AC/2024/RS 1

SIES

College of Arts, Science & Commerce (Empowered Autonomous)

RISE WITH EDUCATION

NAAC REACCREDITED "A" GRADE

(Affiliated to University of Mumbai)

Faculty: Science

Program: S.Y.B.Sc.

Subject: ZOOLOGY

Academic Year: 2024 – 2025

Revised Syllabus under Choice Based Credit System (CBCS)
Approved by the Board of Studies in Zoology
Effective from Academic year: 2024-25
Under the aegis of National Education Policy (NEP)

Preamble

"Where the mind is without fear and the head is held high …."

A poem written by Nobel Laureate Rabindranath Tagore (Nobel Prize in Literature in 1913), the poem represents Tagore's vision of a new and awakened India (it is quoted in this preamble in the context of National Education Policy).

Our institution was one of the lead colleges, affiliated to University of Mumbai in implementing India's National Education Policy 2020 (NEP 2020) in academic year 2023-24. Moreover, we were also conferred with 'Empowered Autonomous Status' in 2023-24, which becomes all the more relevant, in terms of our contribution as an educational institution to fulfill the visionary and transformative objectives of National Education Policy. Under the aegis of academic autonomy, the Department of Zoology has the privilege of 'academic freedom' to revise its course and curriculum, however, it is also aware of the fact that 'academic freedom' needs to be justified with 'academic excellence'. One of the ways to achieve this is through fine-tuning the curriculum.

It is relevant to note that for the first time under NEP, the department has enrolled two categories of students, whereby some of them have opted for Zoology as a Major subject (subject of main focus) while choosing Chemistry, Biochemistry, Botany, Microbiology and Physics as their Minor subject; while other students have chosen Zoology as a Minor subject (to gain broader understanding beyond the Major subject) and the other subjects mentioned earlier as a Major subject. It means that, students opting for Zoology as a Major subject will be studying more courses/papers and acquire more credits in comparison to students who have chosen Zoology as a Minor subject. The current syllabus also attempts to integrate a few courses such as Vocational Skill Course (VSC), Skill Enhancement Course (SEC), Generic/Open Electives (GE/OE), Community Engagement and Field Projects, and Co-Curricular Courses, which will help in a holistic development of students and equip them with the necessary skills in order to make them self-sufficient.

Some of the key features of this revised syllabus are as follows:-

- ✓ *Zoology as Major – A course which is aimed at understanding the fundamental concepts in Zoology and build a sound foundation for the subject by inclusion of topics in Core paper such as Invertebrate and Vertebrate Life (Classical Zoology), Cell Biology, Development Biology and Evolution.*
- ✓ *Zoology as Minor – A course which is aimed to enable students to gain comprehensive understanding of zoology with emphasis on the applied aspects of zoology such as animal husbandry, entomology etc.*
- ✓ *Vocational Skill Course – A course, which is aimed at providing hands-on training, competencies, proficiency to students to enhance their skills & employability. For example: Bioinstrumentation – to give students a hands-on experience of instrumentation used in laboratory facility which will enable them to operate instruments independently.*
- ✓ *Skill Enhancement Course – A course, which is aimed at imparting practical skills, nurturing soft skills etc., to enhance the employability of students. For example: Animal Systematics – to introduce the students to the diversity of animal life to understand that part of the world around us comprising of various life forms, besides gaining an insight into field biology which will enable them to be equipped with the skills of understanding taxonomy of animal kingdom.*
- ✓ *Generic or Open Elective – An elective course generally chosen from an unrelated subject / discipline with the intention to seek multidisciplinary exposure. For example, any one of the following elective courses such as: Interfaith dialogue – Indian Origin & Non-Indian Origin Religions (Course offered by Department of Philosophy) or Management principles & Marketing Fundamentals (Course offered by Department of Commerce).*
- ✓ *Field Project (FP): Courses requiring students to participate in field-based learning or projects to study actual field situations regarding issues related to socio-economic development in rural and urban settings.*
- ✓ *Community Engagement and Service (CE): It will involve activities that would expose students to socio-economic issues in society, so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems.*
- ✓ *Co-Curricular Courses – A course which will provide student's a sense of identity & belonging, as well as appreciation of other cultures & identities; For example: courses such as National Cadet Corps (NCC), National Service Scheme (NSS), Yoga education, Health & Wellness, Sports, Cultural activities, courses related to Fine / Applied / Performing Arts etc.*

This revised syllabus is a collective and constructive effort of the faculty, experts from research institutions, alumni and the board members whose valuable suggestions and expertise were instrumental in materializing this syllabus. The comments and recommendations of the contributors and reviewers have been carefully considered and incorporated wherever feasible. For effective teaching-learning, teachers are advised not to follow the syllabus too rigidly, but to exercise their professional discretion and judgment in implementing it. After all teaching is also about creating a conducive environment for learners to sustain enthusiasm about the subject. We sincerely hope that this revised syllabus will encourage critical thinking, instill analytical skills, besides inculcating interdisciplinary approach amongst student's to make learning more meaningful, thereby pursuing academic excellence.

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SIES College of Arts, Science and Commerce (Empowered Autonomous)
Sion (West), Mumbai
SYBSc Zoology Syllabus
Choice Based Credit System (With effect from academic year 2024-25)

THEORY			
Course name and code	**Unit**	**Topic Headings**	**Credits**
SEMESTER III			
Major			
Mandatory Course			
Core Course 1: Invertebrate life, Cell biology and Genetics			
SIUZOMJ211 Theory	1	Invertebrate life	**3**
	2	Cell Biology	
	3	Genetics	
SIUSZOMJP211 Practical	1	Practical based Invertebrate life, Cell biology and Genetics	**1**
Core Course 2: Zoogeography, Animal husbandry and Parasitology			
SIUZOMJ212 Theory	1	Zoogeography	**3**
	2	Animal husbandry-I	
	3	Parasitology-I	
SIUSZOMJP212 Practical		Practical based on Zoogeography, Animal husbandry and Parasitology	**1**
Vocational and Skill Enhancement Courses			
SIUZOVS211		Composting	**2**
		Practical based on Composting	

THEORY			
Course name and code	**Unit**	**Topic Headings**	**Credits**
SEMESTER IV			
Major			
Mandatory course			
Core Course 1: Vertebrate life, Developmental biology and Evolution			
SIUZOMJ221 Theory	1	Vertebrate life	**3**
	2	Developmental biology	
	3	Evolution	
SIUZOMJP221 Practical		Practical based on Vertebrate life, Developmental biology and Evolution	**1**
Core Course 2: Economic entomology, Animal husbandry and Parasitology			
SIUZOMJ222 Theory	1	Economic entomology	**3**
	2	Animal husbandry-II	
	3	Parasitology-II	
SIUZOMJP222 Practical		Practical based on Economic entomology, Animal husbandry and Parasitology	**1**
Skill Enhancement Course			
SIUZOSE221		Tools and techniques in wildlife biology	**2**
		Practical based on Tools and techniques in wildlife biology	

THEORY			
Course name and code	**Unit**	**Topic Headings**	**Credits**
SEMESTER III			
Minor			
Mandatory course			
Core Course 1: Invertebrate life, Zoogeography and Animal husbandry			
SIUZOMN211 Theory	1	Invertebrate life	**3**
	2	Zoogeography	
	3	Animal husbandry-I	
SIUZOMNP211 Practical		Practical based on Invertebrate life, Zoogeography and Animal husbandry	**1**

THEORY			
Course name and code	**Unit**	**Topic Headings**	**Credits**
SEMESTER IV			
Minor			
Mandatory course			
Core Course 1: Vertebrate life, Economic entomology and Animal husbandry			
SIUZOMN221 Theory	1	Vertebrate life	**3**
	2	Economic entomology	
	3	Animal husbandry-II	
SIUZOMNP221 Practical		Practical based on Vertebrate life, Economic entomology and Animal husbandry	**1**

SEMESTER III
Major- Mandatory course

Course Code: SIUZOMJ211
Course Title: Invertebrate life, Cell biology & Genetics
Learning objective:

- *To acquaint the learners with a comprehensive understanding of invertebrate life in terms of their unique reproductive patterns, intricacies in their structures and various adaptations exhibited by them.*
- *To present the learners with nuances of cell and cell organelles with respect to its structural complexity and functions.*
- *To widen the knowledge of the learners with respect to types of sex determination in animals, multiple alleles and the concept of polygenic inheritance*

Expected outcomes: *The learners would be able to:*

- *Recall types of reproduction in Protozoa and Annelida*
- *Define the Polymorphism, bioluminescence*
- *Enlist and describe crustacean and echinoderm larvae*
- *Classify and explain canal systems in Porifera, types of metamorphosis in insects*
- *Discuss theories of coral reef formation, bioluminescence in Protozoa, canal system in Porifera, structure and function of cell organelles*
- *Explain the mechanism of sex determination in animals, inheritance related to sex concept of multiple alleles and polygenic inheritance*
- *Correlate the structure of shell and foot in Mollusca with that of its habitat*

Unit 1: Invertebrate life

1.1 Protozoa: Reproduction, bioluminescence

1.2Porifera: Canal systems, reproduction

1.3 Cnidaria: Polymorphism, coral reefs –types and theories of formation

1.4 Platyhelminthes and Nemathelminthes: Parasitic adaptations

1.5 Annelida: Reproduction

1.6 Arthropoda: Crustacean larvae and metamorphosis in insects

1.7 Mollusca: Shell, foot and torsion

1.8 Echinodermata: Water vascular system and echinoderm larvae

Unit 2: Cell biology

2.1 Plasma membrane:
2.1.1 Structure of plasma membrane
2.1.2 Function: Active, passive transport, endocytosis & exocytosis
2.2 Nucleus:
2.2.1 Structure of nucleus, nucleolous, nuclear pore and pore complex
2.2.2 Organization of chromatin & chromosome
2.2.3 Polytene, lamp brush chromosome
2.3 Cytoplasmic membrane system:
2.3.1 Structure, types and function of endoplasmic reticulum
2.3.2 Structure and function of golgi complex

2.3.3 Structure and function of lysosomes
2.3.4 Mitochondria: Structure, function and polymorphism

Unit 3: Genetics

3.1. Methods of sex determination:
3.1.1. Chromosomal mechanisms – XX-XO, XX-XY and ZZ-ZW
3.1.2. Sex determination in honey bees: haplo-diploidy
3.1.3. Sex determination in drosophila: Genic balance theory, Barr body and Lyon's hypothesis
3.1.4. 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

Major- Mandatory course

Course Code: SIUZOMJP211
Course Title: Practical based on Invertebrate life, Cell biology & Genetics
Learning objective:

- *To enhance the identification skill of the learners.*
- *To improve problem solving ability of the learner.*
- *To gain proficiency in mounting techniques and in handling laboratory instruments.*

Expected outcomes: *The learners would be able to:*

- *Identify the formainiferan shells from the sand sample, polymorphism in Cnidaria, parasitic adaptations, metamorphosis in insects, crustacean larvae*
- *Correlate the structure of mouth parts of insects with their feeding patterns, structure of shell and foot in Mollusca with that of its habitat, the relationship between gene expression and dietary habits of the larva*
- *Interpret the results obtained in the experiment based osmosis of blood cells, blood grouping.*

- *Gain the skill of mounting polytene chromosomes, foraminiferan shells*
- *Solve problems based on genetics*

1) Identification of foraminiferan shells.
2) Study of polymorphism in Cnidaria
3) Study of corals.
4) Study of parasitic adapatations in *Fasicola hepatica.*
5) Study of atoky and epitoky in nereis.
6) Study of crustacean larvae.
7) Study of metamorphosis in insects.
8) Study of modifications of insect mouth parts based on the feeding patterns (Chewing and biting, piercing and sucking, sponging, chewing and lapping type of mouth parts)
9) Study of foot and shell in Mollusca.
10) Study of osmosis using RBCs.
11) Study of cell organelles using cytological preparations.
12) Determination of blood group and Rh factors.
13) Study of Barr bodies using bucal smear.
14) Study of polytene chromosomes of chironemous larva
15) Problems in genetics.

Major- Mandatory course

Course Code: SIUZOMJ212
Course Title: Zoogeography, Animal husbandry & Parasitology
Learning objective:

- *The course aims to introduce learners to the fields of zoogeography, parasitology, and animal husbandry.*
- *The learners will also be acquainted with the entrepreneurial aspects related to the field of animal husbandry.*
- *To familiarize the learners with parasite diversity and taxonomy, clinical relevance and impact of parasites on human health.*

Expected outcomes: *The learners would be able to:*

- *Understand the distribution of animals in space and time, various means of dispersal.*
- *Recognize patterns of animal distribution.*
- *Define the terms based on parasitology.*
- *Recall theories related to animal distribution, types of parasites and host.*
- *Enlist and classify breeds of fowl and goats, enlist protozoan diseases.*
- *Explain the barriers that affect the distribution of animals.*
- *Discuss the cause, prevention and treatment of diseases in poultry and goat.*
- *Discuss causes, mode of transmission, pathogenicity, diagnostic tools, preventive and control measures of protozoan diseases.*
- *Apply knowledge of: zoogeography to analyze real-world scenarios related to animal distribution and dispersal, maintenance of animal husbandry unit (poultry or goat farming) with respect to entrepreneurship skill*
- *Corelate the shape, size various structural modifications and physiological changes of parasites to their parasitic adaptations*

- *Compare and contrast the zoogeographical realms*

Unit 1: Zoogeography

1.1Distribution of animals**:** In space – horizontal or superficial, in time – geological or durational
1.2 Patterns of animal distribution: Continuous, discontinuous, isolation and bipolarity
1.3 Theories of animal distribution
1.4 Barriers of distribution of animals**:** Topographic, climatic, vegetative, large water masses, land mass, lack of salinity and special characteristic habits, homing instinct
1.5 Means of dispersal – Land bridges, natural rafts and drift wood, favouring gales, migration by host, accidental transportation and by human agencies
1.6 Zoogeographical Realms: Palearctic, Ethiopian, Oriental, Australian, Neotropical, Nearctic and Antarctic

Unit 2: Animal husbandry-I
2.1 Poultry
2.1.1 Definition, nomenclature and breeds of fowl
2.1.2 Housing and equipment, brooding and rearing
2.1.3 Raising broilers
2.1.4 Factors affecting size of eggs, abnormal eggs, hatching of eggs
2.1.5 Poultry diseases
2.1.6 Maintenance of hatchery
2.1.7 Economic importance
2.2 Goat farming
2.2.1 Scientific classification: Indigenous and exotic breeds of goats
2.2.2 Nutrition & maintenance of goats
2.2.3 Diseases in goats, prevention and treatment of diseases
2.2.4 Recent techniques to improve production of goats
2.2.5 Economic importance
2.3 Sheep farming
2.3.1 Scientific classification and breeds of sheep
2.3.2 Determining the age of sheep by their teeth
2.3.3 Breeding and management of sheep (AI, IVF)
2.3.4 Economic importance

Unit 3: Parasitology-I
3.1 Introduction to parasitology
3.1.1 Types of parasites
3.1.2 Types of hosts
3.1.3 Parasitic adaptations: Body shape and size, locomotory structures, organs of attachment, respiration, polyembryony, cyst formation, body wall, immunologic responses, reproductive potential
3.2 Protozoan parasites
3.2.1 Protozoan parasites: Morphology, mode of infection, life cycle, pathogenicity, prophylaxis and treatment of–

- *Entamoeba histolytica*
- *Plasmodium vivax*
- *Giardia lamblia*

- *Trypanosoma gambiense*
- *Leishmania donovani*

Major- Mandatory course

Course Code: SIUZOMJP212
Course Title: Practical based on Zoogeography, Animal husbandry & Parasitology
Learning objective:

- *To enhance the identification skill of the learner.*
- *To improve problem solving ability of the learner.*
- *To gain proficiency in using laboratory equipment.*

Expected outcomes: *The learners would be able to:*

- *Identify the protozoan parasites, abnormalities in eggs, breeds of animals with respect to animal husbandry.*
- *Interpret the results obtained in the experiment based on estimation/extraction of protein content, cholesterol.*
- *Solve problems based on parasitology and recommend the control measures and treatment for some parasitic infections.*

1) Identification of zoogeographical realms on world map and description with respect to location, climate, flora and fauna.
2) Determination of protein content in different varieties of egg.
3) Study of abnormalities in eggs.
4) Isolation of cholesterol/lipids from egg yolk.
5) Identification of breeds of poultry, goat and sheep.
6) Identification of protozoan parasites.
7) Problem solving based on parasitology. (Symptoms and diagnostic reports of the patients suffering from parasitic infection will be provided to the students. Students have to identify the parasitic infection and suggest the control measures and treatment for the patient)
8) Field report based on visit to Animal husbandry unit/ Marine habitat.

Major- Mandatory course
Vocational and Skill Enhancement Course

Course Code: SIUZOVS211
Course Title: Composting
Learning objectives:

- *To familiarize the learners with composting practices.*
- *To create awareness amongst the learners about composting as a crucial tool for enhancing soil health.*
- *To impart specific skills required for both small-scale and large-scale composting.*

- *To make the learners aware about composting as an entrepreneurial venture or a potential career path.*

Expected outcomes: *The learners would be able to:*

- *Define the key terms involved in the process of composting*
- *Discuss types of composting and composting bioreactors*
- *Explain the mechanism behind the process of composting*
- *Choose the ingredients of composting*
- *Evaluate the properties of the compost*

Theory

- Introduction to composting
- Composting Bioreactors
- Types of composting
- Science of composting
- Choosing the ingredients for composting
- Compost Properties

Practical

1) Study of materials and equipments used for composting.
2) Determination of temperature of compost using soil thermometer.
3) Identification of earthworms used in vermicomposting
4) Determination of organic content of soil sample.
5) Determination of pH of soil sample.
6) Determination of moisture content of soil.
7) Setting up of composting system in small scale at home or college laboratory.

SEMESTER IV
Major -Mandatory course

Course Code: SIUZOMJ221
Course Title: Vertebrate life, Developmental biology & Evolution
Learning objectives:

- *To acquaint the learners with a comprehensive understanding of vertebrate life, developmental biology and evolution.*

Expected outcomes: *The learners would be able to:*

- *Define and classify: types of eggs, cleavage and blastula*
- *Discuss retrogressive metamorphosis in protochordates, breeding and parental care in class pisces and amphibia, adaptive radiations in reptiles, migration in birds, the roles of various genes in the development of drosophila*
- *Explain: origin and evolution of animals in various classes (from class Pisces to class Mammalia), the concept of fertilization, parthenogenesis, gastrulation, the fate of three germ layers and process of coelom formation*
- *Compare and contrast venomous and non-venomous snakes.*

Unit 1: Vertebrate life

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: Developmental Biology

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-Hallmarks of aging.

Unit 3: Evolution
3.1Evidences of evolution
3.1.1Fossil records and transitional forms
3.1.2Embryological and molecular evidences
3.1.3Industrial melanism with reference to pigeon and snakes
3.2Mechanisms of evolution
3.2.1Natural selection and adaptations
3.2.2Genetic drift and gene flow
3.2.2Mutation and speciation
3.3Population Genetic
3.3.1Hardy Weinberg's Equilibrium
3.3.2Genetic variation and evolutionary forces
3.3.3Microevolution

Course Code: SIUZOMJP221
Course Title: Practical based Vertebrate life, Developmental biology & Evolution
Learning objective:

- *To enhance the identification skill of the students*
- *To improve problem solving ability of the learner*

Expected outcomes: *The learners would be able to:*

- *Identify the specimens or slides with respect to parental care, adaptive radiations and embryology.*
- *Understand various migratory flyways*
- *Compare and contrast* venomous and non-venomous snakes
- *Correlate the adaptive radiations and evolution exhibited by the reptiles and mammals with their habit and habitat*
- *Solve problems based on population genetics*

1) Study of swim bladder in fish
2) Study of parental care in class Pisces and class Amphibia
3) Study of adaptive radiations in reptiles
4) Study of venomous and non-venomous snakes
5) Study of migratory flyways of birds
6) Study of egg laying, marsupials, placentals and aquatic mammals
7) Problems based on population genetics
8) Study of embryos: fish embryos, chick embryo, mammalian embryo
9) Study of different types of eggs, cleavage, blastula and gastrula

Major -Mandatory course

Course Code: SIUZOMJ222
Course Title: Economic Entomology, Animal husbandry & Parasitology
Learning objectives:

- *To highlight entrepreneurial prospects in economic entomology and animal husbandry.*
- *To provide in-depth knowledge about helminth parasites.*

Expected outcomes: *The learners would be able to*

- *Define the terms**:** entomology, pest, vector*
- *Enlist the methods of insect control, dairy products, composition of milk and breeds of cattle.*
- *Describe life history and control measures of insects, breeding and management of cattle.*
- *Discuss the process of apiculture, sericulture and lac culture, methods of insect control, ethical issues in animal husbandry.*

- *Explain: morphology, mode of infection, lifecycle, pathogenicity, diagnosis prophylaxis and treatment of helminth parasites.*
- *Suggest the insect control method based on the type of infestation*

Unit 1: Economic Entomology

1.1 Introduction to Entomology

1.2 Study of insects

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

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

1.2.3 Silk moth: Life history, sericulture, economic importance

1.2.4 Life history and control measures of Aphids

1.2.5 Life history and control measures of Rice weevil

1.2.6 Life history and control measures of Indian meal moth

1.3 Methods of insect control

1.3.1 Chemical control of insects –Synthetic and natural chemicals, Harmful effects of chemical insecticides

1.3.2 Biological control –*Bacillus thureingensis*, Entomophagus insects, Parasitic insects, insectivorous birds

Unit 2: Animal husbandry-II

2.1 Cattle farming:

2.1.1 Origin and ancestors of cow and buffalo in terms of indigenous breeds

2.1.2 Scientific classification of cow and buffalo

2.1.3 Classification of breeds – Milch breeds, dual purpose breeds, draught breeds

2.1.4 Various breeds of cow: Indigenous and exotic

2.1.5 Various breeds of buffalo: Indigenous and exotic

2.1.6 Breeding and management of buffaloes

2.1.7 Economic importance

2.2 Dairy Science:

2.2.1 Composition of Milk

2.2.2 Milk Products

2.3 Ethical issues in animal husbandry.

Unit 3: Parasitology-II

3.1 Morphology, mode of infection, lifecycle, pathogenecity, diagnosis, prophylaxis and treatment of:

3.1.1 *Taenia solium*

3.1.2 *Enterobius vermicularis*

3.1.3 *Ancylostoma duodenale*

3.1.4 *Wuchereria bancrofti*

3.1.5 *Dracunculus medinensis*

Course Code: SIUZOMJP222
Course Title: Practical based Economic Entomology, Animal husbandry-II & Parasitology
Learning objective:

- *To enhance the identification skill of the learner.*
- *To improve problem solving ability of the learner.*

Expected outcomes: *The learners would be able to:*

- *Identify the specimens or slides with respect to entomology, animal husbandry and parasitology.*
- *Mount the legs, mouthparts and sting apparatus.*
- *Correlate the structure (legs of insects, mouth parts of honey bee) with the function*
- *Evaluate the quality of milk and honey.*
- *Isolate economically important molecules like casein.*
- *Solve problems based on parasitology.*

1) Study of insects (Honey bee, Silk moth, Lac insect, Aphid, Rice weevil and Indian meal moth)
2) Study of insect morphology (Study of different types of legs- raptorial, fossorial, cursorial and their adaptations in insects).
3) Study of modifications of legs, sting apparatus and mouth parts of honey bee.
4) Detection of adulterants in honey.
5) Study of different breeds of cattles.
6) Isolation of casein from milk.
7) Detection of adulterants in milk (detergents, starch, urea, glucose).
8) With the help of lactometer detection of adulterants in milk.
9) Study of parasitic adaptations in tape worm.
10) Study of helminth parasites.
11) Problem solving based on parasitology. (Symptoms and diagnostic reports of the patient suffering from helminth infection will be provided to the student. Student has to identify the parasitic infection and suggest control measures and treatment for the same.)
12) Preparation of report based on field visit to Animal husbandry unit/ Apiary/ Sericulture unit/ Marine habitat.

Major- Mandatory course
Skill Enhancement Course

Course Code: SIUZOSE221
Course Title: Tools and Techniques in field biology
Learning objectives:

- *To equip the learners with tools and techniques in field biology.*
- *To enhance the skills of the learners in the field of wildlife biology.*
- *To raise the awareness about the career opportunities in field biology.*

Expected outcomes: *Learners would be able to:*

- *Understand: use of field kit in field biology, bird acoustics.*
- *Discuss: the importance of field notebook for recording observations during fieldwork., the components of a field kit.*
- *Describe the use field guides and digital resources for species identification and information.*
- *Analyze animal tracks and sign, animal scat (feces) for ecological insights.*
- *Explore the application of GPS technology in field biology.*
- *Practice recording and analyzing field observations systematically*

1) Study of field biology by maintaining field note book.
2) Study of field kit and its uses.
3) Identification of tools used in field biology.
4) Study of animal tracks and signs: Pugmarks, hoof marks, owl regurgitate, scratch marks, browse line, dung mount, nests, dens, water holes, scent marking, wild life call (alarm call, matting call).
5) Understanding field biology using various field guides and digital applications.
6) Use of GPS in field biology.
7) Study of bird acoustics.
8) Recording and analysis of field observations.

SEMESTER III
Minor-Mandatory course

Course Code: SIUZOMN211
Course Title: Invertebrate life, Zoogeography and Animal husbandry
Learning objectives:

- *To acquaint the learners with a comprehensive understanding of Invertebrate life in terms of their unique reproductive patterns, intricacies in their structures and various adaptations exhibited by them.*
- *The course aims to introduce learners to the fields of zoogeography and animal husbandry.*
- *The learners will also be acquainted with the entrepreneurial aspects related to the field of animal husbandry.*

Expected outcomes: *The learners would be able to:*

- *Recall types of reproduction in Protozoa and Annelida, theories related to animal distribution*
- *Define the Polymorphism, bioluminescence*
- *Enlist and classify breeds of fowl and goats, crustacean and echinoderm larvae*
- *Understand the distribution of animals in space and time, various means of dispersal.*
- *Classify and explain canal systems in Porifera, types of metamorphosis in insects*
- *Discuss theories of coral reef formation, bioluminescence in Protozoa, canal system in Porifera, the cause, prevention and treatment of diseases in poultry and goat.*
- *Correlate the structure of shell and foot in Mollusca with that of its habitat*
- *Recognize patterns of animal distribution.*
- *Explain the barriers that affect the distribution of animals.*
- *Apply knowledge of: zoogeography to analyze real-world scenarios related to animal distribution and dispersal, maintenance of animal husbandry unit (poultry or goat farming) with respect to entrepreneurship skill*
- *Compare and contrast the zoogeographical realms*

Unit 1: Invertebrate life

1.1 Protozoa: Reproduction, bioluminescence

1.2Porifera: Canal systems, reproduction

1.3 Cnidaria: Polymorphism, Coral reefs –types and theories of formation

1.4 Platyhelminthes and Nemathelminthes: Parasitic adaptations

1.5 Annelida: Reproduction

1.6 Arthropoda: Crustacean larvae and metamorphosis in insects

1.7 Mollusca: Shell, foot and torsion

1.8 Echinodermata: Water vascular system and echinoderm larvae

Unit 2: Zoogeography

1.1Distribution of animals**:** In space – Horizontal or superficial, in time – geological or durational

1.2 Patterns of animal distribution: Continuous, discontinuous, isolation and bipolarity

1.3 Theories of animal distribution

1.3 Barriers of distribution of animals**:** Topographic, climatic, vegetative, large water masses, land mass, lack of salinity and special characteristic habits, homing instinct

1.4 Means of dispersal – Land bridges, natural rafts and drift wood, favoring gales, migration by host, accidental transportation and by human agencies

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

Unit 3: Animal husbandry-I

2.1 Poultry

2.1.1 Definition, nomenclature and breeds of fowl

2.1.2 Housing and equipment, brooding and rearing

2.1.3 Raising broilers

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

2.1.5 Poultry diseases

2.1.6 Maintenance of hatchery

2.1.7 Economic importance

2.2 Goat farming

2.2.1 Scientific classification of indigenous and exotic breeds of goats

2.2.2 Nutrition & maintenance of goats

2.2.3 Diseases in goats, prevention and treatment of diseases

2.2.4 Recent techniques to improve production of goats

2.2.5 Economic importance

2.3 Sheep farming

2.3.1 Scientific classification and breeds of sheep

2.3.2 Determining the age of sheep by their teeth

2.3.3 Breeding and Management of sheep (AI, IVF)

2.3.4 Economic importance

Course Code: SIUZOMNP211

Course Title: Practical based Invertebrate life, Zoogeography and Animal husbandry

Learning objective:

- *To enhance the identification skill of the students.*
- *To improve problem solving ability of the learner.*
- *To gain proficiency in using laboratory equipment.*

Expected outcomes: *The learners would be able to:*

- *Identify the foraminiferan shells, coral, crustacean larvae, Zoogeographical realms abnormalities in eggs, breeds of animals with respect to animal husbandry, protozoan parasites, abnormalities in eggs.*
- *Understand the concept of polymorphism, atoky and epitoky, metamorphosis.*
- *Correlate the adaptations exhibited by the parasite (liver fluke) with the structure of the body, cell wall and physiology.*
- *Correlate the structure of insect mouth parts with their feeding habits and structure of foot & shell of mollusca with their habit and habitat.*
- *Interpret the results obtained in the experiment based on estimation/extraction of protein content, cholesterol.*

- *Solve problems based on parasitology and recommend the control measures and treatment for some parasitic infections.*

1) Identification of foraminiferan shells.
2) Study of polymorphism in Cnidaria.
3) Study of corals.
4) Study of parasitic adapatations in *Fasicola hepatica.*
5) Study of atoky and epitoky in nereis.
6) Study of crustacean larvae.
7) Study of metamorphosis in insects.
8) Study of modifications of insect mouth parts based on the feeding patterns (Chewing and biting, piercing and sucking, sponging, chewing and lapping type of mouth parts)
8) Study of foot and shell in Mollusca.
9) Identification of Zoogeographical realms on world map and description with respect to location, climate, flora and fauna.
10) Determination of protein content in different varieties of egg.
11) Study of abnormalities in eggs.
12) Isolation of cholesterol/lipids from egg yolk.
13) Identification of breeds of poultry, goat and sheep.
14) Field report based on visit to Animal husbandry unit/ Marine habitat.

SEMESTER IV
Minor -Mandatory course

Course Code: SIUZOMN221
Course Title: Vertebrate life, Economic entomology & Animal husbandry
Learning objectives:

- *To acquaint the learners with a comprehensive understanding of Vertebrate life.*
- *To provide in-depth knowledge about economic entomology.*
- *To highlight entrepreneurial prospects in economic entomology and animal husbandry.*

Expected outcomes: *The learners would be able to*

- *Define the terms: entomology, pest, vector.*
- *Enlist the methods of insect control, dairy products and composition of milk, breeds of cattle.*
- *Discuss: retrogressive metamorphosis in protochordates, breeding and parental care in class Pisces and Amphibia, adaptive radiations in reptiles, migration in birds, the process of apiculture, sericulture and lac culture, methods of insect control, ethical issues in animal husbandry*
- *Describe breeding and management of cattle*
- *Explain: origin and evolution of animals in various classes (from class Pisces to class Mammalia)*
- *Compare and contrast venomous and non-venomous snakes.*
- *Suggest the type of insect control method based on the type of infestation*

Unit 1: Vertebrate life
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: Economic Entomology
1.1 Introduction to Entomology
1.2 Study of insects
1.2.1 Honeybee: Social life and communication, life history, apiculture, economic importance
1.2.2 Lac insect: Life cycle, lac culture, composition and uses of lac
1.2.3 Silk moth: Life history, sericulture, economic importance
1.2.4 Life history and control measures of Aphids
1.2.5 Life history and control measures of Rice weevil
1.2.6 Life history and control measures of Indian meal moth
1.3 Methods of insect control
1.3.1 Chemical control of insects –Synthetic and natural chemicals, Harmful effects of chemical insecticides
1.3.2 Biological control –*Bacillus thureingensis*, Entomophagus insects, Parasitic insects, insectivorous birds

Unit 3: Animal husbandry-II
3.1 Cattle farming:
3.1.1 Scientific classification of cow, buffalo
3.1.2 Classification of breeds – Milch breeds, dual Purpose breeds, draught breeds
3.1.3 Various breeds of cow: Indigenous and exotic
3.1.4 Various breeds of buffalo: Indigenous and exotic
3.1.5 Breeding and management of buffaloes
3.1.6 Economic importance
3.2 Dairy Science:
3.2.1 Composition of Milk
3.2.2 Milk Products
3.3 Ethical issues in animal husbandry.

Course Code: SIUZOMNP221
Course Title: Practical based Vertebrate life, Economic entomology & Animal husbandry

Learning objective:
- *To enhance the identification skill of the learner.*

- *To improve problem solving ability of the learner.*

Expected outcomes: *The learners would be able to:*

- *Identify the specimens or slides with respect to parental care, adaptive radiations entomology and animal husbandry.*
- *Mount the legs, mouthparts and sting apparatus.*
- *Correlate the structure (legs of insects, mouth parts of honey bee) with the function*
- *Evaluate the quality of milk and honey.*
- *Isolate economically important molecules like casein.*
- *Understand various migratory flyways*
- *Compare and contrast* venomous and non-venomous snakes
- *Correlate the adaptive radiations and evolution exhibited by the reptiles and mammals with their habit and habitat*
- *Solve problems based on population genetics*

1) Study of swim bladder in fish.
2) Study of parental care in class Pisces and class Amphibia.
3) Study of adaptive radiations in reptiles.
4) Study of venomous and non-venomous snakes.
5) Study of migratory flyways of birds.
6) Study of egg laying, marsupials and aquatic mammals.
7) Study of insect morphology (Study of different types of legs- raptorial, fossorial, cursorial and their adaptations in insects).
8) Study of modification of legs mouth parts and sting apparatus of honey bee.
9) Detection of adulterants in honey.
10) Study of different breeds of cattles.
11) Isolation of casein from milk.
12) Detection of adulterants in milk (detergents, starch, urea, glucose).
13) Detection of density of milk with the help of lactometer.

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SYBSc Zoology Syllabus
Choice Based Credit System (With effect from academic year 2024-25)
Scheme of Examination

For Major and Minor Courses

The performance of learners for Major and Minor courses will be evaluated in two parts for the theory component of thecourse:

1. Internal Assessment with 25 marks
2. Semester End Examination (written) with 50 marks

The Practical component of the Course will be evaluated by conducting Semester EndPractical Examination of 25 marks.

Internal Assessment Theory (25 Marks)

It is the assessment of learners on the basis of continuous evaluation as envisaged in the NEP by way of participation of learners in various academic and correlatedactivities in the given semester of the program.

Marks: 25

1. Journal work based on Major/ Minor Practical and Viva based on practical and theory **05 Marks**
2. Class test **05 Marks**
3. At the departmental level evaluation will be conducted on the basis of Presentation/Preparation of Educational reels/Brochure preparation for Ecotourism or pathology lab or laboratory exercises / Report submission based on field visits/ Submission of review of a book/ Submission of journal article or documentary. **10 Marks**

Semester End Assessment Theory (50 Marks)
Marks: 50; Duration: 2 hours

Theory question paper pattern:

- There shall be three questions of 15 marks each. On each unit there will be one question andthe 4th question of 5 marks will be based on the entire syllabus.
- All questions will be compulsory with internal choice within the questions.
- Questions may be subdivided and the allocation of marks depends on the weightage of thetopic.

Semester End Assessment Practical
Marks: 25 Marks; **Duration: 2 hours**

For Vocational and Skill Enhancement Course, Skill Enhancement Course and Field Project

Vocational and Skill Enhancement Course (VSC) will be conducted in semester III and Skill Enhancement Course (SEC) will be conducted in semester IV for all the students who have opted Zoology as major subject.
The performance of the learners for VSC in semester III and SEC in semester IV will be evaluated as:

- Class test based on the course **25 Marks**
- Students will be assessed on the basis of performance in laboratory/field during the course **10 Marks**
- Activity-1 in semester III (VSC): Preparation of compost using kitchen waste/ floral waste/ garden waste by setting up and monitoring a compost bin or compost bioreactor and report preparation based on the observations **15 Marks**
- Activity-2 in semester IV (SEC): Report submission based on recording and analysis of field observations **15 Marks**

Field project will be conducted in semester III for all the students who have opted Zoology as major subject.

- Students will be conducting project for 2-3 months under the guidance/supervision of a teacher/mentor
- Students will be assessed on the basis of:

✓ Project proposal **10 Marks**
✓ Actual project implementation **20 Marks**
✓ Presentation **10 Marks**
✓ Submission of Report **10 Marks**

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