. Jones and Pavel A. Pevzner; MIT Press, First Indian Reprint; 2005
- Bioinformatics - Managing Scientific Data; Zoe Lacroix, Terence Critchlow; Morgan Kaufmann Publishers (Elsevier Science); 2003
- Phylogenetics: Theory and Practice of Phylogenetic Systematics; Second edition; Bruce S. Lieberman; Wiley-Blackwell; 2011
- Molecular Evolution: A Phylogenetic Approach; Roderick D.M. Page, Edward C. Holmes; Well Publishing; 1998

- Essential Bioinformatics; Jin Xiong; Cambridge University Press; 2006
- Proteomics - From Protein Sequence to Function; First Edition; S.R. Pennington, M.J. Dunn; Springer publications; 2001
- Proteomics; Timothy Palzkill; Springer; 2002
- Metabolomics - A Powerful Tool in Systems Biology; Jens, Nielsen, Michael C., Jewett; Springer; 2007
- Systems Metabolic Engineering; Dr. Christoph Wittmann & Sang Yup Lee; Springer; 2012
- Bioinformatics (Bios Instant Notes); Second Edition (Special Indian Edition); T. Charlie Hodgman, Andrew French & David R. Westhead; Garland Science (Taylor and Francis Group); 2010
- Understanding Bioinformatics; Marketa Zvelebil & Jeremy O. Baum; Garland Science (Taylor and Francis Group); 2008
- Bioinformatics Computing – The complete practical guide to bioinformatics for Life scientists; Bryan Bergeron; Eastern Economy Edition; Prentice-Hall of India Pvt. Ltd., New Delhi; 2003
- Bioinformatics; Prakash S. Lohar; MJP Publishers, Chennai; 2009
  Introduction to Bioinformatics; First Edition; S. Sundara Rajan & R. Balaji; Himalaya Publishing House, Mumbai; 2002

Paper Code: SIUSZO43
Parasitology, Fisheries and Economic Zoology

Learning Objectives

- *To acquaint learners with the concepts of Helminth parasites, their relationship with environment, make them aware about the modes of transmission of parasites.*
- *To disseminate information on economic aspects of zoology like sheep farming, cattle farming and dairy science.*
- *To learn about fishes, their culturing, crafts and gear used and economical aspects of fisheries.*
- *To encourage young learners for self-employment.*

Unit1: Helminth Parasitology **15 Lectures**

1.1 Morphology,modeofinfection,lifecycle,pathogenecity,prophylaxisand treatment of:
1.1.1 *Taenia solium*
1.1.2 *Enterobius vermicularis*
1.1.3 *Ancylostoma duodenale*
1.1.4 *Wuchereria bancrofti*
1.1.5 *Dracunculus medinensis*

Unit2: Fishery Science **15 Lectures**

2.1 Types of Fisheries (Marine: coastal, offshore and deep sea fisheries; Brackish water, Freshwater, Culture fisheries with emphasis on locally important species)
2.2 Important Capture Fisheries of India
2.2.1 Fin-fish: Oil sardine, Mackerel, Bombayduck, Pomfret and Shark
2.2.2 Crustacean fisheries: Prawns, crabs and lobsters
2.2.3 Molluscan fisheries: Edible and pearl oyster, process of pearl formation
2.2.4 Fish preservation
2.2.5 Principles of preservation
2.2.6 Methods of preservation

2.2.7 Fish products
2.2.8 Crafts and gears used on Indian coasts
2.2.9 Crafts: Dugout, Outrigger canoe, Catamaran, Masula, Satpati,Trawler
2.2.10 Gears: Gill net and driftnet, dol net, cast net, purse seine, shore seine, long line and hooks

Unit 3:**Animal Husbandry – Sheep farming, Cattle farming, Dairy Science**

15 Lectures

3.1 Sheep farming
3.1.1 Various breed of sheep: Indigenous and exotic breeds
3.1.2 Determining the age of sheep by their teeth
3.1.3 Breeding and Management of sheep
3.1.4 Economic importance
3.1.5 Cattle farming:
3.1.6 Classification of breeds – Milch breeds, Dual Purpose Breeds, Draught breeds
3.1.7 Various breeds of cow: Indigenous and exotic
3.1.8 Various breeds of buffalo: Indigenous and exotic
3.1.9 Breeding and management of buffaloes
3.1.10 Economic importance
3.2 Dairy Science:
3.2.1 Composition of Milk
3.2.2 Milk Products
3.2.3 Ethical issues in animal husbandry.

References:

Fishery Science

- Fish and Fisheries in India - Jhingran V G Hindustan Publishing Corp., New Delhi
- Marine Fisheries - D. V Bal and K V Rao; Tata Mcgraw Hill, New Delhi
- Crafts and gear of India Y Sri Krishnan & Lata Shenoy, ICAR Publication
- Fish and Fisheries – Srivastava
- Wealth of India – An Encyclopedia of India's Raw Material Resources
- Food and Agriculture Organisation, India – projects and activities (http://www.fao.org/countryprofiles/index/en/?iso3=IND)
- A textbook of marine ecology – Thampy and Nair

Practical I (SIUSZOP41) based on SIUSZO41

1) Study of Ascidian tadpole (Retrogressive metamorphosis)
2) Study of swim bladder (*in situ*)
3) Parental Care and Breeding: Seahorse, Gouramy, Siamese fighter, Catfish, Tilapia, Caecilian, Midwife toad, Neoteny (axolotl larvae)
4) Adaptive radiation in reptiles: Turtle, Tortoise, Chameleon, Flying lizard (*Draco dussumieri*), Wall lizard (Gecko), RatSnake, Sea Snake, Crocodile or Gharial
5) Study of venomous snakes: Krait, Cobra, Russell's viper, Sawscaled viper, Jaw of Venomous Snake

6) Study of Adaptive radiations in Mammals: Duckbilled Platypus, Kangaroo, Bottlenose dolphin, Bluewhale, Sea Cow [Dugong], Flying Squirrels, Hoolock Gibbon
7) Study of Osmosis using RBCs
8) Study of ultra-structure of Cell Organelles using electron micrograph- Mitochondria, Endoplasmic reticulum, Golgi complex, Nucleus and Lysosomes
9) Study of Chromosome morphology using Onion root tip-squash preparation
10) Study of Polytene Chromosome: Temporary preparation of Salivary gland of Chironomous larva/ drosophila/mosquito
11) Bibliography
12) Abstract writing
13) Preparation of Power point presentation based on the research paper provided to you

Practical II (SIUSZOP42) based on SIUSZO42

1) Problems in Molecular Biology
2) Problems based on Biotechnology
3) Internet connectivity, search engines, visits to bioinformatics and related sites.

Practical III (SIUSZOP43) based on SIUSZO43

1) Study of Helminthes Parasites
   a) Identification of Taenia, Enterobius, Ancyclostoma, Wuchereria and Dracunculus.
   b) Parasitic adaptation–Scolex & Mature Proglottid of Tapeworm.

2) Study of Morphological Characters of a fish: Pomfret, Shark, Sting Ray, Bombay duck and Mackerel

3) Study of Fishery–Identification of the specimen with special reference to Fishery
   a) Fresh water fishery – Rohu, Catla, Mrigal.
   b) Marine water fishery–Oil sardine, mackerel, Bombay duck, Pomfret and Shark) Study of Crustacean fisheries & Molluscan fisheries: Prawns/ Shrimps, Lobsters, Crabs, Edible/pearl oyster, Sepia, Loligo, Katelysia, Mytilus

4) Identification and Uses of Crafts and Gear
   a) Crafts: Dugout, Outrigger, Catamaran, Masula, Satpati, Trawler
   b) Gears: Gillnet, Dol net, Cast net, Purse seine, Shore seine, Longline

5) Identification of animals with reference to Animal husbandry:
   a) Cattle – Milk breeds – Sahiwal
   b) Dual purpose breeds – Hariyana
   c) Draught purpose – Khillari
   d) Sheep – Gaddi, Marvari
   e) Buffalo – Murrah, Jaffrabadi

6) To detect adulterants in the Milk (starch, glucose and urea)
7) Extraction of Casein from Milk and its Qualitative test.
8) Preparation of Paneer from Milk
9) To measure the density of Milk by Lactometer
10) Field Visit Report: Visit to nearby Poultry farm / Goatery /Animal Husbandry farm

/ Apiary/ Sericulture Plant / Dairy farm / Sheep farm / Vermiculture Unit / Fish farm / Fish Market / Fish Landing Center / Fish Processing Industry
(Visit to minimum any one of them is compulsory as a part of study tour; either short or long to be taken as a part of the workload)

Practical Examination Question Paper Pattern
Semester III–Practical (SIUSZOP31)
Practical I based on SIUSZO31

Time: 2 hours **Marks: 50**

Q.1 Major Experiment **16**
Mounting and identification of any four foraminiferan shells from the given sample

Q.2 Identification **24**
Spot A: Any one specimen /permanent slides with reference to Reproduction in Paramoecia or canal system in Porifera
Spot B: Any one specimen /permanent slides with reference to Polymorphism in Coelenterates or any one coral
Spot C: Any one specimen /permanent slides with reference to T. S of Liver fluke, larvae of Liver Fluke, Trocophore larva or Heteronereis
Spot D: Any one specimen /permanent slides with reference to Crustacean larvae/Echinoderm larvae
Spot E: Any one specimen /permanent slides with reference to Metamorphosis in insects
Spot F: Any one specimen /permanent slides with reference to Shell in Mollusca
Spot G: Any one specimen /permanent slides with reference to Embryology
Spot H: Any one specimen /permanent slides with reference to Speciation
Q.3 Viva voce based on practical I and theory paper I **05**
Q.4 Journal **05**

****

Semester III – Practical (SIUSZOP32)
Practical II based on SIUSZO32

Time: 2 hours **Marks: 50**

Q.1 Prepare a Titration Curve using strong acid and base. **15**

OR

Determination of pKa for Weak acid

OR

Select the Best Filter for each of the given two Coloured solutions.

Q.2Estimation of the Blood glucose level using glucose estimation kit **15**
[GOD/POD method]

OR

Determination of concentration of unknown solution with the help of colorimeter

OR

Prepare a temporary slide to show the presence of Barr bodies

OR

Prepare buffers as per the instructions and check the pH using pH meter and Henderson Hasselbalch equation
Q.3 Solve problems based on Genetics **10**

Q.4 Viva voce based on Practical II and Theory paper II **05**
Q.5 Journal **05**

****

Semester III – Practical (SIUSZOP33)
Practical III based on SIUSZO33

Time: 2 hours **Marks: 50**

Q.1 Estimation of total Protein in the given sample of Egg **12**

OR

Estimate total Fats/Lipids in the given sample of Egg.

Q.2 Mount (Mouthparts/Sting apparatus/all the three types of legs) of Honey bee **10**

Q.3 Identification **18**
Spot A: Any one slide wrt Protozoan parasite
Spot B: Any one specimen or slide wrt Life cycle of Honey bee or silk worm or Bee hive
Spot C: Any one specimen or slide of Harmful insects
Spot D: Any one specimen or slide of harmful insects
Spot E: Any one specimen or slide from Animal husbandry
Spot F: Any one specimen or slide from Animal husbandry
Q.4 Viva voce based on Practical III and Theory III **05**
Q.5 Journal **05**

****

Practical Examination Question Paper Pattern
Semester IV–Practical
Practical I (SIUSZOP41) based on SIUSZO41

Time: 2 hours **Marks: 50**

Q.1 Demonstrate the process of osmosis in RBCs using different solutions provided to you **12**

OR

Prepare a temporary slide showing the presence of polytene chromosomes
Q.2 Prepare a power point presentation based on the research paper provided to you and present it **05**
Q.3 Write an abstract on the research paper provided to you **05**
Q.4 Identification: **18**
Spot A: Any one specimen/ slide with reference to Protochordates
Spot B: Any one specimen/ slide with reference to breeding and parental care
Spot C: Any one specimen/ slide with reference to adaptive radiations in reptiles
Spot D: Any one specimen/ slide with reference to adaptive radiations in mammals
Spot E: Any one specimen/ slide with reference to venomous / non-venomous snakes
Spot F: Any one specimen/ slide with reference to Ultra structure of Cell organelles
Q.5 Viva voce based on Practical I and Theory I **05**
Q.6 Journal **05**

****

Semester IV–Practical
Practical II (SIUSZOP42) based on SIUSZO42

Time: 2 hours **Marks: 50**

Q.1 Problems based on molecular biology	**10**
Q.2 Problems based on molecular biology	**10**
Q.3 Identification of genes and restriction sites on plasmid map	**05**
Q.4 Submission of report on Bioinformatics	**15**
Q.5 Viva voce based on Practical II and Theory paper II	**05**
Q. 6 Journal	**05**

****

Semester IV–Practical
Practical III (SIUSZOP43) based on SIUSZO43

Time: 2 hours **Marks: 50**

Q.1 Extract casein from given sample of Milk and confirm its presence by qualitative test **12**

OR

Detect the presence of adulterants (Starch/ Urea/ Glucose) in the given sample of milk

Q.2 Measure the density of milk by lactometer **05**

Q.3 Identification: **18**

Spot A: Anyone specimen/ Slide with reference to Helminth parasites
Spot B: Anyone specimen/ Slide with reference to parasitic adaptation
Spot C: Anyone specimen/ Slide with reference to Fish morphology
Spot D: Anyone specimen/ Slide with reference to Fishery biology
Spot E: Anyone specimen/ Slide wrt Crafts/ Gears
Spot F: Anyone specimen/ Slide wrt Animal husbandry

Q.4 Viva voce based on Practical III and Theory paper III **05**

Q.5 Report on Filed visit and viva based on it **05**

Q.6 Journal **05**

****

S. Y. B. Sc. Zoology Syllabus (Autonomous)
Credit Based Semester and Grading System
(With effect from academic year 2019 - 20)

Scheme of Examination

The performance of learners will be evaluated in two parts for the Theory component of the Course:

1. Internal Assessment with 40% marks
2. Semester End Examination (written) with 60% marks

The Practical component of the Course will be evaluated by conducting Semester End Practical Examination of 50 marks.

\

Internal Assessment Theory (40%)

It is the assessment of learners on the basis of continuous evaluation as envisaged in the Credit Based System by way of participation of learners in various academic and correlated activities in the given semester of the program.

Marks: 40

1. Class test (Centralized Examination): **20 Marks**
2. At the departmental level evaluation will be conducted on the basis of Seminar/Assignment/Poster presentation/Research paper review/Abstract writing / Group discussion by the student: **20 Marks**

Semester End Assessment Theory (60%)

Marks: 60
Duration: 2 hours
Theory question paper pattern:

- There shall be four questions of 15 marks each. On each unit there will be one question and the 4th question will be based on the entire syllabus.
  OR
  There shall be three questions of 20 marks each, each question based on one unit.
- All questions are compulsory with internal choice within the questions.
- Questions may be subdivided and the allocation of marks depends on the weightage of the topic.
-

Semester End Assessment Practical

Marks: 50
Duration: 2 hours

****