UNIVERSITY

OF

KALYANI

SYLLABUS
&
STRUCTURE

for

Under Graduate (UG)
General Course of
B.Sc. with Zoology

under

CHOICE BASED
CREDIT SYSTEM
(CBCS)

Effective from the academic session
2018-19

Type of courses to be offered

- Core (CC)
- Discipline Specific Elective (DSE)
- Skill Enhancement (SEC)
- Ability Enhancement Core (AECC)

PREAMBLE

The University Grants Commission (UGC) has taken various measures by means of formulating regulations and guidelines and updating them, in order to improve the higher education system and maintain minimum standards and quality across the higher educational institutions in India. The various steps that the UGC has initiated are all targeted towards bringing equity, efficiency and excellence in the higher education system of country. These steps include introduction of innovation and improvements in curriculum structure and content, the teaching-learning process, the examination and evaluation systems, along with governance and other matters. The introduction of Choice Based Credit System (CBCS) is one such attempt towards improvement and bringing in uniformity of system with diversity of courses across all higher education institutes in the country. The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising of core, elective, skill enhancement and ability enhancement courses. The courses shall be evaluated following the grading system, is considered to be better than conventional Points system. This will make it possible for the students to move across institutions within India to begin with and across countries for studying courses of their choice. The uniform grading system shall also prove to be helpful in assessment of the performance of the candidates in the context of employment.

TOTAL NUMBER OF COURSES

Type of course	Core Course (CC)	Discipline Specific Elective Course (DSE)	Ability Enhancement Course		TOTAL
			Ability Enhancement compulsory course (AECC)	Skill Enhancement course (SEC)	
No. of course	12	6	2	4	24
Credit/course	6	6	2	2	120

DETAIL OF COURSES

Sl. No.	Particulars of Course	Credit Point Theory + Practical
1.	Core Course: 12 Papers	
1. A.	Core Course: (Theory)*(12 papers)	4x12 = 48
1. B.	Core Course: (Practical)*(12 papers)	2x12 = 24

Sl. No.	Particulars of Course	Credit Point Theory + Practical
2.	Elective Courses: (6 papers)	
2. A.	DSE: (Theory)*(6 papers)	4x6 = 24
2. B.	DSE: (Practical)*(6 papers)	2x6 = 12
3.	Ability Enhancement Courses	
3. A.	Ability Enhancement compulsory course (AECC): (Theory)*(2 papers) (2 papers of 2 credits each)	2x2 = 4
3. B.	Skill Enhancement Course (SEC): (Theory)*(4 papers) (4 papers of 2 credits each)	2x4 = 8
Total Credit:		120

DESCRIPTION OF COURSE TYPES INTRODUCED IN CBCS CURRICULUM

- **Core Course (CC):** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

- **Discipline Specific Elective Course (DSE):** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the student's proficiency/skill is termed as an Elective Course and if the Elective courses that are offered by the main discipline/subject of study are referred to as Discipline Specific Elective.

- **Skill Enhancement Course (SEC):** These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

- **Ability Enhancement Compulsory Course (AECC):** Ability enhancement courses are the courses based upon the content that leads to Knowledge enhancement. Two compulsory courses in Semesters I & II.
  - Compulsory English/Bengali/Hindi/Arabic as MIL (Sem I for Prog./Genl.),
  - Environmental Science (Sem II for Prog./Genl.)

SEMESTER WISE DISTRIBUTION OF COURSES & CREDITS

Courses/ (Credits)	Semesters						Total No. of Course	Total Credit
	Sem-I	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-VI		
CC-1, 2, 3 (6)	3 (1A,2A,3A)	3 (1B,2B,3B)	3 (1C,2C, 3C)	3 (1D,2D, 3D)	-	-	12	72
DSE - 1, 2, 3 (6)	-	-	-	-	3 (1A,2A,3A)	3 (1B,2B,3B)	6	36
AECC (2)	1 (MIL)	1 (ENV)	-	-	-	-	2	04
SEC (2)	-	-	1	1	1	1	4	08
Total No. of Courses/ Semester	4	4	4	4	4	4	24	-
Total Credits /Semester	20	20	20	20	20	20	-	120

Full marks of a course, having 6 credits/ 2credits, along with distribution of marks:

Full marks of each course of B.Sc. (Gen.), carrying **6 credits**, be **75**

Full marks of each course B.Sc. (Gen.), carrying **2 credits**, be **50**

For practical, distribution of 75 marks be as follows:

Class **Attendance cum Internal Assessment: 20% of 75 marks = 15 marks** of which 5 marks be reserved for theoretical class attendance in the following manner:

Attendance **50%** & above but **below 60% - 2** marks
Attendance 60% & above but **below 75% - 3** marks
Attendance 75% & above but **below 90% - 4** marks
Attendance **90% & above - 5** marks

and **10 marks** be reserved for **class test/ assignment/ seminar** (theoretical -5 & practical -5).

Semester-end-Practical Examination of each course = **20 marks**, distribution of which may be as under:

a) Lab. Note Book = 05
b) Viva- voce = 05
c) Experiment = 10

Semester-end-Theoretical Examination of each course = **40 marks**, distribution of which may be as under:

a) Answer 05 questions out of 08 carrying 02 marks each = 05 x 02 = 10
b) Answer 02 questions out of 04 carrying 05 marks each = 02 x 05 = 10
c) Answer 02 questions out of 04 carrying 10 marks each = 02 x 10 = 20

However, questions, carrying 5 or 10 marks, need not necessarily to be a single question.

In the **Semester-end-Examination of AECC**, carrying **2 credits (ie. FM 50):**

MCQ be set and **OMR** sheet be used. Under AECC, **ENVS be taught in the 1st Semester** and **Compulsory English/Bengali/Hindi/Arabic as MIL be taught in the 2nd Semester**.

Distribution of 50 marks (for each SEC) be as follows:

Internal Assessment: 20% of 50 marks = **10 marks** be reserved for **class test/ assignment/ seminar**.

40 marks be allotted for Semester-end-Theoretical Examination of each course, distribution of which may be as under:

a) Answer 05 questions out of 08 carrying 02 marks each = 05 x 02 = 10

b) Answer 02 questions out of 04 carrying 05 marks each = 02 x 05 = 10

c) Answer 02 questions out of 04 carrying 10 marks each = 02 x 10 = 20

However, questions, carrying 5 or 10 marks, need not necessarily to be a single question.

Distribution of **total marks (1650)**, equivalent to **132 credits**, **of all courses** to be studied by a student of B.Sc. (Gen).

a) **CC**	= 75x12	= **900**
b) **DSE**	= 75x6	= **450**
c) **GE**	= 75x4	= **300**
d) **AECC**	= 50x2	= **100**
e) **SEC**	= 50x4	= **200**

STRUCTURE OF CURRICULUM

Core Courses (CC): 12 compulsory courses – 04 courses to be taken, one each in **Semesters I, II, III, IV**.

1. Animal Diversity and Taxonomy
2. Comparative Anatomy, Developmental Biology of Vertebrates and Ecology
3. Cell Biology, Genetics and Evolutionary Biology
4. Physiology and Biochemistry

Discipline Specific Elective Courses (DSE): 02 courses to be taken, one each in **Semesters V and VI**.

1. Fish and fisheries
2. Wildlife conservation and Management
3. Parasitology
4. Biology of Insecta

Ability Enhancement Compulsory Courses (AECC): 2 compulsory courses – to be taken in **Semesters I and II (one in each semester)**

English Communication / MIL

Environmental Science

Skill Enhancement Courses (SEC): to be taken in **Semesters III, IV, V and VI**.

1. Aquarium fish keeping
2. Apiculture
3. Sericulture
4. Medical Diagnostics Techniques

SEMESTER & COURSEWISE CREDIT DISTRIBUTION

(6 Credits: 75 Points; L: Lecture; P: Practical)

		Credits	
Course Type	**Total Papers**	**Theory + Practical**	**Theory***
Core Courses	12	12*4 =48 12*2 =24	12*5 =60 12*1=12
Discipline Specific Electives	6 (from 3 subjects)	6*4=24 6*2=12	6*5=30 6*1=6
Ability Enhancement Language Courses	2	2*2=4	2*2=4
Skill Enhancement Courses	4	4*2=8	4*2=8
Totals	24	120	120

*Tutorials of 1 Credit will be conducted in case there is no practical component

- All Pass courses will have 3 subjects/disciplines of interest. Student will select 4 core courses each from disciplines of choice including Zoology as one of the disciplines.
- Student will select 2 DSE courses each from disciplines of choice including Zoology as one of the disciplines.
- Student may also choose Skill Enhancement courses in Zoology.

Scheme for CBCS Curriculum with Course Details

Semester	Course Name	Course Detail	Credits
I	ZOOL-G-CC-T-01	Animal Diversity and Taxonomy	4
	ZOOL-G-CC-P-01	Animal Diversity and Taxonomy Lab	2
II	ZOOL-G-CC-T-02	Comparative Anatomy, Developmental Biology of Vertebrates and Ecology	4
	ZOOL-G-CC-P-02	Comparative Anatomy, Developmental Biology of Vertebrates and Ecology Lab	2
III	ZOOL-G-CC-T-03	Cell Biology, Genetics and Evolutionary Biology	4
	ZOOL-G-CC-P-03	Cell Biology, Genetics and Evolutionary Biology Lab	2
	ZOOL-G-SEC-T-01	Aquarium Fish Keeping	2
IV	ZOOL-G-CC-T-04	Physiology and Biochemistry	4
	ZOOL-G-CC-P-04	Physiology and Biochemistry Lab	2
	ZOOL-G-SEC-T-02	Apiculture	2
V	ZOOL-G-SEC-T-03	Sericulture	2
	ZOOL-G-DSE-T-01	Fish and Fisheries	4
	ZOOL-G-DSE-P-01	Fish and Fisheries Lab	2
VI	ZOOL-G-SEC-T-04	Medical diagnostics Lab	2
	ZOOL-G-DSE-T-02	Parasitology	4
	ZOOL-G-DSE-P-02	Parasitology Lab	2

Core Subjects Syllabus

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-CC-T-01	Animal Diversity and Taxonomy	4 (40)	60	60

Unit 1: Basics of Animal Classification

Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy.

Unit 2: Protista

Protozoa. Outline of classification (salient features and classification scheme upto subphylum only).

a. Locomotion in *Amoeba*; Conjugation in *Paramoecium*.

b. Life cycle and pathogenicity of *Entamoeba histolytica*.

Unit 3: Porifera

Outline of classification (salient features and classification scheme upto subclass only). Canal system in sponges.

Unit 4: Cnidaria

Outline of classification (salient features and classification scheme upto subclass only). Metagenesis in *Obelia*.

Unit 5: Platyhelminthes

Outline of classification (salient features and classification scheme upto subclass only). Life cycle and pathogenicity and control measures of *Fasciola hepatica*.

Unit 6: Nematoda

Outline of classification (salient features and classification scheme upto subclass only). Life cycle, and pathogenicity and control measures of *Ascaris lumbricoides*.

Unit 7: Annelida

Outline of classification (salient features and classification scheme upto subclass only). Excretion in Annelida through nephridia.

Unit 8: Arthropoda

Outline of classification (salient features and classification scheme upto class only). Social life in termite.

Unit 9: Mollusca

Outline of classification (salient features and classification scheme upto subclass only). Respiration in *Pila*.

Unit 10: Echinodermata

Outline of classification (salient features and classification scheme upto subclass only). Water-vascular system in Asteroidea

Unit 11: Protochordata

Retrogressive metamorphosis in *Ascidia*.

Unit 12: Pisces

Outline of classification (salient features and classification scheme upto subclass only). Swim bladder in fishes.

Unit 13: Amphibia

Outline of classification (salient features and classification scheme upto order only). Parental care in Amphibia.

Unit 14: Reptilia

Outline of classification (salient features and classification scheme upto order only). Poison apparatus and Biting mechanism in Snake.

Unit 15: Aves

Outline of classification (salient features and classification scheme upto subclass only). Exoskeleton and Migration in Birds.

Unit 16: Mammalia

Outline of classification (salient features and classification scheme upto infraclass only). Exoskeletal derivatives of mammals.

Classification scheme to be followed from Ruppert and Barnes for Invertebrates and Young for Vertebrates.

Reference Books

- Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition
- The Invertebrates: A New Synthesis, III Edition, Blackwell Science
- Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
- Parker, T. J. &Haswell, W. (1972). Text Book of Zoology, Volume II: Marshall and Willam (Eds.) 7th Ed. Macmillan Press, London.
- Jordan, E.L. &Verma, P.S. (2003). Chordate Zoology. S. Chand & Company Ltd. New Delhi.
- Sinha, K. S., Adhikari, S., Ganguly, B. B. & BharatiGoswami, B. D. (2001). Biology of Animals. Vol. II. New Central Book Agency (P) Ltd.

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-CC-P-01	Animal Diversity, Taxonomy Lab	2 (20)	30	60

List of Practicals

1. Identification of:
    a. Porifera - *Sycon, Obelia, Physalia, Corallium, Metridium, Pennatula.*
    b. Annelids - *Nereis, Pheretima,Hirudinaria.*
    c. Arthropods – *Limulus, Palaemon, Eupagurus, Scolopendra, Bombyx, Periplaneta,* termites and honey bees.
    d. Onychophora – *Peripatus.*
    e. Molluscs - *Pila, Sepia.*
    f. Echinodermata - *Asterias, Echinus.*
    g. Protochordata – *Balanoglossus.*
    h. Fishes - *Sphyrna, Torpedo, Labeo, Exocoetus, Echeneis, Hippocampus.*
    i. Amphibia - *Hyla, Tylototriton.*
    j. Reptilia - *Trionyx, Hemidactylus, Chamaeleon, Draco, Naja.*
    k. Mammalia: Bat
2. Pecten from Fowl head
3. Dissection of brain and pituitary of Rohu/Catla/Mrigal
4. Identification and significance of adult *Fasciola hepatica,* and *Ascaris lumbricoides*

Identification upto Subclass in invertebrates and upto Order in vertebrates, with labeled diagrams, systematic position and characters, in Lab Notebook.

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-CC-T-02	Comparative Anatomy, Developmental Biology of Vertebrates and Ecology	4 (40)	60	60

Unit 1: Integumentary System

Structure, function and derivatives of integument in mammals

Unit 2: Skeletal System

Jaw suspensions.

Unit 3: Digestive System

Teeth.

Unit 4: Circulatory System

Comparative account of heart and aortic arches

Unit 5: Urinogenital System

Succession of kidney, Types of mammalian uteri.

Unit 6: Nervous System

Cranial nerves in mammals.

Unit 7: Early Embryonic Development

Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal): Planes and patterns of cleavage; Embryonic induction and organizers

Unit 8: Late Embryonic Development

Fate of Germ Layers; Extra-embryonic membranes in birds.

Unit 9: Post Embryonic Development

Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each)

Unit 10: Introduction to Ecology

Autecology and synecology, Levels of organization.

Unit 11: Population and Community

Geometric, exponential and logistic growth, equation, Gause's Principle with laboratory and field examples.

Community characteristics: species diversity, abundance, dominance, richness. Vertical stratification. Ecological succession with one example.

Unit 12: Ecosystem

Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids.

Unit 13: Applied Ecology

Wildlife Conservation (in-situ and ex-situ conservation).
Management strategies for tiger conservation; Wild life protection act (1972)

Reference Books

- Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
- Slack JMW, Essential Developmental Biology.
- Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
- Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies
- Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons Saxena, R.K. &Saxena, S.C.(2008) : Comparative Anatomy of Vertebrates, Viva Books Pvt. Ltd.
- Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
- Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
- Robert Leo Smith Ecology and field biology Harper and Row publisher
- Ecology: Theories & Application (2001). 4th Edition by Peter Stilling.
- Ecology by Cain, Bowman & Hacker. 3rd edition. Sinauer Associates

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-CC-P-02	Comparative Anatomy and Developmental Biology of Vertebrates Lab	2 (20)	30	60

List of Practicals

1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs
2. Study of disarticulated skeleton of Toad, Pigeon and Guineapig.
3. Demonstration of Carapace and plastron of turtle OR
4. Identification of mammalian skulls: One herbivorous (Guineapig) and one carnivorous (Dog) animal
    a. Dissection of Tilapia: Circulatory system, Brain, pituitary, urinogenital system.
    b. Study of whole mounts of developmental stages of chick through permanent slides: 24, 48, 72, and 96 hours of incubation.
5. Study of an aquatic ecosystem: Phytoplankton and zooplankton, determination of pH, and Dissolved Oxygen content (Winkler's method) and free CO_2.
6. Report on a one-day visit to Sanctuary/Zoo/Sericulture station/Fishery/apiculture station/pond ecosystem/agroecosystem.

Either 3 or 4.
Lab note book, with labelled diagrams and identifications, with reason.

Separate Lab Notebooks for Identification and Ecology.
Separate Field Notebook.

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-CC-T-03	Cell Biology, Genetics and Evolutionary Biology	4 (40)	60	60

MG **Unit 1: Overview of Cells**

Basic structure of Prokaryotic and Eukaryotic cells

MG **Unit 2: Plasma Membrane**

Ultra structure and composition of Plasma membrane: Fluid mosaic model. Transport across membrane: Active and Passive transport, Facilitated transport. Cell junctions: Tight junctions, Gap junctions, Desmosomes.

TP **Unit 3: Cytoplasmic organelles I**

1. Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes.

RB **Unit 4: Cytoplasmic organelles II**

Mitochondria: Structure, Mitochondrial Respiratory Chain.

MG **Unit 5: Nucleus**

Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome).

MA **Unit 6: Cell Division**

Cell cycle and its regulation.

RB **Unit 7: Cell Signaling**

Cell signaling transduction pathways; Types of signaling molecules and receptors

MA **Unit 8: Mendelian Genetics and its Extension**

Principles of inheritance. Sex-linked, sex- influenced and sex-limited inheritance.

RS **Unit 9: Linkage, Crossing Over and Chromosomal Mapping**

Linkage and Crossing Over

RS **Unit 10: Mutations**

Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example of each)

RB **Unit 11: Sex Determination**

Mechanisms of sex determination in *Drosophila*

MA **Unit 12: Evolution – 1: Idea**

Geological time scale

TP **Unit 13: Evolution - 2: Mechanism**

Natural selection (concept of fitness, types of selection, selection coefficient, mode of selection heterozygous superiority).

TP **Unit 14: Evolution - 3: Effect**

Species concept, Isolating mechanisms, modes of speciation

RS **Unit 15: Evolution - 4: Humans**

Unique Hominid characteristics contrasted with primate characteristics.

Reference Books

- Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
- Douglas J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
- iGenetics: A Molecular Approach. 3rd edition. Peter.J.Russell.
- Developmental biology by Scott F. Gilbert, 9th edition.
- Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings
- Russell, P. J. (2009). Genetics- A Molecular Approach. 3d. ed. Benjamin Cummings
- Lewin's Cells – 3rd Edition – Cassimeris/Lingappa/Plopper – Johns & Bartlett Publishers
- Biology of Cancer by Robert. A. Weinberg. 2nd edition.
- Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.

SEMESTER - III

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-CC-P-03	Cell Biology, Genetics and Evolutionary Biology Lab	2 (20)	30	60

List of Practicals

MA 1. Study of various stages of meiosis.

RS/RB/TP 2. Study of fossils from models/ pictures.

MG 3. Chi-square analyses.

Lab note book, with drawing and labelling; methods where applicable.

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-CC-T-04	Physiology and Biochemistry	4 (40)	60	60

Unit 1: Digestion and Absorption of Food

Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins.

Unit 2: Functioning of Excitable Tissue (Nerve and Muscle)

Structure of neuron, Propagation of nerve impulse (myelinated and non-myelinated nerve fibre); Structure of skeletal muscle, Mechanism of muscle contraction (Sliding filament theory.

Unit 3: Respiratory Physiology

Transport of oxygen and carbon dioxide in blood, Factors affecting transport of gases.

Unit 4: Renal Physiology

Functional anatomy of kidney, Mechanism and regulation of urine formation

Unit 5: Cardiovascular Physiology

Structure of heart, Coordination of heartbeat, Cardiac cycle, ECG

Unit 6: Endocrine and Reproductive Physiology

Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes), Brief account of Menstrual cycle.

Unit 7: Carbohydrates

Glycolysis, Citric acid cycle

Unit 8: Lipids

Fatty acid biosynthesis

Unit 9: Proteins

Amino acids: Structure, Classification
Proteins: Levels of organization; Protein metabolism: Urea cycle

Unit 10: Nucleic Acids

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids

Unit 11: Enzymes

Classification; Cofactors; Specificity; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions.

Reference Books

- Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York.
- Berg, J.M., Tymoczko, J.L. and Stryer, L.(2007). Biochemistry, VI Edition, W.H. Freeman and Co., New York.
- Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Well, P.A. (2009). Harper's Illustrated Biochemistry, XXVIII Edition, International Edition, The McGraw- Hill Companies Inc.

- Hames, B.D. and Hooper, N.M. (2000). Instant Notes in Biochemistry, II Edition, BIOS, Scientific Publishers Ltd., U.K.

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-CC-P-04	Physiology and Biochemistry Lab	2 (20)	30	60

List of Practical

List of Practicals

1. Preparation of temporary mounts: Blood film.
2. Estimation of haemoglobin using Sahli's haemoglobinometer.
3. Examination of permanent histological sections of mammalian duodenum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary.
4. Qualitative tests of functional groups in carbohydrates, proteins and lipids.

Lab notebook with labelled diagrams, methods and results.

SEMESTER - V

Discipline Specific Electives (DSE) Courses Syllabus

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-DSE-T-01	Fish and Fisheries	4 (40)	60	60

MG

Unit 1: Introduction and Classification

1. Feeding habit, habitat and manner of reproduction
2. Classification of fish (up to Subclasses)

TP

Unit 2: Morphology and Physiology

Types of fins and their modifications; Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder: Types and role in Respiration, buoyancy; Osmoregulation in Elasmobranchs; Reproductive strategies (special reference to Indian fish); Electric organ.

MA

Unit 3: Fisheries

Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears.

RS

Unit 4: Aquaculture

Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Induced breeding of fish; Management of finfish hatcheries; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products

TP

Unit 5: Fish in research

Transgenic fish.

Zebrafish as a model organism in research

Reference Books

- Q Bone and R Moore, Biology of Fishes, Taylor and Francis Group, CRC Press, U.K.
- D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK
- von der Emde, R.J. Mogdans and B.G. Kapoor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands
- C.B.L. Srivastava, Fish Biology, Narendra Publishing House
- J.R. Norman, A history of Fishes, Hill and Wang Publishers
- S.S. Khanna and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House.

Note: Classification to be followed from: Romer A. S. (1959)

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-DSE-P-01	Fish and Fisheries Lab	2 (20)	30	60

List of Practical

List of Practicals

1. Morphometric and meristic characters of fishes.
2. Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas*, *Echeneis*, exotic carps.
3. Study of different types of scales (through permanent slides/ photographs).
4. Study of crafts and gears used in Fisheries (Pictures/models). Characters.
5. Water quality criteria for Aquaculture: Assessment of pH, DO, free CO_2, productivity, alkalinity, hardness, chloride (by titration/refractometer).
6. Study of air breathing organs in *Channa*, *Heteropneustes*, *Anabas* and *Clarias.* Drawing with characters.
7. Project Report on a visit to any fish farm/ pisciculture unit/Zebrafish rearing Lab.

Lab notebook with labelled diagrams, methods and results.
1, 3, 4, 6: Identification with diagram, systematic position (where applicable) and diagnostic characters.

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-DSE-T-02	Wildlife Conservation and Management	4 (40)	60	60

Unit 1: Introduction to Wild Life

Brief introduction to Conservation: Importance of conservation; Causes of depletion.

Unit 2: Evaluation and management of wild life

Habitat analysis: Physical parameters – Topography, soil and water; Biological Parameters – food and cover estimation; Brief idea on remote sensing and GIS in wildlife status estimation.

Unit 3: Management of habitats

Setting back succession; Advancing the successional process; Cover construction; Restoration of degraded habitats.

Unit 4: Population estimation

Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores; Pug marks and census method.

Unit 5: Aims and objectives of wildlife conservation

Necessity for wildlife conservation; modes of conservation – in-situ conservation and ex-situ conservation.

Unit 6: Management planning of wild life in protected areas

Estimation of carrying capacity; Eco tourism / wild life tourism in forests.

Unit 7: Man and Wildlife

Causes and consequences of human-wildlife conflicts.

Unit 8: Protected areas

National parks & sanctuaries. Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.

Reference Books

- Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management. Blackwell Science.
- Woodroffe R., Thirgood, S. and Rabinowitz, A. (2005). People and Wildlife, Conflict or Co- existence? Cambridge University.
- Bookhout, T.A. (1996). Research and Management Techniques for Wildlife and Habitats, 5 th edition. The Wildlife Society, Allen Press.
- Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences
- Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation

Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing.

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-DSE-P-02	Wildlife Conservation and Management Lab	2 (20)	30	60

List of Practicals

1. Identification (at least 5 each) of flora, mammalian fauna, avian fauna, herpeto-fauna of locality; field notebook with pictures/sketches and brief description.
2. Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses); note book with pictures/sketches and short description.
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers, etc. Descriptions to be noted in field notebook.
4. Monitoring for estimation of faunal abundance and diversity in locality (direct and indirect evidences): setting pitfall, spring and light traps and recording results from collections therein; pellet collection, dissection and recording; bird counts, migratory bird counts.

Animals collected from traps should be released back into their own habitat as far as possible; only pictures/sketches and descriptions should be retained submitted. Nests/eggs should not be disturbed/collected unless abandoned. In no case should wildlife be harmed – only non-invasive recording and data collection is permitted.

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-DSE-T-03	Parasitology	4 (40)	60	60

Unit 1: Introduction to Parasitology

MA Brief introduction of Parasitism, Parasite, Parasitoid and Vectors (mechanical and biological vector) Host parasite relationship

Unit 2: Parasitic Protists

RS Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Trypanosoma gambiense, Leishmania donovani*

Unit 3: Parasitic Platyhelminthes

RB Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Schistosoma haematobium*.

Unit 4: Parasitic Nematodes

TP Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti.*

Unit 5: Parasitic Arthropods

MG Biology, importance and control of ticks (Soft tick *Ornithodoros,* Hard tick *Ixodes*), mites (*Sarcoptes*), Lice (*Pediculus*), Flea (*Xenopsylla*) .

Unit 6: Parasite Vertebrates

MA Brief account of Vampire bat

Reference Books

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

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-DSE-P-03	Parasitology Lab	2 (20)	30	60

List of Practicals RESPECTIVE TEACHERS

1. Study of life stages of any one: *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani* through permanent slides/micro photographs
2. Study of adult and life stages of any one: *Schistosoma haematobium*, *Taenia saginata* through permanent slides/micro photographs
3. Study of adult and life stages of any one: *Ancylostoma duodenale*, *Brugia malayi* and *Trichinella spiralis* through permanent slides/micro photographs
4. through permanent slides/micro photographs
5. Study of any one: *Pediculus humanus*, *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/ photographs
6. Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]
7. 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

6 and 7: Wet lab.

Lab notebook with labelled diagrams, methods and results.

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-DSE-T-04	Biology of Insecta	4 (40)	60	60

Unit 1: Introduction to Biology of Insecta

General Features of Insects.

Unit 2: Insect Taxonomy

Classification of insects up to orders (according to Brusca and Brusca, 2016).

Unit 3: General Morphology of Insects

Head – Types of antennae, Mouth parts w.r.t. feeding habits; Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat.

Unit 4: Physiology of Insects

Structure and physiology of Insect digestive, reproductive, and nervous systems; Metamorphosis: Types and Neuroendocrine control of metamorphosis.

Unit 5: Insect Society

Social insects with special reference to termites. Trophallaxis.

Unit 6: Insect Plant Interaction

role of allelochemicals in host plant mediation. Major insect pests in paddy.

Unit 7: Insects as Vectors

Brief discussion on houseflies and mosquitoes as important vectors.

Reference Books

- A general text book of entomology, Imms , A. D., Chapman & Hall, UK
- The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK.
- The Insect Societies, Wilson, E. O., Harward Univ. Press, UK.
- Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA.
- Medical Entomology, Hati A. K., Allied Book Agency, 2010.

Note: Classification to be followed from IMMS A. D. (1938).

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-H-DSE-P-06	Biology of Insecta Lab	2 (20)	30	60

List of Practicals

1. Study of life cycle of Mosquito, various castes of *Apis*, *Camponotus Odontotermes.* Diagrams and descriptions in note-book.
2. Methodology of collection and preservation. Key to common insect orders.
3. Mounting of wings, different kinds of antennae, legs and mouth parts of insects (at least 4, one of each).
4. Submission of collected, preserved and mounted representative insects from at least ten orders from locality.

Lab notebook with labelled diagrams (1 and 2); Submissions (3 and 4).

RS

Skill Enhancement Courses (SEC) Syllabus

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-SEC- 01	Aquarium Fish Keeping	2 (20)	30	30

RS

Unit 1: Introduction to Aquarium Fish Keeping

Exotic and Endemic species of Aquarium Fishes

RS

Unit 2: Biology of Aquarium Fishes

Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Anemone fish and Butterfly fish

RS

Unit 3: Food and feeding of Aquarium fishes

Use of live fish feed organisms. Preparation and composition of formulated fish feeds

RS

Unit 4: Fish Transportation

Live fish transport - Fish handling, packing and forwarding techniques.

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-SEC- 02	Apiculture	2 (20)	30	30

Unit 1: Biology of Bees

Biology and social organization of honey bees.

Unit 2: Rearing of Bees

Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth; Bee Pasturage; Selection of Bee Species for Apiculture; Bee Keeping Equipment; Methods of Extraction of Honey (Indigenous and Modern).

Unit 3: Diseases and Enemies

Bee Diseases and Enemies; Control and Preventive measures.

Unit 4: Bee Economy

Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc.

Unit 5: Entrepreneurship in Apiculture

Report on a visit to an apiculture farm.

Reference Books:

- Economic Zoology – Chaki, Kundu, Sarkar, New Central Book Agency.
- Moumachhi o tader palonkotha – Kishor Dhara,

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-G-SEC- 03	Sericulture	2 (20)	30	30

RB **Unit 1: Introduction**

1. Types of silkworms, Distribution and Races
2. Exotic and indigenous races
3. Mulberry and non-mulberry Sericulture

TP **Unit 2: Biology of Silkworm**

1. Life cycle of *Bombyx mori*
2. Structure of silk gland and secretion of silk

RS/MA **Unit 3: Rearing of Silkworms**

1. Rearing house and rearing appliances.
2. Disinfectants: Formalin, bleaching powder,
3. Silkworm rearing technology: Early age and Late age rearing
4. Types of mountages
6. Spinning, harvesting and storage of cocoons

MG **Unit 4: Pests and Diseases**

1. Pests of silkworm: Uzi fly, dermestid beetles and vertebrates
2. Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial
3. Control and prevention of pests and diseases

MA/MG/ RB/TP/RS **Unit 5: Entrepreneurship in Sericulture**

Report on a visit to various sericulture centre.

Reference Books:

- Economic Zoology – Chaki, Kundu, Sarkar, New Central Book Agency.

Course Code	Course Title	Total credits (FM)	Total no. of Lectures	Total no. of hours
ZOOL-H-SEC-04	Medical Diagnostic Techniques	2 (20)	30	30

Unit 1: Diagnostics Methods Used for Analysis of Blood

MA Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.)

Unit 2: Diagnostic Methods Used for Urine Analysis

MA Urine Analysis: Physical characteristics; Abnormal constituents

Unit 3: Non-infectious Diseases

RB Testing of blood glucose using Glucometer/Kit

Unit 4: Infectious Diseases

MA Diagnosis of Tuberculosis and Hepatitis, Malarial parasite (Microscope based and ELISA based)

Unit 5: Clinical Biochemistry

RS LFT, Lipid profiling

Unit 6: Clinical Microbiology

RS Antibiotic Sensitivity Test

Unit 7: Tumors

TP Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).

Unit 8: Lab visit

Visit to Pathological Laboratory and Submission of Project.

Reference Books

- Godkar P.B. and Godkar D.P. Textbook of Medical Laboratory Technology, II Edition, Bhalani Publishing House
- Guyton A.C. and Hall J.E. Textbook of Medical Physiology, Saunders
- Prakash, G. (2012), Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co. Ltd.