

**INTEGRATED B.Sc.-M.Sc. IN ANIMAL SCIENCE**  
(WITH EFFECT FROM 2018-19)  
[CHOICE BASED CREDIT SYSTEM]



**DEPARTMENT OF ANIMAL SCIENCE**  
**KAZI NAZRUL UNIVERSITY**  
**ASANSOL - 713340**  
**WEST BENGAL, INDIA**

## ***The Department of Animal Science***

The development of biological sciences leads to the up gradation of general life-style of animal and mankind. Technological intervention (based on physics, chemistry and mathematics) on the biological sciences is growing rapidly. This is the need of the time to focus on the holistic approach of life sciences, especially to animal studies for the sustainability of animal as well as human. The environmental factors and physiological response should be monitored very closely for an overall understanding of the subject and society. Since the inception in the year 2016, the mission of the department to provide an in-depth exposure to the students in the emerging field of animal science with an overview of life sciences and subsequently prepare them to be leaders in the field of research and development in academia and industry with a vision of societal sustainability.

### **Vision of the Department:**

Be recognized as a centre of excellence that teaches the biotechnological intervention on animal studies with a holistic approach of Life Sciences. The scientific approach may take the leadership for the sustainability of both animal and mankind. The synchronization of body physiology and environmental stimuli will be focused to understand the individual and societal interaction.

### **Mission of the Department:**

To translate the vision into reality, the Department is committed to -

1. Emerge as a centre of excellence in animal science by providing training at both undergraduate and post-graduate level.
2. Create an interdisciplinary approach in teaching.
3. Establish state-of-the-art facility for cutting edge research.
4. Develop the minds of students with logical questions and power to analyze them for becoming skilled human resource.
5. Organize meaningful seminars, workshop for scientific and social awareness.

### **Course Description:**

'Integrate B.Sc.-M.Sc. in Animal Science' is a 5 years course distributed in 10 semesters of 6 months each. Lateral entry in the PG level is also allowed to the students wishing to pursue a degree of 'M.Sc. in Animal Science', which is a 2 years course involving 4 semesters. Currently the department offers 5 Major Elective Course for specialization.

## Summary of the courses and credits

### B.Sc. Level

	Core Course (C)		Discipline Specific Elective (DSE)		Skill Enhancement Course (SEC)	Generic Elective (GE) <i>Interdisciplinary</i>		Ability Enhancement Compulsory Courses (AECE)	Total credits
	Theory	Practical	Theory	Practical	Theory	Theory	Practical		
Semester - I	8	4	-	-	-	6	-	4	22
Semester - II	8	4	-	-	-	4	2	4	22
Semester - III	12	6	-	-	4	4	2	-	28
Semester - IV	12	6	-	-	4	4	2	-	28
Semester - V	8	4	8	4	-	-	-	-	24
Semester - VI	8	4	8	4	-	-	-	-	24
<b>Total</b>	<b>56</b>	<b>28</b>	<b>16</b>	<b>8</b>	<b>8</b>	<b>18</b>	<b>6</b>	<b>8</b>	<b>148</b>

### M.Sc. Level

	Core Course (C)		Major Elective Course (MJE)		Minor Elective Course (MIE)	Project / Term Paper / Dissertation	Total credits
	Theory	Practical	Theory	Practical			
Semester – VII / I	18	4	-	-	-	-	22
Semester – VII / II	18	4	-	-	4	-	26
Semester – IX / III	12	4	-	-	4	-	20
Semester – X / IV	-	-	6	2	-	12	20
<b>Total</b>	<b>48</b>	<b>12</b>	<b>6</b>	<b>2</b>	<b>8</b>	<b>12</b>	<b>88</b>

**Core Courses:** Course that should compulsorily be studied by a candidate as a core requirement.

**Discipline Specific Elective Course:** Course offered by the main discipline/ subject of study, which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope and which may be chosen from a pool of courses.

**Skill Enhancement Course:** Value-based and/ or skill-based course, aimed at providing hand-on training, competency, skill etc.

**Generic Elective Course (Interdisciplinary Course):** Course chosen generally from an unrelated discipline/ subject of study with an intention to seek an exposure to other subjects.

**Ability Enhancement Compulsory Courses:** Courses based on the contents that lead to knowledge enhancement and consist of (i) Environmental Studies & (ii) English/ MIL Communication.

**Minor Elective Courses (Interdisciplinary Course):** M.Sc. Zoology students will opt one Minor Elective course of 4 credits in the Semester II offered by other PG Departments

**Major Elective Courses (Specialization):** Students will opt one out of the Major Electives offered by the department in PG level.

**Project Work/ Term Paper/ Dissertation:** Involves application of knowledge in solving / analyzing /exploring a real life situation / problem.

### B.Sc. Level Course Details

Semester	Course Code	Course Name	Credits (Th + Pr)	Marks	
<b>I</b>	IBSMSASC101	Invertebrate Diversity, Structure & Functions	4+2	100	
	IBSMSASC102	Vertebrate Diversity, Structure & Functions	4+2	100	
	GE1	<i>Interdisciplinary</i> (Chemistry)	6+0	100	
	AEE101	Environment Studies	4+0	50	
<b>II</b>	IBSMSASC201	Animal Husbandry & Animal Nutrition	4+2	100	
	IBSMSASC202	Cell Biology	4+2	100	
	GE2	<i>Interdisciplinary</i> (Chemistry)	4+2	100	
	AECCE201	English/MIL	4+0	50	
<b>III</b>	IBSMSASC301	Animal Genetics	4+2	100	
	IBSMSASC302	Molecular Biology	4+2	100	
	IBSMSASC303	Fundamentals of Biochemistry	4+2	100	
	GE3	<i>Interdisciplinary</i> (Botany)	4+2	100	
	IBSMSASSE301	Apiculture	<b>any one</b>	4+0	50
	IBSMSASSE302	Sericulture			
	IBSMSASSE303	Molecular Cloning			
IBSMSASSE304	Animal Breeding				
<b>IV</b>	IBSMSASC401	Animal Taxonomy & Animal Preservation	4+2	100	
	IBSMSASC402	Animal Parasitology	4+2	100	
	IBSMSASC403	Immunology	4+2	100	
	GE4	<i>Interdisciplinary</i> (Botany)	4+2	100	
	IBSMSASSE401	Aquarium Fish keeping	<b>any one</b>	4+0	50
	IBSMSASSE402	Quantification Techniques			
	IBSMSASSE403	Laboratory Animal Management			
IBSMSASSE404	Diagnostic Biochemistry				
<b>V</b>	IBSMSASC501	Animal Developmental Biology	4+2	100	
	IBSMSASC502	Animal Ecology	4+2	100	
	IBSMSASDSE501	Animal Behaviour & Chronobiology	4+2	100	
	IBSMSASDSE502	Biology of Insecta	4+2	100	
<b>VI</b>	IBSMSASC601	Microbiology	4+2	100	
	IBSMSASC602	Animal Evolution & Adaptation	4+2	100	
	IBSMSASDSE601	Parasitology	4+2	100	
	IBSMSASDSE602	Aquatic Biology	4+2	100	
<b>Total =</b>			<b>148</b>	<b>2400</b>	

### M.Sc. Level Course Details

Semester	Course Code	Course Name	Credits (Th + Pr)	Marks	
<b>VII / I</b>	IBSMSASC701 / MSCASC101	Cell and Molecular Biology	6+0	50	
	IBSMSASC702 / MSCASC102	Biotechnology and Instrumentation	6+0	50	
	IBSMSASC703 / MSCASC103	Environmental Biology and Wild life	6+0	50	
	IBSMSASC704 / MSCASC104	Practical - I	0+4	50	
<b>VIII / II</b>	IBSMSASC801 / MSCASC201	Animal Physiology	6+0	50	
	IBSMSASC802 / MSCASC202	General and Applied Entomology	6+0	50	
	IBSMSASC803 / MSCASC203	Animal Parasitology and Pathology	6+0	50	
	IBSMSASC804 / MSCASC204	Practical - II	0+4	50	
	MSCASMIE201	<i>Interdisciplinary</i> (Environmental Health & Safety)	4+0	50	
<b>IX / III</b>	IBSMSASC901 / MSCASC301	Arthropods & Host Parasite Relationships	6+0	50	
	IBSMSASC902 / MSCASC302	Ethology & Conservation Biology	6+0	50	
	IBSMSASC903 / MSCASC303	Practical - III	0+4	50	
	MSCASMIE301	<i>Interdisciplinary</i> (Bioethics & Biopolitics)	4+0	50	
<b>X / IV</b>	IBSMSASC1001 / MSCASC401	Dissertation/ Project/ Term Paper	0+12	50	
	IBSMSASMJE1001 / MSCASMJE401	Environmental Factors and Rhythm Physiology	<b>any one</b>	6+2	100
	IBSMSASMJE1002 / MSCASMJE402	Molecular Parasitology and Immunology			
	IBSMSASMJE1003 / MSCASMJE403	Animal Breeding and Laboratory Animals			
	IBSMSASMJE1004 / MSCASMJE404	Molecular and Clinical Toxicology			
	IBSMSASMJE1005 / MSCASMJE405	Entomology			
<b>Total =</b>					

## NOTES ON MARKS DISTRIBUTION:

### SEMESTER: I - VI

1. In a course (paper) of 100 marks, 50 will be Theory and 50 will be Practical. Courses which are without any Practical, full marks will be 50.
2. In each course, 20% marks in Theory & 60% marks in Practical is allotted for Internal Assessments i.e., in Theory of 50 marks, **10 marks** will be allotted for Internal Assessment & **40 marks** for End Semester Examination and in Practical of 50 marks, **30 marks** will be allotted for Internal Assessment & **20 marks** for End Semester Examination.
3. Marks distribution for each theoretical paper of End Semester Examination will be as follows:
 

**UNIT I** (Total Marks 20): *Four questions (out of five) of 1 mark each, four questions (out of five) of 2 marks each and one question (out of two) of 8 marks are to be answered.*

**UNIT II** (Total Marks 20): *Four questions (out of five) of 1 mark each, four questions (out of five) of 2 marks each and one question (out of two) of 8 marks are to be answered.*

### SEMESTER: VII - X

1. Each course (paper) is of 50 marks for both Theory and Practical, except the Major Elective.
2. Major Elective course is of 100 marks, 50 will be Theory and 50 will be Practical.
3. In each Theory course 20% marks & Practical course 60% marks is allotted for Internal Assessments i.e., in Theory of 50 marks, **10 marks** will be allotted for Internal Assessment & **40 marks** for End Semester Examination and in Practical of 50 marks, **30 marks** will be allotted for Internal Assessment & **20 marks** for End Semester Examination.
4. Marks distribution for each theoretical paper of End Semester Examination will be as follows:
 

**UNIT I** (Total Marks 20): *Four questions (out of five) of 1 mark each, four questions (out of five) of 2 marks each and one question (out of two) of 8 marks are to be answered.*

**UNIT II** (Total Marks 20): *Four questions (out of five) of 1 mark each, four questions (out of five) of 2 marks each and one question (out of two) of 8 marks are to be answered.*

## Detailed Syllabus

### Semester - 1

#### IBSMSASC101 – Invertebrate Diversity, Structure & Function

Full Marks: 100

CA+ESE marks: Theory 10+40, Practical 30+20

Credit: 6

L-T-P: 4-0-4

**Learning Outcomes:** On completion of this course the students will be able to:

- Develop understanding on the diversity of invertebrate life.
- Group animals on the basis of their morphological characteristics/ structures.
- Develop critical understanding how animals changed from a primitive cell to a collection of simple cells to form a complex body plan.
- Understand the relative position of individual organs and associated structures through dissection of the invertebrate representatives.
- Realize that very similar physiological mechanisms are used in very diverse organisms.

#### Theory (4 credits)

##### Unit-I: Invertebrate Diversity

1. Five and six kingdom concepts, Domain Concept
2. Outline classification of sub-kingdom Protozoa (up to Phylum examples with scientific names) (Levine et al., 1980)
3. Classification with characteristic features and examples with scientific names of:
  - a. Phylum Cnidaria, Phylum Platyhelminthes, Phylum Mollusca and Phylum Echinodermata – as per Ruppert and Barnes (6<sup>th</sup> Ed.1994) up to sub-classes
  - b. Phylum Porifera – as per Hyman (1940); and Phylum Annelida – as per Ruppert and Barnes (6<sup>th</sup> Ed. 1994) up to orders
  - c. Phylum Arthropoda, (and Nematoda) – as per Ruppert and Barnes (6<sup>th</sup> Ed. 1994) up to classes
  - d. Outline classification of Minor phyla
  - e. Salient features and affinities of *Peripatus*, *Limulus* and *Balanoglossus*.

##### Unit-II: Invertebrate Structure & Function

1. Structure of digestive system and mechanism of digestion
2. Respiratory Structure and mechanism of respiration
3. Circulatory system and mechanism of circulation
4. Excretory system and mode of excretion
5. Osmoregulation and homeostatic mechanism
6. Reproductive system and reproduction
7. Locomotory structures and mechanism of locomotion
8. Nervous system and sensory structures
9. Larval forms.

##### Practical (2 credits)

1. Digestive system of earthworm, cockroach & snail
2. Reproductive system of Earthworm & Cockroach
3. Nervous system of earthworm & cockroach
4. Identifications of animals with reasons from different invertebrate phylum
4. Invertebrate animals preservation technique

<b>IBSMSASC102 – Vertebrate Diversity, Structure &amp; Function</b>			
Full Marks: 100	CA+ESE marks: Theory 10+40, Practical 30+20	Credit: 6	L-T-P: 4-0-4

**Learning Outcomes:** On completion of this course the students will be able to:

- Develop understanding on the diversity of vertebrate life.
- Group vertebrate animals on the basis of their morphological characteristics/ structures.
- Understand the relative position of individual organs and associated structures through dissection of the invertebrate representatives.
- Realize that very similar physiological mechanisms are used in very diverse organisms.
- Have an overview of the evolutionary concepts including homology and homoplasy, and detailed discussions of major organ systems.
- Engage in field-based study of the biodiversity research activities to understand well the theoretical aspects taught and gathering data in the field.

### Theory (4 credits)

#### Unit-I: Vertebrate Diversity

1. Origin of Chordates
2. Classification with characteristic features and examples with scientific names of: Protochordates, Pisces, Amphibia, Reptilia, Aves and Mammalia
3. Zoogeography and distribution pattern of vertebrate animals.
4. Diversity of domesticated animals like Dog, Horse, Cows and buffalos and their origins

#### Unit-II: Vertebrate Structure & Function

1. Skeleton system
2. Circulatory system
3. Integumentary system and its derivatives
4. Respiratory structures and function
5. Alimentary canal with special reference to stomach and intestine
6. Excretory system with special reference to Kidney
7. Flight mechanism birds
8. Echolocation in chiropterans and cetaceans
9. Animal migration and mechanism of navigation
10. Metamorphosis: progressive and retrogressive, neoteny and paedomorphosis
11. Cranial kinesis with reference to biting in snakes
12. Aestivation and hibernation

#### Practical (2 credits)

1. Circulatory system of Toad, *Labeo*,
2. Nervous system of *Labeo* (Brain, Lateral line sense organ) & Cranial nerves of Chicken
3. Identifications of different bones of Toad, Pigeon, Varanus and Rabbit or Rat
4. Identification soft different animals from each class of vertebrate animals
5. Visit to any place to study Biodiversity.



<b>AEE101 - Environment Studies</b>			
Full Marks: 50	CA+ESE marks: 10+40	Credit: 4	L-T-P: 4-0-0

**Theory (4 credits)****1. Multidisciplinary nature of environmental studies**

- i) Definition, Nature, Scope and importance
- ii) Types and Components of environment
- iii) Environmental education.
- iv) Global environmental crisis.

**2. Natural Resources: Renewable and Non-renewable resources**

- i) Forest resources: Uses types and importance, deforestation and its effects
- ii) Water resources: Distribution of water on earth, use and overuse
- iii) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies
- iv) Food resources: World food production & distribution. Food crisis- its causes
- v) Energy resources: Renewable and Non-renewable energy sources, Use of alternate energy sources
- vi) Land resources: Land as a resource, Land degradation, Landslides, Soil erosion
- vii) Role of an individual in the conservation of natural resources
- viii) Equitable use of resources for sustainable life style.

**3. Ecology and Ecosystems:**

- i) Concept of ecology, autecology and synecology
- ii) Concept of an ecosystem: Different types of ecosystem, Biomes
- iii) Energy flow in the ecosystem, Energy flow models
- iv) Food chains, food webs and ecological pyramids
- v) Biogeochemical cycles: Nitrogen and Phosphorus

**4. Bio-diversity and its conservation**

- i) Introduction- Definition: Genetics, species and ecosystem diversity
- ii) Threats to bio-diversity: Value of bio-diversity, Hot-spots of bio-diversity
- iii) Conservation of bio-diversity: *In situ* and *Ex situ* conservation of bio-diversity
- iv) Endangered and endemic species of India

**5. Environmental Pollution**

- i) Air pollution: Definition, Sources, Causes, Effects and Control measures
- ii) Water pollution: Definition, Sources, Causes, Effects and Control measures
- iii) Soil pollution: Definition, Sources, Causes, Effects and Control measures
- iv) Noise pollution: Definition, Sources, Causes, Effects and Control measures
- v) Fireworks pollution: Definition, Composition/Ingredients, Effects, Monitoring strategies
- vi) Thermal Pollution: Brief concepts
- vii) Nuclear Pollution: Brief concepts

**6. Social Issues and the Environment**

- i) Water conservation, rain water harvesting
- ii) Climate change, global warming, acid rain, ozone layer depletion
- iii) From unsustainable to sustainable development
- iv) Urban problem related to energy
- v) Govt. Agencies viz. CPCB, SPCB and their functions
- vi) Constitutional Provisions for protecting environment-Articles 48(A), 51A (g)
- vii) The Environment (protection) Act, 1986
- viii) Environment protection movements in India: Chipko Movements, Silent Valley Movements in Karnataka

**7. Human Population and the Environment**

- i) Definition, characteristic; Human population growth
- ii) Population explosion- Family Welfare Programme
- iii) Environment and human health: Concept of health & disease
- iv) Human rights, value education, role of Information technology in environment

## Semester - 2

### IBSMSASC201: Animal Husbandry & Animal Nutrition

Full Marks: 100

CA+ESE marks: Theory 10+40, Practical 30+20

Credit: 6

L-T-P: 4-0-4

**Learning Outcomes:** On completion of this course the students will be able to:

- Select and develop a breeding system for a livestock enterprise.
- Understand the importance of genetic improvement in animal production.
- Formulate feed rations for different classes of livestock.
- Identify common problems associated with livestock health and solutions.
- Identify current and future issues relating to animal husbandry.
- Understand different marketing opportunities available for livestock production.
- Entrepreneurship development related with Animal Husbandry.
- Gain first hand practical knowledge on animal husbandry from firm visit.

### Theory (4 credits)

#### UNIT-I: Animal Husbandry

1. **Breeds:** Various indigenous breeds of livestock including poultry; Exotic breeds experienced in India; Origin, distribution and breed description of important breeds.
2. **Farm Animal Practices:** Dentition and ageing of animals. Disbudding, marking of animals, Grooming, Dipping, Castration, Isolation, quarantine, Disinfection and disposal of carcasses. Drug administration, Vices of animals, their prevention and care.
3. **Dairy Farming:** Opportunities in dairy farming, Dairy in gunder mixed and as specialized farming. Management of calves, heifer, pregnant, lactating and dry animals, bulls and bullocks. Housing systems, Layout and design of different buildings for dairy animals. Methods of milking and precautions. Factors affecting quality and quantity of milk. Organic Livestock Production.
4. **Fodder Production:** Importance of grasslands and fodder in livestock production. Feed and fodder requirements of individual animal. Supply of greens throughout the year. Scarcity fodder, Recycling of animal wastes and washings for fodder production.
5. **Sheep and Goat Farming:** Home stead farmings, Commercial farming, Goat as poor man's cow.
6. **Poultry Production:** Economic Importance of commercial poultry farming, Backyard poultry farming. Brooding management. Incubation and hatching, Management of broilers, layers and breeder flock. Designer egg.

#### UNIT-II: Animal Nutrition

1. **Livestock Feeds:** Common feeds and fodder and their Energy Nutrition: Energy sources, Measures of food energy and their application such as Gross Energy, Digestible Energy, Metabolisable Energy, Net Energy, Total Digestible Nutrients. Energy requirement for maintenance, growth, pregnancy and lactation in milk producing livestock.
2. **Protein Nutrition:** Biological value of protein, Protein efficiency ratio, digestible crude protein. Use of NPN instruments, bypass protein. Protein requirements for maintenance, growth, pregnancy and lactation in milk producing livestock. Improvement of poor quality roughages.
3. **Mineral and Vitamin Nutrition:** Major and trace minerals, their sources, physiological function and deficiency symptoms. Role of vitamins, their sources and deficiency symptoms.
4. **Feed Additives:** Role of probiotics, prebiotics, antibiotics, enzymes, antioxidants, buffers, mould inhibitor and methane inhibitors. Anti nutritional and toxic factors present in livestock feed and fodder.
5. **Storage & Conservation of Feeds and Fodders:** Storage of feeding ingredients. Conservation of fodder through hay and silage making and their use in livestock feeding.

6. **Computation of Ration:** Balanced ration, Formulation of ration and feeding of dairy cattle and buffaloes during different phases of growth and production (young, pregnant, lactating and dry animals).
7. Formulation of ration and feeding of sheep, goat, pig and poultry.

#### **Practical (2 credits)**

1. Identification of different breeds of cow, poultry birds and ducks
2. Incubation of Eggs
3. Formulation of Feeds
4. Identification of deficiency syndrome in cow and poultry birds
5. Visit to animal farms/ dairy/ poultry firm etc.

<b>IBSMSASC202: Cell Biology</b>			
Full Marks: 100	CA+ESE marks: Theory 10+40, Practical 30+20	Credit: 6	L-T-P: 4-0-4

**Learning Outcomes:** On completion of this course the students will be able to:

- Gather knowledge regarding structural aspects of cell
- Understand the functioning of nucleus and extra nuclear organelles and understand the intricate cellular mechanisms involved.
- Understand the utility of cell in an organism.

#### **Theory (4 credits)**

##### **UNIT-I: Cell Anatomy**

1. Structure of Animal Cell and their structural variations,
2. Structure of different cellular organelle
3. Structure of Chromosome and special chromosomes
4. Structure of Microtubules
5. Structure of Cell junction and their types
6. Structure of different modified cellular organelle
7. Structure and classification of DNA and RNA.

##### **UNIT-II: Cell Physiology**

1. Transportation of Molecules into and out of the cell,
2. Osmoregulation of cell
3. Cell cycle
4. Cell Signalling
5. DNA Replication Mechanism
6. Formation of Spindle fibers
7. Cell division physiology
8. Formation of Nucleolus
9. Mitochondrial function physiology
10. Formation of Chromosome structure

#### **Practical (2 credits)**

1. Blood film preparation and identification of different blood cells
2. Squash Preparation grasshopper testis and onion root tips for study of cell division
3. DNA & RNA extraction and estimation.
4. Polytene chromosome preparation from *Drosophila* or Chironomid larva

## Semester – 3

### IBSMSASC301 – Animal Genetics

Full Marks: 100

CA+ESE marks: Theory 10+40, Practical 30+20

Credit: 6

L-T-P: 4-0-4

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *To have clear concepts about genetic basis of traits and mechanism of heredity.*
- *Understand how DNA encodes genetic information.*
- *Apply the principles of Mendelian inheritance.*
- *Understand the cause and effect of alterations in chromosome number and structure.*
- *Relate the conventional and molecular methods for gene manipulation in other biological systems.*
- *Discuss and analyze the epigenetic modifications and imprinting and its role in diseases.*

#### Theory (4 credits)

##### UNIT-I:

1. Mendelism
2. Crossing over and Linkage
3. Sex Linked inheritance
4. Sex Determination in *Drosophila* and Man

##### UNIT-II:

1. Cytoplasmic inheritance
2. Gene interactions with example
3. Mutation and its types and molecular mechanism
4. Genetic Code
5. Epigenetics and Phenocopies

#### Practical (2 credits)

1. Karyotype preparation
2. Estimation of DNA and RNA
3. Identification of mutant variety of *Drosophila*
4. Pedigree Analysis

### IBSMSASC302 – Molecular Biology

Full Marks: 100

CA+ESE marks: Theory 10+40, Practical 30+20

Credit: 6

L-T-P: 4-0-4

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Impart the knowledge of molecular aspects of life and understand the molecular basis of life.*
- *Develop an understanding of concepts, mechanisms and evolutionary significance and relevance of molecular biology in the current scenario.*
- *Understand the process of DNA replication, transcription and translation*

#### Theory (4 credits)

##### UNIT-I:

1. Salient features of DNA and RNA; Watson and Crick model of DNA
2. DNA Replication in prokaryotes and eukaryotes, DNA polymerases, primosome, RNA priming, Replication of circular and linear ds-DNA, replication of telomeres

3. RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, transcription factors
4. Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; mechanism of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain

#### UNIT-II:

1. Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of hnRNA
2. Transcription regulation in prokaryotes: lac operon and trp operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers
3. Pyrimidine dimerization and mismatch repair, proto-oncogene, oncogene, tumour suppressor gene, activation of oncogene, multy hit and two hit hypothesis
4. Ribo-switches, RNA interference, miRNA, siRNA

#### Practical (2 credits)

1. Paper and Thin layer chromatography
2. Gel electrophoresis
3. Study of nuclease action

### IBSMSASC303 – Fundamentals of Biochemistry

Full Marks: 100

CA+ESE marks: Theory 10+40, Practical 30+20

Credit: 6

L-T-P: 4-0-4

**Learning Outcomes:** *On completion of this course the students will be able to:*

- Understand about the importance and scope of biochemistry.
- Understand the complexity, structural organization and function of cellular biomolecules.
- Understand the structure and biological significance of carbohydrates, amino acids, proteins, lipids and nucleic acids.
- Understand the concept of enzyme, its mechanism of action and regulation.
- Learn biochemical tests for amino acids, carbohydrates, proteins and nucleic acids.
- Learn measurement of enzyme activity and its kinetics.
- Enrich the fundamental knowledge on cellular and molecular chemistry of living system.

#### Theory (4 credits)

##### UNIT-I:

1. Structure, types and Biological importance: carbohydrate, Protein, lipid and nucleic acids
2. Enzymes: Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Lineweaver-Burk plot; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action

##### UNIT-II:

1. Carbohydrate Metabolism; Sequence of reactions and regulation of glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis
2. Protein Metabolism; Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids
3. Lipid Metabolism;  $\beta$ -oxidation and omega-oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis

**Practical (2 credits)**

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids
2. Paper chromatography of amino acids
3. Action of salivary amylase under optimum conditions
4. Effect of pH, temperature and inhibitors on the action of salivary amylase
5. Demonstration of protein estimation by Lowry et al (1951).

**IBSMSASSE301 - Apiculture**

Full Marks: 50

CA+ESE marks: 10+40

Credit: 4

L-T-P: 4-0-0

**Learning Outcomes:** On completion of this course the students will be able to:

- Explain the prerequisites to get started in beekeeping.
- Discuss the responsibilities of urban beekeepers.
- Identify where to purchase equipment and demonstrate how to assemble it.
- Name and identify major parts of the honeybee such as the stinger or mandibular parts.
- Describe bee biology and anatomy from the perspective of managing bees.
- Describe the importance of wax and identify what to look for in comb during hive inspections.
- Take beekeeping as an occupation.

**Theory (4 credits)****UNIT-I:****Introduction to Apiculture:**

1. History of Bees and Beekeeping.
2. Systematics, Bee species, Bee morphology, Colony organization, Polymorphism, Caste system, Division of labour, Bee flora, Foraging and Honey flow periods.

**Bee keeping as an occupation:**

3. Extent of Beekeeping in West Bengal and India.
4. Limitations on the development of beekeeping.
5. Advantages of extensive Beekeeping.
6. Beekeeping equipments: Bee box and tools and initiation into keeping a colony, the future of beekeeping.

**UNIT-II:****The first step in beekeeping:**

1. Establishment of a colony. Purchase of a colony, the Apiary site, how to manage a colony, the manipulation of a colony.
2. Bee products: Honey, Bees wax, Pollens, Royal Jelly, Propolis and Bee venom.
3. Taking care of bee diseases and enemies.
4. Bee flora and planned pollination services.

**Beekeeping techniques and Apiary management:**

5. Routine management, Seasonal management, Migratory beekeeping.
6. Harvesting and marketing of bee products.
7. Important Institutions pertinent to Apiculture: National Bee Board, Bee research and Training Institute, Apiaries.
8. Economics and extension of Bee keeping.

<b>IBSMSASSE303 - Sericulture</b>			
Full Marks: 50	CA+ESE marks: 10+40	Credit: 4	L-T-P: 4-0-0

**Learning Outcomes:** On completion of this course the students will be able to:

- Explain the prerequisites to get started in sericulture.
- Generate skilled man power in the field of sericulture.
- Impart training in extension management and transfer of technology.
- Impart training in Post Cocoon Technology.
- Understand the scope of sericulture.
- Take sericulture as an occupation.

**Theory (4 credits)**

**UNIT-I:**

**Silkworm distribution and races:**

1. Distribution and types of races of silkworm. Exotic and indigenous races.
2. World silk production. World map and Silk Road, spread of Sericulture to Europe, South Korea, Japan, India and other countries.
3. Mulberry and non-mulberry Sericulture

**Biology of silkworm:**

3. Morphology and Biology of silkworm.
4. Selection of mulberry variety and establishment of mulberry garden, Rearing house and rearing appliances.
5. Silkworm rearing technology: Early age and late age rearing. Selection of silkworm races/breeds for rearing.
6. Incubation - definition, requirement of environmental conditions, incubation devices.
7. Types of mountages, Spinning, harvesting and storage of cocoons.
8. Identification of stages of development; black boxing and its importance.

**UNIT-II:**

**Diseases of silk worm and prevention and control:**

1. Disinfectants: Formalin, bleaching powder RKO.
2. Classification of silkworm diseases.
3. Protozoan disease: symptomatology due to *Nosema bombycis* infection, source, mode of infection and transmission, cross infectivity, prevention and control.
4. Bacterial, Viral, Fungal diseases: causative agents, symptoms, transmission prevention and control.

**Prospects of Sericulture in India:**

5. Sericulture Types- natural and synthetic fibres- types of silk produced in India.
6. Importance of mulberry silk.
7. Silk industry in different states, employment, potential in mulberry and nonmulberry sericulture.
8. Employment generation in sericulture: Role of women in sericulture.
9. Sericulture organization in India; role of state departments of Sericulture, Central Silk Board, Universities and NGOs in Sericulture development.

<b>IBSMSASSE303 - Molecular Cloning</b>			
Full Marks: 50	CA+ESE marks: 10+40	Credit: 4	L-T-P: 4-0-0

**Learning Outcomes:** On completion of this course the students will be able to:

- Understand about the importance and scope of molecular cloning technology.
- Understand the purpose of the technique, its proper use and possible modifications/ improvement.

- *Learn the theoretical basis of technique, its principle of working and its correct application.*
- *Understand the technique of cell and tissue culture.*
- *Understand the process of preparation of buffer. Learn the techniques of separation of amino acids, proteins and nucleic acids.*

### **Theory (4 credits)**

#### **UNIT-I: Genetic Engineering:**

1. Enzymes in genetic engineering – restriction enzymes type I, II & III, ligases, enzymes to modify the ends of DNA molecules; alkaline phosphatase, polynucleotide kinase, terminal 16 transferase, polymerases, reverse transcriptase etc.
2. Gene cloning vectors: plasmids – pBR 322, Ti plasmids – bacteriophages – lambda phage, M13, charon phages – cosmids – virus – phagemids – BAC, PAC - special vectors – shuttle vectors, expression vectors, yeast artificial chromosomes, MAC etc.
3. Gene isolation, identification and synthesis; Construction of chimeric DNA – cohesive end ligation – use of linkers – blunt end ligation; construction and screening of cDNA and genomic libraries – colony hybridization – plaque hybridization.

#### **UNIT-II:**

1. PCR technology – gene amplification – primer designing – variation in PCR – real time PCR.
2. Gene transfer in animals and plants: Gene transfer method (transfection) – direct gene transfer – Ti plasmid – electroporation – uptake by protoplast – microinjection – liposome mediated DNA delivery – Transgenic animals and plants.
3. Blotting techniques: Southern blotting – northern blotting – western blotting – dot blots.
4. Transgenic Plants and Transgenic animals.



## Semester - 4

### IBSMSASC401: Animal Taxonomy & Animal Preservation

Full Marks: 100	CA+ESE marks: Theory 10+40, Practical 30+20	Credit: 6	L-T-P: 4-0-4
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**Learning Outcomes:** On completion of this course the students will be able to:

- Understand the historical development of systematics from ancient to the present.
- Appreciate the complexities and difficulties of various species concepts.
- Gain a basic grasp on the rules and philosophy of nomenclature.
- Know about the steps required to do systematic and dichotomous key.
- Gain the knowledge on animal preservation and taxidermy and their importance.

#### Theory (4 credits)

##### UNIT-I: Animal Taxonomy

1. Basics of Animal Classifications
2. History of Biological Taxonomy
3. Definitions: Classification, Systematics and Taxonomy: Hierarchy, Taxonomic types;
4. Codes of Zoological Nomenclature; Principle of priority; Synonym and Homonym
5. Species Concept – Biological and evolutionary;
6. Basic idea of Cladistics
7. Concepts about Numerical, Molecular and Biochemical Taxonomy

##### UNIT-II: Animal Preservation

1. Preservatives - Types and mode of action and uses
2. Basic idea about Taxidermy
3. Whole mount preparation and its technique
4. Importance of animal preservation
5. Technique of Insect preservation
6. Museum and its role.

#### Practical (2 credits)

1. Identification of animals with the help of dichotomous key (insect specimen)
2. Preparation of dichotomous key

### IBSMSASC402: Animal Parasitology

Full Marks: 100	CA+ESE marks: Theory 10+40, Practical 30+20	Credit: 6	L-T-P: 4-0-4
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**Learning Outcomes:** On completion of this course the students will be able to:

- Diagnose the causative agents, describe pathogenesis and treatment for important diseases like malaria, ascariasis, filariasis, trypanosomiasis etc.
- Gain knowledge about different vectors and their management.
- Identify important parasites.

#### Theory (4 credits)

##### UNIT-I:

1. Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector);
2. Host parasite relationship.
3. Study of Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of-  
*Entamoeba histolytica*,

*Plasmodium vivax,*  
*Taenia solium,*  
*Ascaris lumbricoides,*  
*Wuchereria bancrofti,*  
*Trypanosoma*

#### UNIT-II:

1. Myiasis,
2. Mosquitoes,
3. Sand flies,
4. Rat flea,
5. House flies

#### Practical (2 credits)

1. Gut content analysis of Toad, cockroach, goat and chicken
2. Identification of different parasites commonly found in India

### IBSMSASC403: Immunology

Full Marks: 100

CA+ESE marks: Theory 10+40, Practical 30+20

Credit: 6

L-T-P: 4-0-4

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Understand the basis of animal immune system.*
- *Understand the relationship between disease and immune system.*
- *Identify the major cellular and tissue components which comprise the innate and adaptive immune system.*
- *Understand how are immune responses are initiated and regulated.*
- *Understand how the immune system distinguishes self from non-self.*

#### Theory (4 credits)

##### UNIT-I:

1. Cells and organs of the Immune system,
2. Properties and functions of cytokines,
3. Therapeutics of Cytokines,
4. Structure and functions of MHC molecules.
5. Endogenous and exogenous pathways of antigen processing and presentation,
6. Hypersensitivity
7. Innate and Adaptive immunity,

##### UNIT-II:

1. Antigenicity and immunogenicity,
2. Immunogens, Adjuvants and Haptens,
3. Factors influencing immunogenicity,
4. B and T-Cell epitopes,
5. Structure and functions of different classes of immunoglobulins,
6. Antigen-antibody interactions,
7. Immunoassays (ELISA and RIA),
8. Polyclonal sera,
9. Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis

#### Practical (2 credits)

1. Histological study of spleen, thymus and lymph nodes through slides/ photographs

2. Preparation of stained blood film to study various types of white blood cells
3. Ouchterlony's double immuno-diffusion method
4. Demonstration of ELISA.

### IBSMSASSE401: Aquarium Fish keeping

Full Marks: 50

CA+ESE marks: 10+40

Credit: 4

L-T-P: 4-0-0

**Learning Outcomes:** On completion of this course the students will be able to:

- To learn the scientific method of setting an aquarium.
- To learn the culture breeding and marketing techniques of common indigenous ornamental fishes.

#### Theory (4 credits)

#### UNIT-I: Designing and preparation of aquaria with accessories:

1. Importance and history of aquarium fish keeping.
2. Design and construction of aquaria: aquarium fabrication- shape, size, volume, type of glass tank, cutting of glass, preparation of glass tank, strengthening and supporting of tank, fitting of tanks into room settings.
3. Aquarium floor setting – type and size of pebbles, gravels, granites used for bed setting and its advantages.
4. Filters- biological, chemical and mechanical. Aquarium accessories like aerators, decorative, lighting, heating and feeding trays.
5. Water quality management in aquarium systems – sources of water, containers, storage, temperature, pH, dissolved carbon dioxide, ammonia, hardness, turbidity and ozone in aquarium.
6. Aquarium plants: Uses of aquarium plants, different varieties of plants like submerged plants (tubers, rooted plants, cutting plants) and emerged plants.

#### Unit II: Common ornamental aquarium fishes and brood stock management:

1. Common ornamental fishes: Identification and biology of the common ornamental fishes. *Xiphophorus helleri* (red sword tail), *Xiphophorus maculatus* (red platy), *Pterophyllum scalare altum* (angel fish), *Carassius auratus* (red oranda), *Betta splendens* (Siamese fighting fish), *Trichogaster leeri* (pearl gourami) etc.
2. Conditions for breeding of common ornamental fishes - pH, temperature and sex ratio.
3. Brood stock management - selection of brooders, maintenance and management of brood stocks.
4. Selective breeding and hybridization techniques. Induced breeding.
5. Colour enhancement techniques.
6. Food and feeding - live feed and formulated feed. Preparation and culture of live feed (Artemia, Infusoria, Spirulina).
7. Common disease of ornamental aquarium fishes - their causative agents - virus, bacteria, fungi, protozoa and nematode; symptoms, treatment and prophylactic measures.

### IBSMSASSE404: Diagnostic Biochemistry

Full Marks: 50

CA+ESE marks: 10+40

Credit: 4

L-T-P: 4-0-0

**Learning Outcomes:** On completion of this course the students will be able to:

- Understand different disorders, disease and syndromes in human.
- Understand the biochemical basis of diseases and disorders.
- Understand the principles of tests and diagnosis of diseases and disorders.

- *Understand the working mechanism of machines used in tests and diagnosis.*
- *Apply the knowledge in self-employment in future.*

### **Theory (4 credits)**

#### **UNIT-I**

##### **Diagnosis of in born errors in metabolism:**

1. Metabolic disorders of carbohydrates - galactosemia, glycogen storage disease, deficiency of glucose-6-phosphate dehydrogenase, Hypoglycemia, Diabetes mellitus.
2. Metabolic disorder of lipid: Tay-Sachs disease, Nieman Pick disease.
3. Metabolic disorder of amino acid: phenylketonuria, alkaptonuria, Maple syrup urine disease.
4. Metabolic disorder of nucleotides: gout, Lesch -Nyhan Syndrome.

##### **Diagnostic Enzymes:**

5. Functional plasma enzymes, isozymes and diagnostic tests.
6. Enzyme pattern in health and diseases as is special reference to plasma lipase, amylase, alkaline and acid phosphatase, cholinesterase, LDH and CPK.

#### **UNIT-II**

##### **Organ function test:**

1. Liver function test (SGPT, SGOT, ALP, GGTP, Bilirubin) for Jaundice, Hepatitis.
2. Renal function test (creatinine and inulin clearance).
3. Cardiac function test (ECG & EKG).
4. Brain function test (CT scan and MRI).

##### **Diagnostic Imaging:**

5. Basic principles and uses of X-rays, USG, MRI, PET, SPET.

## Semester – 5

### IBSMSASC501 – Animal Developmental Biology

Full Marks: 100

CA+ESE marks: Theory 10+40, Practical 30+20

Credit: 6

L-T-P: 4-0-4

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Develop critical understanding how a single-celled fertilized egg becomes an embryo and then a fully formed adult by going through three important processes of cell division, cell differentiation and morphogenesis.*
- *Understand how developmental processes and gene functions within a particular tissue or organism can provide insight into functions of other tissues and organisms.*
- *Realize that very similar mechanisms are used in very diverse organisms; and development is controlled through molecular changes resulting in variation in the expression and function of gene networks.*
- *Understand how the field of developmental biology has changed since the beginning of the 19th century with different phases of developmental research predominating at different times.*
- *Understand the relevance of developmental biology in human welfare.*

### Theory (4 credits)

#### UNIT-I:

1. Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern formation, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division.
2. Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes.
3. Fertilization (External and Internal): Changes in gametes, Blocks to polyspermy.
4. Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); Early development of frog and chick upto gastrulation.
5. Embryonic induction and organizers; Fate of Germ Layers.

#### UNIT-II:

1. Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta).
2. Metamorphosis: Changes, hormonal regulations in amphibians and insects.
3. Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each).
4. Ageing: Concepts and Theories
5. Teratogenesis: Teratogenic agents and their effects on embryonic development.
6. In-vitro fertilization, Stem cell (ESC), Amniocentesis.

### Practical (2 credits)

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-budstage, tadpole (external and internal gill stages)
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
3. Study of the developmental stages and life cycle of *Drosophila* from stock culture
4. Study of different sections of placenta (photomicrograph/ slides)
5. Project report on *Drosophila* culture/ chick embryo development

## IBSMSASC502 – Animal Ecology

Full Marks: 100

CA+ESE marks: Theory 10+40, Practical 30+20

Credit: 6

L-T-P: 4-0-4

**Learning Outcomes:** On completion of this course the students will be able to:

- Understand what makes the scientific study of animal ecology a crucial and exciting endeavour.
- Engage in field-based research activities to understand well the theoretical aspects taught besides learning techniques for gathering data in the field.
- Solve the environmental problems involving interaction of humans and natural systems at local or global level.
- Analyze the different methods of air, water, and soil quality monitoring process.
- Study, monitor, observe and prepare report on ecosystem.

### Theory (4 credits)

#### UNIT-I:

1. Levels of organization, Laws of limiting factors, study of physical factors.
2. Population attributes: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion.
3. Exponential and logistic growth, equation and Patterns, and k strategies.
4. Population regulation – density-dependent and independent factors.
5. Population interactions; Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition.
6. Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect.

#### UNIT-II:

1. Ecological succession with one example; Theories pertaining to climax community.
2. Types of ecosystems with one example in detail,
3. Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies.
4. Nutrient and biogeochemical cycle with one example of Nitrogen cycle.
5. Wild life Conservation (ideas of in-situ and ex-situ conservation). Management strategies for tiger conservation.
6. Protection laws for wild life conservation, Bio-resource assessment and planning.

### Practical (2 credits)

1. Preparation of nested quadrat and estimation of effective quadrat size
2. Determination of population density in a natural/ hypothetical community by quadrat method and calculation of Sorenson's Similarity & Shannon-Weiner diversity indices for the same community
3. Study of an aquatic ecosystem: Major Phytoplankton (Upto Family) and zooplankton (Upto Genus), temperature, turbidity/ penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method) and free CO<sub>2</sub>
4. Estimation of Primary productivity by light & dark bottle method
5. Report on a visit to National Park/ Biodiversity Park/ Wildlife sanctuary/ Sea Shore

## IBSMSASDSE501 - Animal Behaviour & Chronobiology

Full Marks: 100

CA+ESE marks: Theory 10+40, Practical 30+20

Credit: 6

L-T-P: 4-0-4

**Learning Outcomes:** On completion of this course the students will be able to:

- Learn a wide range of theoretical and practical techniques used to study animal behaviour.
- Develop skills, concepts and experience to understand all aspects of animal behaviour.
- Objectively understand and evaluate information about animal behaviour and ecology encountered in our daily lives.
- Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild.
- Consider and evaluate behaviour of all animals in the natural environment.

### Theory (4 credits)

#### UNIT-I:

- 1. Introduction to Animal Behaviour:** Origin and history of Ethology; Brief profiles of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen, Proximate and ultimate causes of behaviour
- 2. Patterns of Behaviour:** Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting.
- 3. Social Behaviour:** Concept of Society; Communication and the senses; Altruism; Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance.
- 4. Sexual Behaviour:** Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

#### UNIT-II:

- 1. Biological Rhythm:** Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms; Circannual rhythms.
- Photoperiod and regulation seasonal reproduction of vertebrates; Role of melatonin.
- 3. Biological Clocks:** Relevance of biological clocks; Adaptive significance of biological clocks.

### Practical (2 credits)

1. To study nests and nesting habits of social insects (Termites and Ants).
2. To study geotaxis behaviour in earthworm.
3. Visit to Forest/ Wild life Sanctuary/ Biodiversity Park/ Zoological Park to study behavioural activities of animals and prepare a short report.
4. Study of circadian functions in humans (daily eating, sleep and temperature patterns).
5. Preparation of kinematic diagram / ethogram through ad libitum study.

<b>IBSMSASDSE502 - Biology of Insecta</b>			
Full Marks: 100	CA+ESE marks: Theory 10+40, Practical 30+20	Credit: 6	L-T-P: 4-0-4

**Learning Outcomes:** On completion of this course the students will be able to:

- Gain basic knowledge about insect world, their morphology and functioning.
- Understand the biology of insects, their behavior and importance in human life.
- Develop awareness about the causative agents and control measures of many commonly occurring diseases.
- Devise strategies to manage the vectors population.
- Identify important insects and learn techniques of insect study.

### Theory (4 credits)

#### UNIT-I:

- 1. Introduction:** General Features of Insects. Distribution and Success of Insects on the Earth.
- 2. Insect Taxonomy:** Basis of insect classification; Classification of insects up to orders.

3. **General Morphology of Insects:** External Features; Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits, Types of Legs adapted to diverse habitat.
4. **Physiology of Insects:** Structure and Physiology of Insect respiratory & endocrine systems. Sensory receptors. Growth and metamorphosis.

#### **UNIT-II:**

1. **Insect Society:** Group of social insects and their social life. Social organization and social behaviour (w.r.t. any one example).
2. **Insect Plant Interaction:** Theory of co-evolution, role of allelochemicals in host plant mediation.
3. **Insects as Vectors:** Insects as mechanical and Biological vectors, Brief discussion on houseflies and mosquitoes as important insect vectors.

#### **Practical (2 credits)**

1. Study of different kinds of mouth parts of insects
2. Study of insect wings and their venation.
3. Methodology of collection, preservation and identification of insects
4. Morphological studies of various castes of Apis, Camponotus and Odontotermes
5. Study of any three insect pests and their damages
6. Study of any three beneficial insects and their products
7. Field study of insects and submission of a project report on the insect diversity



## Semester - 6

### IBSMSASC601: Microbiology

Full Marks: 100

CA+ESE marks: Theory 10+40, Practical 30+20

Credit: 6

L-T-P: 4-0-4

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Understand the disease-causing potential of bacteria and viruses, and the responses of the immune system.*
- *Summaries and orally present current microbiological problem areas.*
- *Describe the mechanisms for transmission, virulence and pathogenicity in pathogenic micro-organisms.*
- *Assess the importance of incidence, prevalence and epidemiology in microbiological diagnostic activities.*
- *Carry out common procedures for culturing, purifying and diagnostics of micro-organisms.*
- *Develop bioreactor-based industries and entrepreneurship.*

### Theory (4 credits)

#### UNIT-I:

1. History and development of Microbiology.
2. Contributions of Leeuwenhoek, Koch, Pasteur, Jenner and Flemming

#### **Bacteria**

3. Structure and function of capsule, pili, flagella, cell wall, cell membrane, outer membrane, reserve materials, cytoplasmic inclusions, plasmid and bacterial chromosome
4. Bacterial endospore: Structure, properties, spore- formation and germination

#### **Virus**

5. Structural organization of viruses
6. Prions and Viroids
7. Lytic cycle of bacteriophages with reference to *E. coli* and T4
8. Lysogeny, lysogenic conversion, induction and significance

#### UNIT-II: **Medical Microbiology**

1. Control of microorganisms.
2. Physical and chemical agents, chemotherapeutic agents: sulfa drugs and antibiotics
3. Microbial virulence
4. Mode of transmission, pathogenicity and prevention of microbial diseases: Airborne (Tuberculosis and Influenza), Food and water borne (Typhoid and Cholera) and Arthropod borne (Dengue, JE and Yellow fever)

#### Practical (2 credits)

1. Preparation of liquid media (broth) and solid media for routine cultivation of bacteria
2. Preparation of slant and stab
3. Pure culture techniques: Spread plate, pour plate and streak plate
4. Isolation and enumeration of bacteria from natural sources: soil, air and water
5. Simple staining of bacteria and study of cell types; differential staining: Gram staining, endospore staining and acid-fast staining
6. Biochemical tests for characterization: Catalase, Nitrate reduction, Indole production, Methyl red and Voges-Proskauer test
7. Sugar fermentation test

<b>IBSMSASC602: Animal Evolution &amp; Adaptation</b>			
Full Marks: 100	CA+ESE marks: Theory 10+40, Practical 30+20	Credit: 6	L-T-P: 4-0-4

**Learning Outcomes:** On completion of this course the students will be able to:

- Acquire an in-depth knowledge on the diversity and relationships in animal world.
- Develop a holistic appreciation on the phylogeny and adaptations in animals.
- Understand the evolution of universe and life.
- Understanding on the process and theories in evolutionary biology.
- Develop an interest in the debates and discussion taking place in the field of evolutionary biology.
- Solve statistical problems related to biology and evolutionary biology.

**Theory (4 credits)**

**UNIT-I:**

1. Origin of Life
2. Origin of Chordates
3. Origin of Elephants and Horse
4. Lamarckism and Darwinism Mutation Theory of Evolution
5. Genetic Drift & Hardy & Weinberg Law
6. Isolation and Speciation
7. Punctuated Equilibrium & Neutral Theory

**UNIT-II:**

1. Adaptation, Acclimatization and, Homeostasis
2. Aquatic, Volant, Fossorial and Parasitic Adaptations
3. Fossils and Fossilizations
4. Geological Time Scale
5. Origin of Man

**Practical (2 credits)**

1. Determination gene frequency with the help of Hardy-Weinberg Laws
2. Chi square test
3. Student's t-test

<b>IBSMSASDSE601: Parasitology</b>			
Full Marks: 100	CA+ESE marks: Theory 10+40, Practical 30+20	Credit: 6	L-T-P: 4-0-4

**Learning Outcomes:** On completion of this course the students will be able to:

- Diagnose the causative agents, describe pathogenesis and treatment for important protozoan, and helminthes diseases.
- Understand the role of arthropods in human diseases.
- Gain knowledge about vertebrate parasites.
- Identify and diagnose important parasites.

**Theory (4 credits)**

**UNIT-I:**

1. **Introduction to Parasitology:** Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector); Host parasite relationship.

- 2. Parasitic Protists:** Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica*, *Trypanosoma gambiense*, *Plasmodium vivax*.
- 3. Parasitic Platyhelminthes:** Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Schistosoma haematobium*, *Taenia solium* and *Echinococcus granulosus*.

#### UNIT-II:

- 1. Parasitic Nematodes:** Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti*.
- 5. Parasitic Arthropods:** Biology, importance and control of ticks, mites, *Pediculus humanus* (head and body louse).
- 6. Parasitic Vertebrates:** A brief account of parasitic vertebrates; Hood Mockingbird and Vampire bat.

#### Practical (2 credits)

- Study of life stages of *Entamoeba histolytica*, *Trypanosoma gambiense* and *Plasmodium vivax* through permanent slides/ micro photographs
- Study of adult and life stages of *Schistosoma haematobium*, *Taenia solium* and through permanent slides/ micro photographs
- Study of adult and life stages of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti* through permanent slides/ micro photographs
- Study of *Pediculus humanus* (Head louse and Body louse) through permanent slides/ photographs
- Study of monogenea from the gills of fresh/ marine fish (Gills can be procured from fish market as by product of the industry)
- Study of nematode/ cestode parasites from the intestines of Poultry bird (Intestine can be procured from poultry/ market as a by-product)
- Submission of a brief report on parasitic vertebrates

### IBSMSASDSE602: Aquatic Biology

Full Marks: 100

CA+ESE marks: Theory 10+40, Practical 30+20

Credit: 6

L-T-P: 4-0-4

**Learning Outcomes:** On completion of this course the students will be able to:

- Understand the aquaculture systems.
- Understand conditioning factors and how they can be manipulated.
- Describe water depuration mechanisms.
- Understand the environmental impacts of aquaculture.
- Measure, monitor and manage aquatic parameters.

#### Theory (4 credits)

##### UNIT-I:

- 1. Aquatic Biomes:** Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.
- 2. Freshwater Biology:** Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico-chemical characteristics: Light, Temperature, Thermal stratification, Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases (Oxygen, Carbon dioxide). Nutrient Cycles in Lakes- Nitrogen, Sulphur and Phosphorous.

**UNIT-II:**

- 1. Freshwater Biology:** Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill stream fishes.
- 2. Marine Biology:** Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.
- 3. Management of Aquatic Resources:** Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment – BOD and COD.

**Practical (2 credits)**

1. Identify the important macrophytes, phytoplanktons and zooplanktons present in a lake ecosystem.
2. Determine the amount of Turbidity/ transparency, Dissolved Oxygen, Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake/ water body.
3. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity meter, Turbidity meter, PONAR grab sampler) and their significance.
4. A Project Report on a visit to a Sewage treatment plant/ Marine bio-reserve/ Fisheries Institutes.

Semester – 7 / 1**IBSMSASC701 / MSCASC101 – Cell and Molecular Biology**

Full Marks: 50

CA+ESE marks: 10+40

Credit: 6

L-T-P: 6-0-0

**Learning Outcomes:** *On completion of this course the students will be able to:*

- Understand the molecular mechanism underlying biological phenomenon.
- Understand the utility of molecular interactions in biological phenomenon.
- Develop an understanding how cells work in healthy and diseased states and to give a 'health forecast' by analyzing the genetic database and cell information.
- Get new avenues of joining research in areas such as genetic engineering of cells, cloning, vaccines development, human fertility programme, organ transplant, etc.

**Theory (6 credits)****Unit-I**

1. Structure, organization & function of membrane system; Glycoconjugates and proteins in membrane system.
2. Ion transport, Na-K ATPase, Mitochondria, Molecular basis of ATP Synthesis.
3. The law of DNA constancy and C-value paradox; cot curves: classes of DNA (Palindromes, High repetitive, Middle repetitive, unique Sequences); structure and organization of chromatin; chromosomal banding, banding techniques and sister chromatid differentiation.
4. **Gene:** Modern concept of Gene, fine structure of Gene.
5. **DNA:** Evidence of DNA as genetic material, DNA structure Eukaryotic genome organization (coding and noncoding sequences, Satellite DNA); DNA damage and repair, DNA replication, Forms of DNA (A, B, Z DNA)

**Unit-II**

1. **RNA:** Structure of transfer, ribosomal and messenger RNA, Molecular mechanism of transcription in Prokaryote and eukaryotes, Reverse transcription post transcriptional modifications (capping, polyadenylation, splicing of intron and exons), and processing of RNA.
2. **Genetic Code:** Properties of Genetic code, Deciphering of Codon, Anticodon.
3. **Protein Synthesis:** Molecular mechanism of Protein synthesis, post translational modification of Protein, Regulation of gene expression in pro and eukaryotes, Attenuation and anti termination, Operon concept.

**IBSMSASC702 / MSCASC102 – Biotechnology and Instrumentation**

Full Marks: 50

CA+ESE marks: 10+40

Credit: 6

L-T-P: 6-0-0

**Learning Outcomes:** *On completion of this course the students will be able to:*

- Acquire basic understandings of tools and technique of biotechnology.
- Apply knowledge of biotechnology in development of animal production and welfare.
- Appreciate shifting their orientation of learning from a descriptive explanation of biology to a unique style of learning through graphic designs and quantitative parameters to realize how such research and innovations have made science interdisciplinary and applied.
- Develop future course of their career development in higher education and research with a sound base.
- Apply their knowledge with problem solving approach to recommend strategies of genetic engineering for possible applications in biotechnology and allied industry.

**Theory (6 credits)****Unit-I**

1. Recombinant DNA, Construction of Recombinant DNA, Gene cloning, cloning vectors (Plasmids, Bacteriophages, Cosmids, Plant and Animal viruses).
2. Gene transfer using vector less systems.
3. Isolation of genes, synthesis of genes.
4. Sequencing of Nucleic Acid (Maxam Gilbert, Sanger's method)
5. Basics of Southern, Northern, and South-Western blotting techniques.
6. Transgenic Plants and Transgenic animals..
7. Isolation and purification of enzymes (Extraction, centrifugation, dialysis, chromatography and electrophoretic separation).
8. Adsorption, covalent binding, cross binding and entrapping methods. Application of immobilized enzymes.
9. General account of Biotechnology in agriculture in medicine.

**Unit-II**

1. Culture techniques of cells - Disaggregation of cells, cell viability and preparation of substrate.
2. Primary cell culture, Sub culture and cell lines - Characteristics of cell line and their maintenance, kinetics of cell growth and applications of cell line.
3. Culture media – Type of media (Serum, Serum free and chemically defined media)
4. Tissue and Organ culture – Different methods of tissue and organ culture.
5. Embryo – culture and transfer in farm animals.

**Biochemical Techniques:**

6. Theory and applications of chromatography.
7. Theory and applications of spectrophotometer.
8. Theory and applications of electrophoresis.
9. Theory and applications of tracer techniques (autoradiography).
10. Structure, principles and applications of microscopes (Optical, Phase-contrast and Electron)
11. Structure, principle sand applications of Atomic absorption Spectrometer.
12. Structure, principle sand applications of Mass Spectrometer.
13. Structure, principles and applications of ESR Spectrometer.
14. Structure, principles and applications of X-ray Diffraction

**IBSMSASC703 / MSCASC103 – Environmental Biology and Wildlife**

Full Marks: 50

CA+ESE marks: 10+40

Credit: 6

L-T-P: 6-0-0

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Build ideas on wildlife and its association with environment and use it in protection of animal and plant diversity.*
- *Develop an understanding of how animals interact with each other and their natural environment.*
- *Develop the ability to use the fundamental principles of wildlife ecology to solve local, regional and national conservation and management issues.*

**Theory (6 credits)****Unit-I**

1. Concept of Ecology, Environmental Biology & Environmental Science, scope and practical applications.
2. Biological control of Geo-Chemical Environment, The Gaia Hypothesis and its cybernetic nature.
3. Concept of energy flow and bioenergetics (productivity, food-web, food chain, tropic levels and energy quality).

4. The energetic of scale, law of diminishing returns and concept of carrying capacity. Basic concept of population rates, growth forms.
5. Density dependent and density independent control. Population structure distribution Aggregation,
6. Isolation and Territoriality. Energy partitioning and r- and K-selection.

## Unit-II

1. Basic structure and organization of various communities and their interactions.
2. Inter species interaction (competition, co-existence, predation, parasitism and allelopathy) and positive interactions (commensalisms, mutualism and proto co-operation).
3. Concept of ecological niche. Species Diversity. Strategies and concepts of ecological climax.
4. Evaluation of biosphere, nature selection and co-evaluation. Pollutions of air, water and soil and strategies for their control. Environmental policies of India.
5. Wildlife depletion - cause and nature and threatened species of animals.
6. Wildlife programme in India and wildlife acts in India. Wildlife projects – Projects tiger, Asian elephant project, white winged wood duck project and Conservation of Rhinos.
7. Parks - brief description of National parks and Sanctuaries.

### IBSMSASC704 / MSCASC104 : Practical - I

Full Marks: 50

CA+ESE marks: 30+20

Credit: 4

L-T-P: 0-0-8

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Acquire and implement the knowledge of practical molecular biology and biotechnology.*
- *Collect first hand information on wildlife and analyze them.*

### Practical (4 credits)

1. Thin layer chromatographic separation of amino acids from different tissues/ blood and their quantification,
2. Isolation of bacterial plasmid,
3. Electrophoretic studies of nucleic acid from different tissues
4. Chromosome banding technique
5. Visit to National parks/ Sanctuaries/ Wildlife projects/ Natural habitats etc. to study the wildlife.

Semester – 8 / 2**IBSMSASC801 / MSCASC201: Animal Physiology**

Full Marks: 50

CA+ESE marks: 10+40

Credit: 6

L-T-P: 6-0-0

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Have basic understandings of the principles of animal systems.*
- *Understand the working of animal systems and applications in development of molecular tools.*
- *Understand how mammalian body gets nutrition from different biomolecules.*
- *Understand the mechanism and regulation of breathing, oxygen consumption and determination of respiratory quotient.*
- *Understand the organization of nervous system and process of nerve conduction.*
- *Understand the process of muscle contraction.*

**Theory (6 credits)****UNIT-I**

- 1. Digestive System:** Detailed structure of Gastrointestinal tract, associated digestive glands and their secretions, Digestive enzymes and regulations of their secretion in mammals. Mechanism of digestion and absorption of different food materials.
- 2. Respiratory System:** Different respiratory organs, Mechanism of breathing and its regulation in mammals, Respiratory pigments, Metabolic pathways - Glycolysis, TCA Cycle, Oxidative phosphorylation.
- 3. Blood Vascular System:** Various component soft circulatory system, Blood, Composition and function of blood, Blood volume, Blood coagulation, Haematopoiesis, Blood pressure, Blood groups, Transport of O<sub>2</sub> and CO<sub>2</sub>, Oxygen regulation in mammals, Physiological types of hearts, Cardiac cycle and its regulation.

**UNIT-II**

- 4. Nervous System:** Structure of a typical neuron, Conduction of nerve impulse, Resting potential, Synaptic transmission and Neuro transmitters.
- 5. Muscular System:** Ultra structure and chemical composition of skeletal muscle, Mechanism of muscle contraction, Energy supply and heat production during muscle contraction.
- 6. Excretory System:** Different excretory products, Structure of kidney and a nephron, formation of urine and its regulation and excretion, Acid-base balance, Homeostasis.

**IBSMSASC802 / MSCASC202: General and Applied Entomology**

Full Marks: 50

CA+ESE marks: 10+40

Credit: 6

L-T-P: 6-0-0

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Know the insect world and its importance.*
- *Understand the physiology of insects.*
- *Understand the application of insect products for animal or human welfare.*
- *Understand the mode of action of insecticides and the consequences of their use.*
- *Understand the effective way of insect pest management strategy.*

**Theory (6 credits)****UNIT-I**

1. Brief classification of Insects upto order level with characters and examples of each order.
2. Integumentary system including morphology of Insect's integument and its function.



3. **Digestive System:** Morphology, physiology and nutritional needs of insects.
4. **Respiratory System:** Morphology and physiology of respiratory organs.
5. **Circulatory System:** Morphology and physiology of different types of circulatory organs.
6. **Excretory System:** Morphology of different excretory organs and their functions.
7. **Nervous System:** Its structure and different sense organs of insects.
8. Sound and light producing organs in insects.
9. **Insects World:** Insects, Pests, Beneficial insects, Apiculture, Sericulture and Lac Insect culture.
10. Common pests of sugarcane crop in India – their biology and control.
11. Common pests of paddy and their biology and control.
12. Common pests of vegetables and oil seed crops in India.
13. Common pests of cotton their biology & control.
14. Common pests of stored grains & their control.

## UNIT-II

1. **Pest's Control:** Possible measures - Physical, Biological, Chemical techniques. Biological control of Insects Pests, Integrated Pest Management (IPM).
2. **Chemical Control of Pests:** Common Insecticides: Chlorinated Hydrocarbons, Phytotoxins, Botanicals and other inorganic chemicals.
3. Different fumigants and their mode of actions, Deterrents.
4. **Modes of action of toxicants:** Respiratory poisons, Nerve poisons.
5. Chemical nature of toxicants.
6. **Pest control by other means:** Semi-chemicals: Attractants, Repellants.
7. Antifeedants, Hormones & their analogues.
8. **Pesticide Application Equipments:** Machines and tools used in pest control.

<b>IBSMSASC803 / MSCASC203: Animal Parasitology and Pathology</b>			
Full Marks: 50	CA+ESE marks: Theory 10+40	Credit: 6	L-T-P: 6-0-0

**Learning Outcomes:** On completion of this course the students will be able to:

- Enhance the knowledge on animal parasites and their pathological outcomes.
- Carry out common procedures for culturing, purifying and diagnostics of parasites and understand their disease-causing potential.
- Diagnose the causative agents, describe pathogenesis and treatment for important diseases.
- Know how resistance development and resistance transfer occur.
- Gain experience at reading and evaluating the scientific literature in the area.

## Theory (6 credits)

### UNIT-I

1. Concept of parasitism, types of parasites & hosts.
2. Hyper parasitism in the animal kingdom.
3. Host parasite interactions – effects of parasites on hosts.
4. Parasite adaptations – adaptations to transmission and infectiousness.
5. Taxonomy, morphology, lifecycle, pathogenesis & control of  
*Ancylostoma duodenale*,  
*Wuchereria bancrofti*,  
*Schistosoma mansoni*,  
*Diphyllobothrium latum*

### UNIT-II

1. Amoebiasis: a. Taxonomy, morphology and life cycle of  
b. *Entamoeba histolytica*

c. *Entamoeba coli*

d. Diagnosis, pathogenesis, prevention and control of the above parasites.

2. Trypanosomiasis:
  - A. Taxonomy, morphology and life cycle of
    - a. *Trypanosoma gambiense*
    - b. South American Trypanosomiasis (Chagas disease).
  - B. Diagnosis, pathogenesis, prevention and control of African trypanosomiasis.
3. Giardiasis:
  - A. Taxonomy, morphology and life cycle of *Giardia lamblia*
  - B. Diagnosis, pathogenesis, prevention and control of the above parasite.
4. Malaria:
  - Taxonomy, morphology and life cycle of
    - a. *Plasmodium*
    - b. Fever cycle in Malaria.
    - c. Diagnosis, pathogenesis, prevention and control of Malaria.

### **IBSMSASC804 / MSCASC204: Practical - II**

Full Marks: 50

CA+ESE marks: 30+20

Credit: 4

L-T-P: 0-0-8

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Understand and analyze different systems of insects practically.*
- *Identify medically important ecto- and endo-parasites.*
- *Develop research interests.*

#### **Practical (4 credits)**

1. Dissection of central and stomatogastric nervous system of Cockroach
2. Digestive system of Blue bottle fly and wasp
3. Sting apparatus of honey bee
4. Silk gland of silkworm larva
5. Mounting of different types of mouth parts, wing and antenna in insects
6. Study of different ecto- and endoparasites of different animals.

### **MSCASMIE201: Environmental Health & Safety (Minor Elective)**

Full Marks: 50

CA+ESE marks: Theory 10+40

Credit: 4

L-T-P: 4-0-0

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Identify current national and global public health problems.*
- *Aware about the issues of food safety, water safety, vaccination, exposure to toxins etc.*
- *Frame a public health plan during any epidemic or spread of infectious disease etc.*
- *Understand the fundamental issues of environment.*
- *Analyze different sources of environmental problems and methods of measurement of pollution.*
- *Evaluate the status of environmental education and public awareness along with their implications.*

#### **Theory (4 credits)**

##### **Unit-I**

##### **Ecology and Environment:**

1. Basic ideas on Species, Population, Community and Ecosystem.
2. Nutrient Cycles (Nitrogen, Phosphorus, Magnesium).

### 3. Environmental Issues.

#### **Environmental Pollution and Health Hazards:**

Outline of Environmental pollution with special emphasis on bio-waste, medical waste and municipal waste pollution and health hazards.

#### **Environmental Health and Diseases:**

1. Basic concept on health and diseases, Principle of communicable and non-communicable diseases and conditions.
2. Food pollution (Additives, Preservatives, Contaminants), Present status, Types and problems.
3. Health programme in India, Hospital waste management in India.

#### **Unit-II**

##### **Medical Geology:**

1. Concept, Contribution to medical geology from public health and Environmental medicine, Development of Medical Geology, Geological sources of Nutrients, Mineral elements needed for good health.
2. Dietary sources and bioavailability of essential mineral elements, Some case studies.

##### **Medical Microbiology:**

1. Concept of Pathogens, Infection and Intoxication.
2. Communicable disease, causative agents, symptoms, mode of transmission, prevention and treatments.

##### **Environmental Laws:**

Constitutional provisions and Rules and Regulations.

Semester – 9 / 3**IBSMSASC901 / MSCASC301 – Arthropods & Host-Parasite Relationship**

Full Marks: 50

CA+ESE marks: 10+40

Credit: 6

L-T-P: 6-0-0

**Learning Outcomes:** *On completion of this course the students will be able to:*

- Know the benefits and bad effects of arthropods in animal life.
- Epidemiological study and management of arthropods.
- Learn different culture techniques.
- Know the causative agents of diseases and diagnostic methods of diseases.
- Understand tumor and cancer.

**Theory (6 credits)****UNIT-I**

1. Morphology and life cycle of human lice. Skin reactions to *Pediculus* and diseases transmitted by human louse.
2. Diseases and control mechanism of *Xenopsylla* sp.
3. Mosquitoes as carriers of parasitic disease: Biology of culicids and their role as pathogen transmitters.
4. Host specificity amongst parasites – Terminology and integration.
5. Introduction to culture techniques – terminology, advantages and basic problems involved in in-vitro culture.

**UNIT-II**

1. Introduction to Pathology – health and disease.
2. Causes of disease: Exogenous and endogenous agents.
3. Clinical methods for the diagnosis of diseases.
4. Benign and Malignant tumours. Terminology, classification and causes of Cancer. Characteristic features of malignancy.
5. Epidemic Disease and cause, Endemic disease and cause, their precautionary measures.

**IBSMSASC902 / MSCASC302 – Ethology & Conservation Biology**

Full Marks: 50

CA+ESE marks: Theory 10+40

Credit: 6

L-T-P: 6-0-0

**Learning Outcomes:** *On completion of this course the students will be able to:*

- Study and apply animal behaviour for benefits of animals as well as humans.
- Gain an appreciation for the modern scope of scientific inquiry in the field of wildlife conservation management.
- Develop an ability to analyze, present and interpret wildlife conservation management information.
- Understand and be able to objectively evaluate the role of behaviour in the protection and conservation of animals in the wild.

**Theory (6 credits)****UNIT-I**

1. Introduction to Ethology, Proximate and ultimate reasoning, Development of Behaviour, Social communication and Dominance, Approaches and Methods in study of Behaviour, Altruism and evolution-group selection, kin selection, reciprocal altruism.

2. Learning, Neural basis of learning, memory, cognition, sleep and arousal
3. Mating system, parental investment and reproductive success, Aggressive behaviour, Habitat selection and optimality in foraging.

## UNIT-II

1. Introduction to Biodiversity concepts, significance, magnitude and distribution, Threats to biodiversity, Major causes of extinction, IUCN threat categories, Red data Book.
2. Mega-diversity zones and Hotspots concepts, distribution and importance, Uses of biodiversity, strategies for sustainable exploitation of biodiversity.
3. Major approaches to management, Indian case studies on conservation/ management strategy (Project Vulture)
4. Concept of Biosphere Reserve, National Park and Wildlife Sanctuary.

### IBSMSASC903 / MSCASC30 : Practical - III

Full Marks: 50

CA+ESE marks: 30+20

Credit: 4

L-T-P: 0-0-8

**Learning Outcomes:** *On completion of this course the students will be able to:*

- Study protozoa and helminthes of medical importance in the laboratory.
- Study and different mosquito species.
- Identify important parasites and their vectors.
- Learn the techniques of observing the wild animals and study their behavior.

#### Practical (4 credits)

1. Smear preparation and staining of parasitic protozoa,
2. Drawing and staining of blood films for parasitic protozoa and microfilaria,
3. Whole mount preparation of trematode and arthropod parasites,
4. Staining of Scolex and proglottids of cestods,
5. Whole mount preparation of mosquito vectors (*Anopheles*, *Culex*, and *Aedes*),
6. Identification of parasites and vectors
7. Visit to Biosphere reserve/ National parks/ Sanctuaries/ Biodiversity hotspot/ Natural habitats etc. to study animal ethology and conservation.

### MSCASMIE301 : Bioethics & Biopolitics (Minor Elective)

Full Marks: 50

CA+ESE marks: 10+40

Credit: 4

L-T-P: 4-0-0

**Learning Outcomes:** *On completion of this course the students will be able to:*

- Learn the ethical and political prospects of study of animals.
- Minimize the cruelty related to animal production and animal-based study.

#### Theory (4 credits)

## UNIT-I

1. What is bioethics, its organisation, Rights and Responsibilities at the End of Life, Rules & Regulations, Legal rights.
2. Animal cruelty, Act and its implications, Role of NGO in animal cruelty prevention.
3. Animal quarantine Act, Animal business and its law.

**UNIT-II**

1. The Movement and Biopolitics - Biopolitics and Bioeconomics: a politics of multiplicity, Biopower and biopolitics,
2. Stop that train; a biopolitical struggle, Biopolitics first use in 1911, Making up people "Global governance and biopolitics",
3. Biopolitics and connective mutation, The Political Immunity of Discourse.

## Semester – 10 / 4

### **IBSMSASC1001 / MSCASC401 : Dissertation**

Full Marks: 50

CA+ESE marks: 30+20

Credit: 12

L-T-P: 0-0-24

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Reflect the overall understanding and knowledge acquired during the entire course.*
- *The assignment will give them a flavour of research in their desired field of interest and improve their writing skills as well. It will further enable the students to think and interpret individually due to different topic chosen.*
- *Gain experience at reading and evaluating the scientific literature in the area.*
- *Apply the knowledge in future course of their career development in higher education and research.*

On a topic related to ‘Major Elective’ which will include -

1. Thesis submission
2. Seminar presentation
3. Viva-voce

### **Any one of the following Major Electives (Special paper)**

#### **IBSMSASMJE1001 / MSCASMJE401: Environmental Factors and Rhythm Physiology**

Full Marks: 100

CA+ESE marks: Theory 10+40, Practical 30+20

Credit: 8

L-T-P: 6-0-4

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Orient themselves about the relationship of the internal and external environment emphasizing the physiology.*
- *Understand the changes in the environment and specific response for a specific activity in terms of time is the key understanding of life in earth.*
- *Understand the internal beauty (mechanism) of each cell of any organism to the changes in the rhythm of the environment.*
- *Understanding the physico-chemical orientation of the cell (physiology in large) in terms of changing environment.*

#### **Theory:**

1. Comparative aspects of endocrine physiology in vertebrates. Evolution of pituitary gland; Physiological actions of hormones secreted from pituitary, adrenal and thyroid gland.
2. Milestones in clock research; Chronobiology in 21st century; Evolution of biological timing system; Clocks, genes and evolution. Biological Rhythms - Ultradian, Tidal/ Lunar, Circadian and Circannual rhythms.
3. Melatonin: Input or output signal of the clock system; Molecular Biology of the circadian pacemaker system: Experiments in the generation of models for the feedback loop comprising the clock, Pre-molecular genetics era, Generic core circadian feedback loop; Molecular clockworks in Fish and Mammal.

4. Photoreception and photo-transduction; the physiological clock and measurement of day length; Role of photic and non-photoc cues in seasonality. Human health and diseases - Chronodisruption.

### Practical:

1. Practical Demonstration.

<b>IBSMSASMJE1002 / MSCASMJE402: Molecular Parasitology and Immunology</b>			
Full Marks: 100	CA+ESE marks: Theory 10+40, Practical 30+20	Credit: 8	L-T-P: 6-0-4

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Acquire substantial knowledge and training on Molecular Parasitology and Immunology with special emphasis on the molecular details of various phenomena involved in the pathogenesis and immunity related to parasitic infections of human and animals.*
- *Do further dissection of various immunobiological and parasitological aspects through research and bolster their candidature in national level examination with the knowledge.*
- *Get hands-on training on various conventional and modern techniques of parasitology and immunology.*
- *Understand the subject as well as to apply the knowledge in the field of their interest.*

### Theory:

1. Parasitic association, Host-parasite interactions, Effect of parasitism on the host, Sources of parasitic infections.
2. Life cycle, mechanism of pathogenesis and drug development against protozoa (*Entamoeba*, *Plasmodium*, *Leishmania*), *Schistosoma*, Intestinal Tapeworms and Extra-intestinal Tapeworm, Filarial nematodes.
3. Cells and organs involved in immune system, Innate immunity, Anatomical barriers, Physiochemical mediators and cell types of innate immunity, Innate receptors (TLR, Scavenger receptor etc.), Signal transduction pathways in activation of innate immunity. Immunoglobulins-structure classes and subclasses. Generation of Antibody Diversity and Gene rearrangement class switching.
4. Different types of serological tests (Precipitation, Agglutination, Immunofluorescence, RIA, ELISA, Flowcytometry). Vaccines for bacterial, viral, protozoal and parasitic infections.

### Practical:

1. Identification of primary and secondary organs (Primary - bone marrow, thymus. Secondary - spleen, GALT, Throat Tonsils). Determining the histological architecture of the tissues through diagrams and writing.
2. Preparation of blood, identification and identification of different immune cells.
3. Isolation of PBMC from human/animal blood using Phycol-density gradient centrifugation.
4. Identification of peritoneal macrophages of rat through Giemsa staining.
5. Determination of antigen-antibody interaction thorough immunodiffusion assay.
6. Demonstration of ELISA



7. Isolation of immunoreactive surface proteins from helminth parasites and determination of protein profile using SDS-PAGE.
8. Identification of different parasites (*Entamoeba histolytica*, *Giardia lamblia*, *Plasmodium*, *Wuchereria bancrofti*, *Hymenolepis* sp./ *Ascaris* sp., *Fasciola hepatica*) through microscopic observation of slides.

<b>IBSMSASMJE1003 / MSCASMJE403: Animal Breeding and Laboratory Animals</b>			
Full Marks: 100	CA+ESE marks: Theory 10+40, Practical 30+20	Credit: 8	L-T-P: 6-0-4

**Learning Outcomes:** On completion of this course the students will be able to:

- Getting acquainted with ethics and practices of laboratory animal house.
- Understand the breeding procedure in Animal Husbandry.
- Get exposure to basics of laboratory animal handling and population genetics.

**Theory:**

1. Molecular markers and their application; RFLP, RAPD, Microsatellite/ Minisatellite markers, SNP marker, DNA fingerprinting. Genomic selection.
2. DNA sequencing, Genome sequencing, Genomic Library, Polymerase Chain Reaction (PCR), its types (PCR-RFLP, AS-PCR etc.) and applications; Transgenesis and methods of gene transfer.
3. Fundamental theorem of natural selection. Artificial selection/ Selective breeding: Multistage, Restricted and retrospective selection indices. Development of specialized sire and dam lines; inbred lines and their maintenance; inbreeding and hybridization.
4. Heterosis. General combining ability, Specific combining ability and reciprocal effects; Utilization of non-additive genetic variance. Crossbreeding systems – crossbreeding effects; recurrent and reciprocal recurrent selection and their forms.

**Practical:**

1. Handling of mice, rat and Guinea pig
2. Collection of blood from laboratory animals
3. Administration of injection in laboratory animals
4. Synchronization of estrus
5. Problems on Hardy Weinberg law
6. Problem on Heterosis

<b>IBSMSASMJE1004 / MSCASMJE404: Molecular and Clinical Toxicology</b>			
Full Marks: 100	CA+ESE marks: Theory 10+40, Practical 30+20	Credit: 8	L-T-P: 6-0-4

**Learning Outcomes:** On completion of this course the students will be able to:

- Learn basic principles of signaling pathways and mechanisms of cell death.
- Understand gene-environment interactions.
- Examine the application how xenobiotics disrupt normal cellular processes of genomics, proteomics, and metabolomics data.
- Understand mechanisms of systemic and organ toxicity induced by xenobiotics; and learns how to analyze and interpret complex data sets in toxicological research and deliver a scientific presentation.

- *Use clinical and laboratory findings in the treatment of acute toxic exposures.*

### Theory:

1. Toxicity tests, Dose, dosage and dose response, Methods of toxicity testing: Bioassays, Acute and Chronic toxicity tests and their importance, lethal dose and lethal concentration, Threshold limitations: Hormesis, Lower dose extrapolation.
2. Pesticides - Classification and mode of action, Effects in Non-targets and environment, Mechanism of action and metabolism of common groups of pesticides: Organophosphate, Organochlorine, Carbamates and Pyrethroids.
3. Study of toxic impacts of common drugs: Paracetamol, Aspirin, Acetaminophen, Thalidomide. Biotransformation and Metabolism of drugs. Factors affecting toxicity and metabolism of drugs. Impacts of drug toxicity on Lungs, Liver and Kidneys.
4. Case history and Toxicity of Lead, Arsenic and Cadmium, Metal chelation, Importance and scopes of Toxicology in Forensic and Clinical science.

### Practical:

1. Determination of LC50/ LD50 of a toxicant using Snail/*Drosophila*/fish using profit analysis.
2. Study of effect of a toxic chemical on HSP expression in transgenic *Drosophila melanogaster*.
3. Spectrophotometric estimation of Catalase and Superoxide diamutase in tissue homogenate of pesticide exposed rat/mice/fish/*Drosophila*.
4. Study of tissue damage in mice/*Drosophila* exposed to a toxicant.
5. Study on effect of toxicant exposure on physical activity of *Drosophila*.

### IBSMSASMJE1005 / MSCASMJE405: Entomology

Full Marks: 100

CA+ESE marks: Theory 10+40, Practical 30+20

Credit: 8

L-T-P: 6-0-4

**Learning Outcomes:** *On completion of this course the students will be able to:*

- *Gain through knowledge about insect world, their morphology, physiology and functioning.*
- *Understand the biology of insects, their behavior and importance in human life.*
- *Understand the impact of insect in animal as well as human health, agriculture and economy.*
- *Devise the effective way of modern eco-friendly insect pest and vector management strategy.*
- *Identify important insects and learn techniques of insect study.*
- *Apply the knowledge in future course of their career development in research or profession.*
- *Interpret literatures and research articles in entomology.*
- *Understand the enormous scope of entomology.*

### Theory:

1. Study of important Insect orders
2. Body organization of Insects – Head, Thorax, Abdomen
3. Appendages - Insect mouthparts, antennae, legs, wings etc. (structure, modification, development, physiology & function)
4. Insect eye & vision
5. Reproductive system and reproduction
6. Endocrine system and exocrine glands

7. Development and metamorphosis in Insects
8. Receptors in Insects
9. Socialism in Insects
10. Important physiological processes in Insects
11. Forest entomology – impact of insects on forest ecology and economy
12. Forensics entomology – the insect detectives
13. Veterinary entomology – flies, fleas, mites and ticks of veterinary importance
14. Medical entomology – ecology of vectors and their role in disease transmission; maggot therapy
15. Application of modern and eco-friendly techniques in industrial entomology, medical entomology and vector/pest management.

**Practical:**

1. Dissection – Cockroach/Butterfly- Male & Female Reproductive system; Blue bottle fly- Digestive & Nervous system; Honey bee- Digestive & Nervous system
2. Identification of Insects upto family
3. Study developmental stages of Insects
4. Mounting of Antenna, Mouthparts, Wings, Legs, Tympanum
5. Chitosan test, staining of Insect blood
6. Insect collection and preservation technique, Insect box