KURUKSHETRA UNIVERSITY KURUKSHETRA

Syllabus of 5th and 6th Semester

for

Under-Graduate Programme

(Subject: Zoology)

w.e.f. session 2024-25

Under Multiple Entry-Exit, Internship and CBCS-LOCF in accordance to NEP-2020

ZOOLOGY: SEMESTER-5									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme A, B & C	**CC-5 MCC-9 4 credit**	B23-ZOO-501	Ecology and Environment	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 300-399

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO)

1. Students will be able to describe interactions and relation between abiotic and biotic factors.
2. Students will able to describe about ecosystem and Biogeochemical cycles.
3. Students will be able to describe about population characteristics & biodiversity.
4. Students will be able to understand the causes of different types of pollution.
5. Students will be able to practical approaches of natural resources and their conservation.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Basic concepts of ecology:** Definition, significance. Concepts of habitat and ecological Niche. **Ecosystem:** Concept, components, properties and functions; Ecological energetics and energy flow models, food chain, food web, trophic structure; ecological pyramids, concept of productivity.	**12**
II	**Factors affecting environment:** Abiotic factors (light-intensity, quality and duration), temperature, humidity, wind, Rainfall, topography; edaphic factors; Biotic factors. Introduction to major ecosystems of the world. **Biogeochemical cycles:** Concept, reservoir pool, gaseous cycles and sedimentary cycles. **Community Ecology:** Characteristics, Composition, structure, origin and development of a community Ecological Succession.	**11**
III	**Population**: Growth and regulation. **Population interactions:** Competition, predation, parasitism, commensalisms and mutualism. Concept of biodiversity and conservation of natural resources.	**11**
IV	**Climate change:** Global warming, Greenhouse Effect, Ozone Depletion, Sustainable Development. **Natural Recourses: Types, Uses and conservation.** **Environmental Pollution:** Air, water, soil and management strategies. Environmental Impact Assessment.	**11**
V Practical	1. Chemical analysis of pond water (pH, Salinity, free CO_2, alkanity, hardness) 2. Chemical analysis of soil for pH, moisture, nitrates, and phosphates. 3. Estimation of DO, BOD for given Sample of water.	**30**

	4. A study of pond ecosystem. 5. Basic Zooplankton & Phytoplankton study of any water body.	

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
2. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
3. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
4. Robert Leo Smith Ecology and field biology Harper and Row publisher
5. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press
6. Rockwood Larry L. (2015) Introduction to Population Ecology,)2nd Edition Wiley-Blackwell

ZOOLOGY: SEMESTER-5									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme B & C	**MCC-10 4 credit**	B23-ZOO-502	Animal Taxonomy	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 300-399

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO)

1. Students will be able to attain knowledge of taxonomy which helps in classifying and identifying biodiversity
2. Students will understand animal relationships by making phylogenetic trees.
3. It will enhance the knowledge of students to understand the overall biodiversity of the world and their application.
4. Students will be able to acquire, analyse and understand the significance of Biosystematics
5. Students will able to learn the practical knowledge of general organisation, affinities and systematic position of animals.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Fundamental concept of taxonomy Introduction to taxonomy: Stages of Taxonomy, objectives of biological classification, Importance and application of biosystematics in zoology, principles and rules of taxonomy, ICZN regulation.	**12**
II	Historical perspectives of biosystematics: Taxonomic stages: alpha, beta and Gamma taxonomy, Taxonomic Hierarchy, Taxonomic characters, Neo taxonomy and difference with classical taxonomy.	**11**
III	Taxonomic procedure Study methods: Collection, preservation and identification, evaluation of taxonomic characters, morphological, embryological, cytogenetical, biochemical, numeral components of classification. Importance of studying taxonomic with demerits	**11**
IV	Concept of speciation Varieties, subspecies, siblings, species and races. Concept of taxon, holotype, paratype, topotype. Molecular basis of taxonomy Phylogenetic: principle. Concept and applications.	**11**
V Practical	1. Demonstration for the preparation and use of different types of taxonomic keys. 2. Construction of cladogram, dendrograms and phylograms. 3. Construction of dichotomous key 4. Classify different animal kingdom upto order 5. Study of museum specimens and slides with emphasis on evolutionary and adaptive significance. 6. Software used to study animal taxonomy.	**30**

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**

➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. G.G. Simpson, Principle of animal taxonomy, Oxford ISH Publishing Company.
2. E. Mayer, Elements of Taxonomy.
3. M. Kato. The Biology of Biodiversity, Springer.
4. E.O. Wilson, Biodiversity, Academic Press, Washington.

ZOOLOGY: SEMESTER-5									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme B & C	**DSE-2 4 credit Select one Option**	B23-ZOO-503	Animal Behaviour and Chronobiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 300-399

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO)

1. Students will be able to describe origin of animal behavior and its perception with environment.
2. Students will able to describe biological clock and concepts of learning.
3. Students will be able to describe different types of social behavior in animals
4. Students will be able to describe effects of various stimuli on animal behavior.
5. Students will be able to describe to understand how animal behavior plays a key role to in interaction the biotic and abiotic world.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Concept of Animal Behaviour;** Mile-Stones in the history of animal behaviour and scope. Stereotyped and acquired behavior patterns : Tropisms, Taxes, Reflexes, Instincts, learning & reasoning; Perception of the environment : Mechanical, Electrical, chemical, olfactory, auditory, visual	**12**
II	**Social behaviour**: Aggregations and society; Advantages of group living; Types of social organization in animals, Group selection, kin selection, altruism, reciprocal altruism, Territoriality. Social behaviour of termites, ants and primates. **Concept of learning:** law of learning, types of learning – Habituation, trial & error learning, latent learning, Insight, Imprinting, Classical conditioning & Instrumental learning. Concept of Migratory behavior	**11**
III	**Behaviour Ecology**: Habitat selection. Various means of communication in animals: Chemical, Visual, auditory, touch etc. Hormones and animal Behaviour: Hormones important to behavioural regulation; Genetic basis of behavior Aggressive behaviour; sexual attraction and sexual behaviour. Pheromones and animal behaviour: types of pheromones, role of pheromones in animal behaviour; pheromones of social insects. Ecological adaptation;	**11**
IV	**Chronobiology :** Introduction to chronobiology; Various terminology used in chronobiology; Biological Rythms and Biological clocks; Types of biological rhythms: Lunar rhythms, circadian rhythms; Circannual rhythms; Epicycles, Tidal rhythms, Sleep Disorders, Insomnia, chronotherapy.	**11**
V Practical	1. To study nests and nesting habits of the birds and social insects. 2. To study the behavioural responses of wood lice to dry and humid conditions.	**30**

	3. To study geotaxis behaviour in earthworm. 4. To study the phototaxis behaviour in insect larvae. 5. Visit to Forest/Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report. 6. Study of behaviour repertoire sheets. 7. Study of circadian functions in humans (daily eating, sleep and temperature patterns).	

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. Alcock J. 2013. Animal Behaviour, Sinauer Associate Inc., USA.
2. Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 2, NCBA, Kolkata
3. Chattopadhyay S. 2012. Life: Evolution, Adaptation, Ethology. 3rd Edn. Books and Allied, Kolkata.
4. Drickamer LC , Vessey SH . 2001. Animal Behaviour. McGraw-Hill
5. Dujatkin LA. 2014. Principles of Animal Behaviour. 3rd Edn. W.W.Norton and Co.
6. Dunlap JC, Loros JJ, DeCoursey PJ. 2004. Chronobiology Biological Timekeeping. Sinauer Assoc.
7. Kumar V. 2002. Biological Rhythms. Narosa Publishing House, New Delhi.

ZOOLOGY: SEMESTER-5									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme B & C	**DSE-2 4 credit Select one Option**	B23-ZOO-504	Comparative Anatomy of Vertebrates	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 300-399

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO)

1. The student will be able to identify and understand comparative anatomical structure of vertebrate organ systems
2. The learner will be able to understand the evolution of various organs and systems in the vertebrate body according to its environment
3. The student will be able to understand the plasticity of organ systems to adapt to the environment and acquire different novel forms
4. The student will be able to enhance the Ability to understand the anatomical organization of organs and systems in representative species
5. Students will be able to describe to understand practical approaches of anatomical systems in vertebrates.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Integumentary and Skeletal System Structure, functions and various derivatives (hard and soft) of integuments of vertebrates Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches	**12**
II	Digestive and Urino-genital System Alimentary canal and associated glands, dentition Succession of kidney, Evolution of urino-genital ducts, Types of mammalian uteri	**11**
III	Respiratory and Circulatory System External and internal respiration, respiratory organ (Skin, gills, lungs and air sacs); respiratory pigments Blood components, General plan of circulation, evolution of heart and aortic arches	**11**
IV	Nervous System and Sense Organs Comparative account of brain, Autonomic nervous system, Spinal cord, Cranial nerves in mammals Classification of receptors, olfactory receptors, Brief account of visual and auditory receptors in Man	**11**
V Practical	1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs 2. Comparative study on skeleton of Frog, Varanus, Fowl, Rabbit 3. Study on Different types of Feathers, Scales and Hair. 4. Mammalian skulls: One herbivorous and one carnivorous animal 5. Study of rat arterial and urinogenital system (demonstration/online videos) 6. Study of structure of any two organs (heart, lung, kidney, eye and ear) from online video/manuals.	**30**

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	**End Term Examination:** ➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education
2. Milton Hilderbrand. Analysis of vertebrate structure. IV. Ed. John Wiley and Sons Inc.,New York.
3. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies
4. Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills
5. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons
6. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House
7. Torrey, T.W. Morphogenesis of vertebrates. John Wiley and Sons Inc., New York and London.

ZOOLOGY: SEMESTER-5									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme B & C	**DSE-3 4 credit Select one Option**	B23-ZOO-505	Biology of Insects	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 300-399

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO): Students will be able to:

1. Attain a solid foundation in insect biology, including general entomology, basic systematic, morphology, physiology, and biodiversity.
2. Understand evolution and biodiversity generation through macro- and micro-evolutionary processes, including how these processes have formed and diversified insects.
3. Develop an understanding of the distributions and abundances of organisms including insects, and their interactions with each other and the environment.
4. Gain appreciation of insects in society and human affairs, and as model systems in insect biology.
5. Develop the ability to design and perform a scientific study on insects, and to analyze results.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Introduction Diversity and General Features of Insects Distribution, origin and Success of Insects on the Earth Economic importance of Insects	**12**
II	Insect Taxonomy Basis of insect classification; Classification of insects up to orders Insects as plant pests, with special reference to Wheat and Paddy Insects as mechanical and Biological vectors, Brief discussion on houseflies and mosquitoes as important insect vectors	**11**
III	General Morphology of Insects External Features; Head – Eyes, Types of antennae, Mouth parts with respect to feeding habits, Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat Abdominal appendages and genitalia	**11**
IV	Physiology of Insects Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system; Sensory receptors; Growth and metamorphosis, Insect Societies, Group of social insects and their social life, Social organization and social behaviour (Termites)	**11**
V Practical	1. Study of one specimen from each insect order 2. Study of different kinds of antennae, legs and mouth parts of insects 3. Study of head and sclerites of any one insect 4. Study of insect wings and their venation.	**30**

	5. Study of insect spiracles 6. Methodology of collection, preservation and identification of insects. 7. Morphological studies of various castes of *Apis* 8. Study of any three insect pests and their damages. 9. Study of any three beneficial insects and their products. 10. Field study of insects and submission of a project report on the insect diversity	

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. A general text book of entomology, Imms , A. D., Chapman & Hall, UK
2. The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK
3. Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA
4. Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA
5. The Insect Societies, Wilson, E. O., Harward Univ. Press, UK
6. Physiological system in Insects, Klowden, M. J., Academic Press, USA
7. The Insects, An outline of Entomology, Gullan, P. J. , and Cranston, P. S., Wiley Blackwell, UK
8. Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA

ZOOLOGY: SEMESTER-5									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme B & C	**DSE-3 4 credit Select one Option**	B23-ZOO-506	Parasitology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 300-399

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO): Students will be able to:

1. Demonstrate detailed knowledge and understanding of the biology, life cycles, pathogenesis, diagnosis of parasitic infections in humans and their relevance for human health and strategies for control.
2. Demonstrate detailed knowledge and understanding of the biology and strategies for control of the vectors and intermediate hosts of human parasites.
3. Carry out practical laboratory identification of the various parasite stages both free and in tissues and diagnose infections.
4. Demonstrate specialised skills acquired through taking modules on: advanced diagnostic, molecular, immunological, genetic, chemotherapeutic, and ecological and/or control aspects of the subject.
5. Demonstrate the ability to design a laboratory or field based research project, apply relevant research skills, critically analyse and interpret data, and work with minimal supervision.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Introduction Introduction to Parasitology; Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship	**12**
II	Parasitic Protists: Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica, Giardia intestinalis*	**11**
III	Parasitic Platyhelminthes: Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciolopsis buski, Schistosoma haematobium,* Parasitic Nematodes: Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ancylostoma duodenale*, Study of structure, life cycle and importance of *Meloidogyne* (root knot nematode)	**11**
IV	Parasitic Arthropoda: Biology, importance and control of ticks, mites, *Pediculus humanus* (head and body louse), Parasitic Vertebrates; A brief account of parasitic vertebrates; *Cookicutter shark*, Hood Mockingbird and Vampire bat	**11**
V Practical	1. Study of life stages of *Entamoeba histolytica, Giardia intestinalis* through permanent slides/micro photographs. 2. Study of adult and life stages of *Fasciolopsis buski* and *Schistosoma haematobium* through permanent slides/micro photographs. 3. Study of adult and life stages of *Ancylostoma duodenale* through permanent slides/micro photographs.	**30**

	4. Study of plant parasitic root knot nematode, *Meloidogyne* from the soil sample. 5. Study of *Pediculus humanus* (Head louse and body louse) through permanent slides/photographs. 6. Submission of a brief report on parasitic vertebrates.	

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors
2. E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition,Lea & Febiger
3. Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group
4. Parija, S. C. Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas), II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
5. Rattan Lal Ichhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi
6. Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers
7. Thomas C. Cheng (1986). General Parasitology, II Edition, Academic Press Inc
8. K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd.

ZOOLOGY: SEMESTER-6									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme A, B & C	**CC-6 MCC-11 4 credit**	B23-ZOO-601	Developmental Biology & Evolution	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 300-399

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO)

1. Students will be able to describe origin of life and theories of evolution.
2. Students will able to describe concept of speciation and evolution of horse and man.
3. Students will be able to describe different stages during fertilization.
4. Students will be able to describe the different stages in the development of chick and frog.
5. Students will be able to describe to understand how evolution and development leads to a sustainable life in species.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	**Historical perspectives, aims and scope of developmental biology.** **Human fertilization-**Generalized structure of mammalian ovum & sperm, spermatogenesis and Oogenesis, fertilization, parthenogenesis, different types of eggs and patterns of cleavage. **Blastulation of Frog and Chick-** Process of blastulation and fate-map construction in frog and chick.	**12**
II	**Gastrulation in Frog and Chick-** Gastrulation in frog and chick upto the formation of three germinal layers. **Elementary knowledge of primary organizers and extra embryonic membranes.** Placenta: types; structure and function of placenta in humans. **Concepts of competence, determination and differentiation. Concept of regeneration.**	**11**
III	**Origin of life.** Concept and evidences of organic evolution. Theories of organic evolution. Concept of micro, macro-and mega-evolution. Evidences of Evolution: Fossil record- types of fossils, geological time scale, Natural selection. Isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation	**11**
IV	Population genetics: Hardy-Weinberg Law **Concept of species:** Different species concept and speciation. Genetic Drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies Phylogeny of horse, Evolution of man.	**11**
V Practical	1. Preparation of permanent/temporary slides of developmental stages of frog/mosquito. 2. Study of Life History of Frog. 3. Study of permanent slides of WM of chick embryo (13-18h, 24-36h, 36-48h, 48-72h). 4. Window preparation and identification of stages of development in chick egg. 5. Histology**:** Preparation and study of permanent histological slides of testis, ovary, kidney, intestine, liver of rat (H & E staining).	**30**

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	**End Term Examination:** ➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA

2. Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press

3. Carlson, R. F. Patten's Foundations of Embryology

4. Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers

5. Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

6. Dobzhansky, Th. Genetics and Origin of Species. Columbia University Press. Dobzhansky, Th., F.J. Ayala, G.L. Stebbines and J.M. Valentine. Evolution. Surjeet Publication, Delhi.

7. Futuyama, D.J. Evolutinary Biology, Suinuaer Associates, INC Publishers, Dunderland.

8. Hartl, D.L. A Primer of Population Genetics. Sinauer Associates, Inc, Massachusetts.

ZOOLOGY: SEMESTER-6									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme B & C	**MCC-12 4 credit**	B23-ZOO-602	Basics of Endocrinology and Immunology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 300-399

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO): Students will be able to

1. Develop an in-depth comprehensive knowledge of endocrinology from a physiological cellular and molecular perspective.
2. This course will make students understand the basic structure and chemical organization of hormones and various signaling molecules.
3. The students will how the immune system can fight infection and other diseases
4. Students will able to understand the concept of vaccines and its cons and pros.
5. The student will get practical knowledge of basic structure and function of hormones and Immune system.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Introduction to hormone History of endocrinology, Classification and Characteristic, pituitary gland and its general physiological action: Adenohypophysis hormone (somatotropin and prolactin), Glycoprotein hormones (FSH, LH and TSH), Neurohypophysis hormone (oxytocin and vasopressin, urotensin), physiological role of adrenal hormone, Thyroid hormone action in poikilotherms and homeotherms.	**12**
II	Hormone Action and applications Membrane and nuclear receptor hormones (regulation and signal transduction) Permissive actions of hormones and termination of hormone action. Endocrine feedback to stumuli. Hormone and human health: Production of hormones as pharmaceuticals, Genetic analysis of Hormonal disorders. Hormones on IVF, Pregnancy testing and Amniocentesis.	**11**
III	Overview of Immune System Introduction to basic concepts in immunology, Components of immune system of Innate and Adaptive Immunity, Cells and organs of immune system (primary and secondary organs), Basic properties of antigen B and T cell epitopes, Adjuvants and haptens, structure ,classes and functions of antibodies and interaction as tools for research and diagnosis.	**11**
IV	Working of immune system Structure and functions of MHC molecules. Basic properties and functions of cytokines, Complement system (component and pathways), Introduction to concept of autoimmunity (Rheumatoid Arthritis and tolerance, AIDS). General introduction to Vaccines with its function in biological sciences.	**11**
V Practical	1. Study of the permanent slides of all the endocrine glands 2. Histological study of lymphoid organs spleen, thymus and lymph nodes through slides/	**30**

	photographs 3. Preparation of stained blood film to study various types of blood cells. 4. ABO blood group determination. 5. Demonstration of a. ELISA b. Immunoelectrophoresis 6. Immunological diagnosis of pregnancy. 7. Qualitative test for the presence of sugar in urine.	

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. General Endocrinology C. Donnell Turner Pub- SaundersToppan Endocrinology: An Integrated Approach; Stephen Nussey and Saffron Whitehead. Oxford: BIOS Scientific Publishers; 2001.
2. Hadley, M.E. and Levine J.E. 2007. Endocrinology, 6th Edition. Pearson Prentice- Hall, Pearson Education Inc., New Jersey.
3. Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.
4. David, M., Jonathan, B., David, R. B. and Ivan R. (2006). Immunology, VII Edition, Mosby, Elsevier Publication.
5. Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication

ZOOLOGY: SEMESTER-6									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme B & C	**DSE-4 4 credit Select one Option**	B23-ZOO-603	Reproductive Physiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 300-399

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO): A students is able to learn about

1.The cellular, molecular and biochemical changes in reproductive physiology

2. The basic and molecular concepts of spermatogenesis folliculogenesis, ovulation, follicular atresia and germ line-soma interaction.

3.The importance of diet, exercise, stress and yoga during ageing

4. Various problems of male sterility and female infertility.

5. To give knowledge of animals reproduction to deal with reproduction and fertility problems in animals and humans.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Reproductive Endocrinology Introduction to gonadal hormones and mechanism of hormone action, basic mechanism of mode of action of steroid hormones, glycoprotein hormones, and prostaglandins, hypothalamo-hypophyseal – gonadal axis, regulation of gonadotrophin secretion in male and female. Mechanism of sex differentiation.	**12**
II	Functional anatomy of male reproduction Outline and architecture of male reproductive system in mammals, spermatogonia, biology of spermatozoa, seminiferous epithelial cycle, spermatogenesis, hormonal control of spermatogenesis, Biochemistry of semen, semen analysis and its utility in medico legal cases.	**11**
III	Functional anatomy of female reproduction Outline and histological of female reproductive system in mammals, Reproductive cycles in mammals and their regulation: ovulation, implantation (its type, squencial events during implantation, delayed implantation), Pregnancy: corpus luteum, hormonal control of pregnancy, Parturition: activation and stimulation of uterus, Hormonal meditation; Lactation, morphological and functional development of mammary glands, maintenance of lactation, milk secretion, Menopause.	**11**
IV	Reproductive Health Infertility in male and female: causes, diagnosis and management; Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, ET, EFT, IUT, ZIFT, GIFT, ICSI, PROST; Modern contraceptive technologies; Demographic terminology used in family planning.	**11**
V	1. Demonstration of Surgical techniques: principles of surgery in endocrinology.	**30**

Practical	Ovarectomy, hysterectorny, castration and vasectomy in rats. 2. Examination of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina 3. Study of modern contraceptive devices 4. Demonstration of male and female reproductive systems of mammals by photograph/online videos. 5. Demonstration of Sperm motility.	

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. Austin, C.R. and Short, R.V. reproduction in Mammals. Cambridge University Press.
2. Degroot, L.J. and Jameson, J.L. (eds). Endocrinology. W.B. Saunders and Company.
3. Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd.

ZOOLOGY: SEMESTER-6									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme B & C	**DSE-4 4 credit Select one Option**	B23-ZOO-604	Neurophysiology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 300-399

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO)

1. Student will able to understand the structure and function of nervous system at various levels of organization
2. This paper will help students to diagnose and monitor the progress of nervous disorders
3. It will help the students to develop knowledge in cellular and molecular or behavioral perspectives
4. Students will able to understand the neural basis of behaviour and sensory physiology in animals.
5. Students develop critical thinking skills to formulate scientific questions

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Introduction to Neuroscience Introduction to origins of Neuroscience; Neuroanatomy, Neurophysiology, Neurobiology and Neuropharmacology of Behaviour. Introduction to the structure and function of the nervous system: Neurons; Neuroglia; Neuron doctrine; The prototypical neuron.	**12**
II	Nerve physiology Basis and significance of membrane potential, equilibrium potential and changes during stimulation action potential generation and its propagation, Na+ K+ current in action potential, Principles of synaptic integration, types of synapsis and synaptic transmission (electric and chemical), synaptic inhibition. EPSP and IPSP Transmission.	**11**
III	Neurotransmitters Different types of neurotranmitters– catecholamines, amino acidergic and peptidergic neurotransmitters; Transmitter gated channels; neurotransmitter receptors; Ionotropic and metabotropic receptors.	**11**
IV	Sensory physiology Mechanism involved in perception of mechano, photoreception, lateral and compound vertebrate eyes, Neural basis of behaviour, behaviour concepts and measurements. Neurobiology: Neural disorders: Parkinson's, Alzheimer's, Epilepsy, Schizophrenia	**11**
V Practical	1. Study of different types of nerve cells with their functions. 2. To demonstrate working of brain with video or photographs. 3. Demonstration the effect of complex trauma on brain function and its recovery 4. Methods used to study neurobiology: CT, MRI, EEG, MEG, PET, FMRI & Visit to lab. 5. Olfaction studies in different groups of vertebrates. 6. Study of novelty, anxiety and spatial learning in mice.	**30**

Suggested Evaluation Methods	
Internal Assessment: ➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	**End Term Examination:** ➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. Neuroscience: Exploring the brain by Mark F. Baer; Barry W. Connors. 2015

2. From Molecules to Networks: An Introduction to Cellular and Molecular Neuroscience by John H. Byrne. Ruth Heidelberg and M. Neal Waxham

3. Neuroscience-Eds. Dale Purves et. al. (3rd Edn)-Sinauer Associates, Inc.-2004

4. Principles of Neural Science-4th Edn-Eds. Kandel, Schwartz and Jessell- McGraw- Hill Companies-2000

5. Nerve Cells and Animal Behaviour-2nd Edn-Peter J Simmons and David Young- CUP-2003

6. EssentialPsychopharamacology-Neuroscientific Basis and Practical Applications- 2nd Edn.-Stephan M. Stahl-CUP-2000

7. Phantoms in the Brain - Vilayanur S. Ramachandran and Sandra Blakeslee-1998

8. The Human Brain Book - Rita Carter-2009

ZOOLOGY: SEMESTER-6									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme B & C	**DSE-5 4 credit Select one Option**	B23-ZOO-605	Molecular Biology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 300-399

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO): Students will be able to understand

1. Molecular Biology which chiefly deals with interactions among various systems of the cell, including those between DNA and RNA and learning how these are regulated
2. The Concept of gene, gene cistron relationship in prokaryotes and eukaryotes
3. DNA regulation and replication; Types of DNA damage, DNA repair pathways Transcription in prokaryotes
4. The process of Reverse transcription; Repeated sequences; Transposons types and transposition mechanism
5. The concept of qualitative and quantitative estimation of nucleic acid by designing and implementing experimental procedures using relevant techniques

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Nucleic Acids: Salient features of DNA and RNA, Watson and Crick model of DNA DNA Replication: DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication	**12**
II	Transcription: RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, transcription factors Translation: Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, Difference between prokaryotic and eukaryotic translation	**11**
III	Post Transcriptional Modifications and Processing of Eukaryotic RNA: Concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of t-RNA Gene Regulation: Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac operon and trp operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing, Genetic imprinting	**11**
IV	DNA Repair Mechanisms: Pyrimidine dimerization and mismatch repair Regulatory RNAs: RNA interference, miRNA, siRNA	**11**
V Practical	1. Study of Polytene chromosomes from Chironomous /Drosophila larvae 2. Estimation of the growth kinetics of E. coli by turbidity method 3. Preparation of solid culture medium (LB) and growth of E. coli by spreading and streaking 4. Demonstration of antibiotic sensitivity/resistance of E. coli to antibiotic pressure and interpretation of results 5. Quantitative estimation of RNA using Orcinol reaction	**30**

	6. Study and interpretation of electron micrographs/photograph showing (a) DNA replication (b) Transcription (c) Translation	

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: Molecular Biology of the Cell, IV Edition.
3. Cooper G. M. and Robert E. Hausman R. E. The Cell: A Molecular Approach, V Edition, ASM Press and Sinauer Associates.
4. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
5. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
6. Lewin B. (2008). Gene XI, Jones and Bartlett
7. McLennan A., Bates A., Turner, P. and White M. (2015). Molecular Biology IV Edition. GS, Taylor and Francis Group, New York and London.

ZOOLOGY: SEMESTER-6									
Remarks	**Course Type**	**Course Code**	**Name of the Course**	**Credit**	**Contact Hours/ Week**	**Internal Assessment marks**	**End Term Marks**	**Max. Marks**	**Exam Duration**
Scheme B & C	**DSE-5 4 credit Select one Option**	B23-ZOO-606	Forensic Biology	3	3	20	50	70	3 hrs.
			Practical	1	2	10	20	30	4 hrs.

Level of the course: 300-399

Pre-requisite for the course (if any): Biology as a Subject at 4.0 Level (Class XII)

Course Learning Outcomes (CLO): The students will be able to know

1. The significance of biological and serological evidence
2. The importance of biological fluids – blood, urine, semen, saliva, sweat and milk – in crime investigations
3. The Enhance the knowledge about wildlife forensics aid in conserving natural resources
4. The Enhance the knowledge of forensic entomology assists in death investigations
5. About practical applications of forensic biology.

Instructions for Paper-Setter

1. Nine questions will be set in all. All questions will carry equal marks.
2. Question No. 1, which will be short answer type covering the entire syllabus, will be compulsory. The remaining eight questions will be set unit wise selecting two questions from each Unit I to IV. The candidate will be required to attempt question No. 1 and four more questions selecting one question from each unit.

UNIT	TOPICS	CONTACT HOURS
I	Biological Evidence Nature and importance of biological evidence. Composition and Functions of Blood and Semen. Significance of hair evidence. Transfer, persistence and recovery of hair evidence. Structure of human hair. Types and identification of microbial organisms of forensic significance, Identification of Blood, Semen, Saliva and Urine through preliminary and confirmatory crystal examinations.	**12**
II	Forensic Botany Identification of wood, leaves, pollens and juices as botanical evidence. Diatoms and their forensic significance.	**11**
III	Wildlife Forensics Fundamentals of wildlife forensic. Significance of wildlife forensic. Protected and endangered species of animals and plants. Illegal trading in wildlife items, such as skin, fur, bone, horn, teeth, flowers and plants. Identification of physical evidence pertaining to wildlife forensics. Identification of pug marks of various animals.	**11**
IV	Forensic Entomology Basics of forensic entomology. Insects of forensic importance. Collection of entomological evidence during death investigations.	**11**
V Practical	1. To examine hair morphology and its Comparison with animal hair. 2. To prepare slides of scale pattern of human hair. 3. To examine human hair for cortex and medulla. 4. To carry out microscopic examination of pollen grains. 5. To carry out microscopic examination of diatoms.	**30**

	6. To cite a crime case in which diatoms have served as forensic evidence. 7. To prepare a case report on forensic entomology. 8. To prepare a case report on problems of wildlife forensics.	

Suggested Evaluation Methods

Internal Assessment:	**End Term Examination:**
➢ **Theory** •Class Participation: 5 •Seminar/presentation/assignment/quiz/class test etc.: 5 •Mid-Term Exam: 10 ➢ **Practicum** •Class Participation: NA •Seminar/Demonstration/Viva-voce/Lab records etc.: 10 •Mid-Term Exam: NA	➢ **Theory** •Written Examination: 50 ➢ **Practicum** Practical Examination: 20

Learning Resources

1. L. Stryer, Biochemistry, 3rd Edition, W.H. Freeman and Company, New York (1988).

2. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, Harper's Biochemistry, APPLETON & Lange, Norwalk (1993).

3. S. Chowdhuri, Forensic Biology, BPRD, New Delhi (1971).

4. R. Saferstein, Forensic Science Handbook, Vol. III, Prentice Hall, New Jersey (1993).

5. G.T. Duncan and M.I. Tracey, Serology and DNA typing in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).