



REVISED CBCS SYLLABUS
FOR
THREE YEARS UNDER-GRADUATE COURSE
IN
B.Sc General Degree Course (w.e.f. 2019-20)



BANKURA UNIVERSITY
BANKURA
WEST BENGAL
PIN 722155



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MODEL STRUCTURE IN B.Sc General Degree Course

SEMESTER – I

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UGP/SC/101/C -1A	Animal Diversity	6	10	40	50		25	15
UGP/102/ C- 2A	Discipline-2	6	10	40	50			
UGP/103/ C- 3A	Discipline-3	6	10	40	50			
UG/ 104/ AECC-ENV	Environmental Studies	4	10	40	50			
Total in Semester - I		22	40	160	200			

SEMESTER –II

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UGP/S.C./201/ C-1B	Comparative anatomy and Developmental Biology of Vertebrate	6	10	40	50		25	15
UGP/202/ C-2B	Discipline - 2	6	10	40	50			
UGP/ 203/C- 3B	Discipline - 3	6	10	40	50			
UG/204/ AECC-E/MIL	English/MIL	2	10	40	50			
Total in Semester - II		20	40	160	200			



SEMESTER – III

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UGP/S.C./ 301/C-1C	Physiology and Biochemistry	6	10	40	50		25	15
UGP/302/C-2C	Discipline - 2	6	10	40	50			
UGP/ 303/ C- 3C	Discipline - 3	6	10	40	50			
UGP/S.C/304/ SEC-1	Apiculture (Economic Zoology)	2	10	40	50			
Total in Semester - III		20	40	160	200			

SEMESTER – IV

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UGP/S.C./401/ C-1D	Genetics and Evolutionary Biology	6	10	40	50		25	15
UGP/ 402/ C- 2D	Discipline-2	6	10	40	50			
UGP/ 403/ C- 3D	Discipline-3	6	10	40	50			
UGP/S.C./404/ SEC-2	Aquarium Fish Keeping (Economic Zoology)	2	10	40	50			
Total in Semester - IV		20	40	160	200			



SEMESTER – V

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UGP/S.C./501/ DSE-1A	DSET 1a Applied Zoology Or 1b Insect vector and Disease DSEP 1a Applied Zoology Lab Or 1b Insect vector and Disease	6	10	40	50		25	15
UGP/ 502/DSE- 2A	Discipline - 2	6	10	40	50			
UGP/ 503/DSE- 3A	Discipline - 3	6	10	40	50			
UGP/S.C./504/ SEC-3	Sericulture (Economic Zoology)	2	10	40	50			
Total in Semester – V		20	40	160	200			

SEMESTER – VI

Course Code	Course Title	Credit	Marks			No. of Hours		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UGP/S.C. / 601/DSE- 1B	DSET 2a Aquatic biology Or 2b Immunology DSEP 2a Aquatic biology Lab Or 2b Immunology Lab	6	10	40	50		25	15
UGP/ 602/DSE- 2B	Discipline - 2	6	10	40	50			
UGP/ 603/DSE- 3B	Discipline - 3	6	10	40	50			
UGP/S.C./ 604/SEC-4	Medical Techniques	2	10	40	50			
Total in Semester – VI		20	40	160	200			

UGP= Under Graduate programme/Pass, S.C.= Subject Code C= Core Course, E/H/MIL= English/ Hindi/ Modern Indian Language, H/MIL/E= Hindi/ Modern Indian Language/ English, AECC-E= Ability Enhancement Compulsory Course-English, AECC-ENV= Ability Enhancement Compulsory Course-Environmental Science, SEC= Skill Enhancement Course, GE= Generic Elective, DSE= Discipline Specific Elective IA= Internal Assessment, ESE= End-Semester Examination, Lec.= Lecture, Tu.= Tutorial, and Pr.=Practical



CBCS Undergraduate Program in Zoology General

Course Type	Number of Courses	Credits		
		Theory	Practical	Theory + Practical
Core course (CC)	12 Papers (Four Papers each in 3 Disciplines of Choice)	4 X12=48	2 X12	72
Discipline Specific Elective Subject(DSE)	6 Papers (Two Papers each in 3 Disciplines of Choice)	4 X06=24	2 X16=12	36
Ability Enhancement Compulsory Course (AECC)	2 Papers (Compulsary Language Paper & Environmental Syudies)	4 X 1=4 2 X 1=2		6
Skill Enhancement Course (SEC)	4 Papers	4 X2=8		8
Total		86	36	122

CORE COURSES

CC- 1A: Animal Diversity

CC- 1B: Comparative Anatomy and Developmental
Biology of Vertebrates

CC- 1C: Physiology and Biochemistry

CC- 1D: Genetics and Evolutionary Biology

DISCIPLINE SPECIFIC ELECTIVE COURSES (DSE)

DSE 1a: Applied Zoology Or 1b Insect Vector
and Disease

DSE 2a : Aquatic Biology or 2b :Immunology

SKILL ENHANCEMENT COURSES: ZOOLOGY

SEC 1: Apiculture

SEC 2: Aquarium Fish Keeping

SEC 3: Sericulture

SEC 4: Medical Techniques



3. Core Subjects Syllabus

3.1 Core T1 - Animal Diversity

Animal Diversity

4 Credits

Theory

Unit-1 Sub- Kingdom Protozoa

General characters and classification of Subkingdom Protozoa up to Phylum (Levine et al., 1980); Locomotory Organelles and locomotion in Protozoa

Unit-2 Phylum Porifera

General characters and classification up to classes (Hyman); Canal System in *Sycon*

Unit-3 Phylum Cnidaria

General characters and classification up to classes; Polymorphism in *Siphonophora*

Unit-4 Phylum Platyhelminthes

General characters and classification up to classes; Life history of *Taenia solium*

Unit-5 Phylum Nematoda

General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations

Unit-6 Phylum Annelida

General characters and classification up to classes; Nephridia in annelids

Unit 7 Phylum Arthropoda

General characters and classification up to classes; Compound eye in Cockroach, Metamorphosis in insects

Unit-8 Phylum Mollusca

General characters and classification up to classes; Respiration in *Pila*, Torsion in gastropods.

Unit-9 Phylum Echinodermata

General characters and classification up to classes; Water-vascular system in *Asterias*

Unit-10 Hemichordata

General features; Chordate features of *Balanoglossus*.

Unit-11 Urochordata and Cephalochordata

General features; Filter feeding in *Branchiostoma*

Unit-12 Pisces

General features and Classification up to Subclasses (Romer, 1959); Osmoregulation in fishes

Unit-13 Amphibia

General features and Classification up to living orders (Nobel 1924); Metamorphosis in Toad

Unit-14 Reptiles

General features and Classification up to living Subclass (Young, 1981); Poisonous and non-poisonous snakes, Biting mechanism in snakes

Unit-15 Aves

General features and Classification up to orders (Young, 1981); Volant adaptations in birds

Unit-16 Mammals

Classification up to Subclasses (Young, 1981); Origin & distribution of Cranial nerves in *Cavia*



Note:

Classification of Unit 3-9 to be followed from –Ruppert & Barnes, (1994), Invertebrate Zoology, VI Edition

Suggested Readings [Consult Latest Editions]

1. Arora, M.P. *Chordata I. Himalaya Pub House*
2. Barnes, R. D. & Ruppert, E. E., (1994). *Invertebrate Zoology*. 6thEd. Brooks Cole.
3. Chatterjee, A & Chakraborty C.S. *Approach to a Text Book of Zoology* Nirjala Library, Kolkata.
4. Dhami P.S and J.K. Dhami – *Invertebrate Zoology* – S. Chand and Co.
5. Jordan, E. L. & Verma, P. S. (2006). *Invertebrate Zoology & Chordate Zoology*. S. Chand & Company Ltd. New Delhi.
6. Kotpal, R.L., 1988 – 1992. (All Series) Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, – Rastogi Publications, Meerut – 250 002.
7. Romer, A.S. & Parsons, T.S. (1986). *The vertebrate body*. 6thEd. Saunders College Pub.
8. Ruppert E. E., Fox, R. & Barnes R. D. (2003). *Invertebrate Zoology: a Functional Evolutionary Approach*. 7th Ed. Brooks Cole.



3.2 Core P1 Animal Diversity

Animal Diversity Lab

2 Credits

Practicals

1. Spot identification of the following specimens:

Amoeba, Euglena, Paramecium, Sycon, Euspongia, Obelia, Physalia, Aurelia, Tubipora, Taenia, Ascaris, Aphrodite, Nereis, Pheretima,, Palaemon, Limulus, Scolopendra, Julus,, Chiton, Dentalium, Unio, Loligo, Ophiura, Echinus, Cucumaria, Balanoglossus, Branchiostoma, Petromyzon, Torpedo, Labeo, Exocoetus, Ichthyophis, Salamandra, Hyla, Chelone, Chamaeleon, Draco, Naja, Passer, Alcedo, Pteropus, Funambulus, Bandicota

2. Identification of the transverse section of male and female Ascaris

3. Submission of a Project Report on 'animal album" containing photographs, cut outs, with appropriate write up about any above mentioned taxa/ Different taxa/ topics may be given to different sets of students for this purpose

Distribution of Marks:

Full marks: 15

1.Spot identification (6 from Item 1; 3 each from non-chordate & chordate)	(6 × 1 ½) = 09
2.Submission of a project report	= 04
3.Submission of laboratory note book:	= 02

Note: Q1. For Item (1), ½ mark for Sc. name and 1 mark for systematic position

Suggested Readings:

1. Chatterjee and Chatterjee: Practical Zoology
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata
3. Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay Advanced Practical Zoology

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B.Sc General Degree Course (Programme)

CBCS w.e.f. 2019-20

3.3 Core T2 - Comparative anatomy and Developmental Biology of Vertebrate

Comparative anatomy and Developmental Biology of Vertebrate

4 Credits

Theory

Unit 1: Integumentary System

Derivatives of integument with reference to glands and digital tips

Unit 2: Skeletal System

Evolution of visceral arches

Unit 3: Digestive System

Brief account of alimentary canal and digestive glands

Unit 4: Respiratory System

Brief account of Gills, lungs, air sacs and swim bladder

Unit 5: Circulatory System

Evolution of heart and aortic arches

Unit 6: Urinogenital System

Succession of kidney, Evolution of urinogenital ducts

Unit 7: Nervous System

Comparative account of brain

Unit 8: Sense Organs

Types of receptors

Unit 9: Early Embryonic Development

Spermatogenesis and oogenesis with reference to mammals, Fertilization: external (amphibians), internal (mammals), patterns of cleavage, fate map, and gastrulation in frog embryo.

Unit 10: Late Embryonic Development

Types of Placenta and their function; Placenta formation in Human.

Unit 11: Control of Development

Fundamental processes in development (brief idea) – Gene activation, determination, induction, Differentiation, morphogenesis, cell movements and cell death.

Suggested Readings:

1. Carlson, Bruce M (1996). Patten's Foundations of Embryology, McGraw Hill, Inc.
2. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
3. Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons.
4. Jordon & Verma . Chordate Emcryp;gy. S. Chand Pub. New Delhi.
5. Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.
6. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
7. Saxena, R.A. & Saxena, S. Coperative Anatomy of Vertebrates. Viva Publication. Walter, H.E. and Sayles, L.P; Biology of Vertebrates, Khosla Publishing House.

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Bankura University

B.Sc General Degree Course (Programme)

CBCS w.e.f. 2019-20

3.4 Core P2 - Comparative anatomy and Developmental Biology of Vertebrate

Comparative anatomy and Developmental Biology of Vertebrate Lab

2 Credits

Practicals

1. Osteology:

Identification of

a) limb bones and girdles of *Columba* and *Cavia*

b) Carapace and plastron of turtle (model/photograph)

c) Mammalian skulls: Guinea pig and Dog.

2. Identification of whole mounts of developmental stages of chick through permanent slides: 24 and 48 hours of incubation.

3. Identification of different sections of placenta (epitheliochorial, endotheliochorial and hemochorial) (photomicrograph/ slides).

4. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.

5. Submission of laboratory note book

Distribution of marks

Full Marks: 15

1. Spot identification (any five from item 1)

$$(5 \times 1 \frac{1}{2}) = 7 \frac{1}{2}$$

2. Spot identification (any three; maximum one from item 2, 3 & 4)

$$(3 \times 2) = 06$$

3. Submission of laboratory note book

$$= 1 \frac{1}{2}$$

Note: Q1. ½ mark for identification and 1 mark for reasons.

Q2. 1 mark for identification and 1 mark for reasons.

Suggested Readings:

1. Chatterjee and Chatterjee: Practical Zoology

2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata

3. Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay Advanced Practical Zoology



3.5 Core T3 – Physiology and Biochemistry

Physiology and Biochemistry

4 Credits

Theory

Unit 1: Digestion

Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids

Unit 2: Respiration

Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood

Unit 3: Cardiovascular system

Structure of Heart, Origin and conduction of the cardiac Impulse, Cardiac cycle, Composition of blood, Hemostasis

Unit 4: Excretion

Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism

Unit 5: Nerve and muscle

Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction

Unit 6: Reproduction and Endocrine Glands

Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle
Pituitary, thyroid, Parathyroid, pancreas and adrenal: Structure and function.

Unit 7: Carbohydrate Metabolism

Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, electron transport chain

Unit 8: Lipid Metabolism

Biosynthesis and β oxidation of palmitic acid

Unit 9: Protein metabolism

Transamination, Deamination and Urea Cycle

Unit 10: Enzymes

Introduction, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation

SUGGESTED READINGS

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edn. W.H Freeman & Co.
2. Chatterjea, MN and Shinde, R (2012) . A Textbook of Medical Biochemistry. 8th Edn. Jaypee Pub., N.Delhi
3. Das, D. (200). Biochemistry. Central Book Agency, Kolkata
4. Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
5. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). Harper's Illustrated Biochemistry. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.
6. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
7. Sathyanarayana U. and Chakrapani, (2002). Biochemistry –Books & Allied (P) Ltd, Kolkata
8. Sembulingam and Sembulingam (2012) Essentials of Medical Physiology. 6th Edn. Jaypee Pub, New Delhi
9. Sherwood, L. (2013). Human Physiology from cells to systems. 8th Edn., Brooks & Cole
10. Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc.

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3.6 Core P3 – Physiology and Biochemistry

Physiology and Biochemistry Lab

2 Credits

List of Practical

1. Preparation of haemin crystals
2. Identification of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland
3. Identification of permanent slides of spinal cord, liver, lung, kidney, Cartilage, Bone
4. Qualitative tests for Glucose (Benedict's test) and Sucrose (Iodine test)
5. Estimation of total protein (Lowry's method.)
6. Study of activity of salivary amylase (Effect of Temperature)
7. Submission of Laboratory Note Book

Distribution of marks

Full Marks: 15

- | | |
|---|--------------|
| 1. One question on Qualitative test (Item No. 4) | 03 |
| 2. One question on quantitative test (From Item 5) | 04 |
| 3. One Experiment (From Item no. 1 or .6) | 03 |
| 4. Identification of histological section [(From Item No. 2 and 3) any two] | (2×1 ½) = 03 |
| 5. Laboratory Note Book | 02 |

Note:

- Q1. Principle 1 marks and result 2 marks
- Q2. Principle 1 marks and result 3 marks
- Q3. Principle 1 marks and result 2 marks
- Q4. ½ marks for identification and 1 mark for reasons each

Suggested Readings:

1. Chatterjee and Chatterjee: Practical Zoology
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata
3. Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay Advanced Practical Zoology

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3.7 Core T4 - Genetics and Evolutionary Biology

Genetics and Evolutionary Biology Theory

4 Credits

Theory

Unit 1: Introduction to Genetics

Principles of Inheritance, Mendel's work on transmission of traits, Progress of genetics.

Unit 2: Extension of Mendelian Genetics

Chromosome theory of inheritance, Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, Extra-chromosomal inheritance

Unit 3: Linkage, Crossing Over and Chromosomal Mapping

Linkage and crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence.

Unit 4: Mutations

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations; Induced versus Spontaneous mutations; Back versus Suppressor mutations,

Unit 5: Sex Determination

Chromosomal mechanisms; dosage compensation in *Drosophila*.

Unit 6: History of Life

Origin of Life, Geological time scale

Unit 7: Introduction to Evolutionary Theories

Lamarckism, Darwinism, Neo-Darwinism, Modern Synthetic Theory

Unit 8: Direct Evidences of Evolution

Types of fossils, fossilization, Incompleteness of fossil record, Dating of fossils, Evolution of horse.

Unit 9: Processes of Evolutionary Change

Speciation; Isolating Mechanisms; Modes of speciation (Allopatric, Sympatric) Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection

Unit 10: Species Concept

Biological, Typological and Evolutionary species concept (Advantages and Limitations)

Unit 11: Macro-evolution

Macro-evolutionary Principles (example: Darwin's Finches); Basic understanding of Micro-evolution.

Unit 12: Extinction

Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution, Anthropogenic extinction.

SUGGESTED READINGS

1. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press.
2. Brooker, R.J. (2012). Genetics: Analysis and Principles. 4th Edn. McGraw Hill.
3. Chattopadhyay, S. (2012). Life: Evolution, Adaptation, Ethology. 3rd Edn. Books and Allied, Kolkata.
4. Futuyma, D. J. (1997). Evolutionary Biology. Sinauer Associates.
5. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Ed. Wiley India.
6. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. (2010). Introduction to Genetic Analysis WH Freeman.
7. Hall, B. K. and Hallgrímsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers
8. Hyde, D. (2009). Introduction to Genetic Principle. McGraw Hill.

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9. Kardong, K. (2004). An Introduction to Biological Evolution. McGraw Hill.
10. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings.
11. Pierce, B.A. (2013). Genetics Essentials: Concepts and Connections. 2nd Edn. Freeman W.H.
12. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
13. Russel, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
14. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.

3.8 Core P 4 - Genetics and Evolutionary Biology

Genetics and Evolutionary Biology Lab

2 Credits

Practicals

1. Identification of major group of fossils from models/ pictures (Petrified fossil, molds, casts, carbon film, trace fossil)
2. Identification of Human Karyotypes (Normal karyotype, Down, Klinefelter's, Turner, Cri-du-Chat syndrome) from photograph
3. Identification of homology and analogy from suitable specimens (Birds and mammals) / pictures,
4. Linkage maps based on Drosophila crosses
5. Identification of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) using suitable examples. Verify the results using Chi-square test
6. Submission of Laboratory Note Book

Distribution of marks

Full Marks: 15

- | | |
|--|------------|
| 1. Identification with reasons (any four from item 1, 2 and 3)
[at least one from each group] | = 08 (4×2) |
| 2. One question (From Item 4 or 5) | = 05 |
| 3. Laboratory Note Book | = 02 |

Note

- Q 1. ½ mark for identification and 1½ mark for reasons

Suggested Readings:

1. Chatterjee and Chatterjee: Practical Zoology
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata
3. Sinha, J.K., Chatterjee, A.K. and P. Chattopadhyay Advanced Practical Zoology



4.1 DSE T1 - Applied Zoology

Applied Zoology

4 Credits

Theory

Unit 1: Introduction to Host-parasite Relationship

Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis

Unit 2: Epidemiology of Diseases

Transmission, Prevention and control of diseases: Tuberculosis, typhoid

Unit 3: Rickettsiae and Spirochaetes

Brief account of *Rickettsia prowazekii*, *Borrelia recurrentis* and *Treponema pallidum*

Unit 4: Parasitic Protozoa

Life history and pathogenicity of *Entamoeba histolytica*, *Plasmodium vivax* and *Trypanosoma gambiense*

Unit 5: Parasitic Helminthes

Life history and pathogenicity of *Ancylostoma duodenale* and *Wuchereria bancrofti*

Unit 6: Insects of Economic Importance

Biology, Control and damage caused by *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio demoleus*, *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*

Unit 7: Insects of Medical Importance

Medical importance and control of *Pediculus*, *Anopheles*, *Culex*, *Aedes*,

Unit 8: Animal Husbandry

Cattle breed, Preservation and artificial insemination in cattle

Unit 9: Poultry Farming

Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs, Deep litter system

Unit 10: Fish Technology

Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed

2015

SUGGESTED READINGS

1. Arora, D. R and Arora, B. (2001). *Medical Parasitology*. II Edition. CBS Publications and Distributors.
2. Atwal, A.S. (1986). *Agricultural Pests of India and South East Asia*, Kalyani Publishers.
3. Banerjee, G.C. (2018). *Animal husbandry*. Oxford and IBH
4. Chatterjee, K. D. (2009). *Parasitology: Protozoology and Helminthology*. XIII Edition, CBS Publishers & Distributors(P) Ltd
5. Dennis, H. (2009). *Agricultural Entomology*. Timber Press (OR).
6. Dunham R.A. (2004). *Aquaculture and Fisheries Biotechnology Genetic Approaches*. CABI publications, U.K.
7. Hafez, E. S. E. (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
8. Kumar and Corton. *Pathological Basis of Diseases*.
9. Paniker, C.K.J., Ghosh, S. [Ed] (2013). *Paniker's Text Book of Medical Parasitology*. Jaypee, New Delhi.
10. Parija, S.C. *Text book of medical parasitology, protozoology & helminthology (Text and colour Atlas)*, II Edition, All India Publishers & Distributers, Medical Books Publishers, Chennai, Delhi
11. Park, K. (2007). *Preventive and Social Medicine*. XVI Edition. B.B Publishers.
12. Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.

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4.2 DSE P1 - Applied Zoology

Applied Zoology Lab

2 Credits

Practicals

1. Identification of *Plasmodium vivax*, *Entamoeba histolytica*, *Trypanosoma gambiense*, *Ancylostoma duodenale* and *Wuchereria bancrofti* and their life stages through permanent slides/photomicrographs or specimens.
2. Identification of arthropod vectors associated with human diseases: *Pediculus*, *Culex*, *Anopheles*, *Aedes*
3. Identification of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identifying feature and economic importance of *Nilaparvata lugens*, *Apion corchori*, *Scirpophaga incertulus*, *Sitophilus oryzae* and *Tribolium castaneum*
5. Visit to poultry farm or animal breeding centre. Submission of visit report
6. Maintenance of freshwater aquarium
7. Submission of laboratory note book

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Distribution of marks

Full Marks: 15

1. Identification with reasons (any 4 from Item No. 1,2 and 3; at least one from each group)	(4 × 2) = 08
2. Identification and economic importance (any two) from Item No. 4,	(2 × 2) = 04
3. Field Report (Item 5)	= 1½
4. Laboratory Note Book	= 1½

Note

- Q 1. ½ mark for identification and 1½ mark for reasons.
Q2 ½ mark for identification and 1½ mark for economic importance

Suggested Readings:

1. Chatterjee and Chatterjee: Practical Zoology
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata
3. Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay Advanced Practical Zoology



4.3 DSE T2a - Insect Vectors and Diseases

Insect Vectors and Diseases

4 Credits

Theory

Unit I: Introduction to Insects

General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts with reference to feeding habits

Unit II: Concept of Vectors

Brief introduction of Carrier and Vectors (mechanical and biological vector), Reservoirs, Host-vector relationship, Adaptations as vectors, Host Specificity

Unit III: Insects as Vectors

Classification of insects up to orders, Characteristic features – Diptera, Siphonaptera, Siphunculata, Hemiptera

Unit IV: Dipteran as Disease Vectors

Dipterans as vectors – Mosquitoes, Sand fly, Houseflies; Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Filariasis; Control of mosquitoes

Unit IV: Siphonaptera as Disease Vectors

Fleas as vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas

Unit V: Siphunculata as Disease Vectors

Human louse (Head, Body and Pubic louse) as vectors; – Typhus fever, Control of human louse

Unit VI: Hemiptera as Disease Vectors

Bugs as; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures

20

Suggested Readings:

1. Chandra, G. (2000). Mosquito. Sribhumi Publication Co. Kolkata
2. Chapman, R.F. (1998). The Insects: Structure and Function. IV Edition, Cambridge University Press, UK
3. Hati A.K. (1998). Medical Entomology, Allied Book Agency, Kolkata
4. Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK
5. Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell
6. Pedigo, L.P. (2002). Entomology and Pest Management. Prentice Hall Publication

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4.4 DSE P2a - Insect Vectors and Diseases

Insect Vectors and Diseases Lab

2 Credits

1

Practical

5

1. Mounting of different kinds of mouth parts of insects
2. Identification of following insect vectors through permanent slides/ photographs: *Aedes*, *Culex*, *Anopheles*, *Pediculus*, *Xenopsylla*, *Cimex*, *Phlebotomus*, *Musca*
3. Study of different diseases transmitted by above insect vectors
4. Submission of a project report on any one of the insect vectors and disease transmitted
5. Submission of laboratory note book

Distribution of marks

Full Marks: 15

- | | |
|--|--------------|
| 1. Mounting (any one from Item no. 1) | = 03 |
| 2. Identification of vector and disease transmission (any 4 from Item No. 2) | (4 × 2) = 08 |
| 4. Submission of Project Report | = 2 |
| 5. Submission of Laboratory Note Book | = 2 |

Note

- Q 1. 1½ mark for mounting and 1½ mark for drawing and labelling
Q 2. ½ mark for identification and 1½ mark about disease transmitted

Suggested Readings:

1. Chatterjee and Chatterjee: Practical Zoology
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata
3. Sinha, J.K., Chatterjee, A.K. and P. Chattopadhyay Advanced Practical Zoology



4.5 DSE T2b - Aquatic Biology

Aquatic Biology

4 Credits

15 Theory

Theory

UNIT 1: Aquatic Biomes

Brief introduction of the aquatic biomes: Freshwater ecosystem (lakes, wetlands, streams and rivers), marine ecosystem; estuaries; intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs.

UNIT 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.

Streams: Different stages of stream development, Physico-chemical environment, Adaptation of hill-stream fishes.

UNIT 3: Marine Biology

Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.

UNIT 4: 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

SUGGESTED READINGS

1. Anathakrishnan : Bio resources Ecology 3rdEdition
2. Goldman : Limnology, 2ndEdition
3. Odum and Barrett : Fundamentals of Ecology, 5thEdition
4. Pawlowski : Physicochemical Methods for Water and Wastewater Treatment, 1stEdition
5. Trivedi and Goyal : Chemical and biological methods for water pollution studies
6. Welch : Limnology Vols. I-II
7. Wetzel : Limnology, 3rdedition

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4.6 DSE P2b - Aquatic Biology

Aquatic Biology Lab

2 Credits

Practicals

5

1. Identify the important zooplanktons present in a lake ecosystem.
2. Determine the pH, turbidity/transparency, dissolved Oxygen, and 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 Institute/ Pond Ecosystem
5. Submission of Laboratory Note Book

Distribution of marks

Full marks: 15

- | | |
|--|-----------|
| 1. Identification with reasons (any three) [From Item 1 and 3] | [2×3] = 6 |
| 2. One experiment (pH/ free CO ₂) (Item 2) | [2+3] = 5 |
| 3. Project Report (From Item 4): | 2 |
| 4. Submission of laboratory note book: | 2 |

Note

- Q 1. ½ mark for identification and 1½ marks for characters
Q 2. For Principle 2 marks and for result 3 marks

Suggested Readings:

1. Chatterjee and Chatterjee: Practical Zoology
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata
3. Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay Advanced Practical Zoology

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DSE 4.7 Immunology

Immunology

4 Credits

Unit 1: Overview of the Immune System

Introduction to basic concepts in immunology, components of immune system, principles of innate and adaptive immune system

Unit 2: Cells and Organs of the Immune System

Haematopoiesis, Cells of immune system and organs (primary and secondary lymphoid organs) of the immune system

Unit 3: Antigens

Basic properties of antigens, B and T cell epitopes, haptens and adjuvants

Unit 4: Antibodies

Structure, classes and function of antibodies, monoclonal antibodies, antigen antibody interactions as tools for research and diagnosis

Unit 5: Working of the immune system

Structure and functions of MHC, exogenous and endogenous pathways of antigen presentation and processing, Basic properties and functions of cytokines, Complement system: Components and pathways.

Unit 6: Immune system in health and disease

Brief description of various types of hypersensitivities, Introduction to concepts of autoimmunity and immunodeficiency

Unit 7: Vaccines 4

General introduction to vaccines, Various types of vaccines

Suggested Reading

Abbas, K. Abul and Lichtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication.

Abbas, K. Abul and Lichtman H. Andrew (2011.) Basic Immunology: Functions and Disorders of Immune System. Saunders Elsevier Publication. Delves, Martin, Burton and Roitt (2006). Roitt's Essential Immunology. 11th Edn. Blackwell Pub.

Khan FH (2011) The Elements of Immunology Pearson

Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.

Mohanty, SK and Leela, KS (2014). Text book of Immunology. 2nd Edn. Jaypee Pub. N. Delhi

Parija, SC (2012). Text book of Microbiology and Immunology. 2nd Edn. Elsevier.

Playfair, JHL and Chain, BM (2001) Immunology at a glance. 7 th Edn. Blackwell Pub.

Shetty, N. (2005). Immunology: Introductory Textbook. 2nd Edn. , New Age Internatl. Pub. N. Delhi 9. Virella, G (2007). Medical Immunology 6th Edn. Informa Healthcare

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DSE 4.8 Immunology Lab

Immunology Lab

2 Credits

2015

PRACTICAL

1. Identification of lymphoid organs of human (Model/Photograph).
2. Identification of histological section of spleen, thymus and lymph nodes through slides/ 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) Immuno-electrophoresis
6. Submission of Laboratory Note Book

Distribution of Marks

Full marks: 15

- | | |
|---|-------------|
| 1. Identification with reasons (any two; From Item no. 1 & 2) | 4 (2×2) * |
| 2. Preparation of stained blood film [from item 3] | 6 (4+1+1) * |
| 3. Blood group determination (From Item no. 4): | 3 (2+1) * |
| 4. Laboratory note book: | 2 |

Note:

- Q1. Identification: ½ mark and reasons: 1½ marks
- Q2. 4 marks for preparation and 1 mark each for identification and drawing
- Q3. Experiment: 2 marks and result: 1 mark

Suggested Readings:

1. Chatterjee and Chatterjee: Practical Zoology
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata
3. Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay Advanced Practical Zoology



5. Skill Enhancement Course

5.1 SEC T1 – Apiculture (Economic Zoology)

Apiculture (Economic Zoology)

2 Credits

Unit 1: Biology of Bees

1. Classification and Biology of Honey Bees
2. Social Organization of Bee Colony

Unit 2: Rearing of Bees

1. Artificial Bee rearing (Apiary), Beehives - Newton and Langstroth
2. Bee Pasturage
3. Selection of Bee Species for Apiculture
4. Bee Keeping Equipment
5. Methods of Extraction of Honey (Indigenous and Modern)

Unit 3 Diseases and Enemies

1. Bee Diseases and Enemies
2. 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

Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Bee hives for cross pollination in horticultural gardens

5.2 SEC T2 Aquarium Fish Keeping (Economic Zoology)

Aquarium Fish Keeping

2 credits

Unit 1: Introduction to Aquarium Fish Keeping

Exotic and Endemic species of Aquarium Fishes

Unit 2: Biology of Aquarium Fishes

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

Unit 3: Food and feeding of Aquarium fishes

Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquarium fish as larval predator

Unit 4: Fish Transportation

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

Unit 5: Maintenance of Aquarium

General Aquarium maintenance - budget for setting up an Aquarium Fish Farm as a Cottage Industry



5.3 SEC T3 Sericulture (Economic Zoology)

Sericulture (Economic Zoology)

2 Credits

Unit 1: Introduction

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

Unit 2: Biology of Silkworm

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

Unit 3: Rearing of Silkworms

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

Unit 4: Pests and Diseases

1. Pests of silkworm
2. Diseases: Protozoan, viral, fungal and bacterial
3. Control and prevention of pests and diseases

Unit 5: Entrepreneurship in Sericulture

Prospectus of Sericulture in India: Sericulture industry in different states, employment, potential in mulberry and non-mulberry sericulture; Visit to sericulture centers.

5.4 SEC T4 Medical Techniques

Medical Techniques

2 Credits

Unit 1:

Introduction to Medical Diagnostics and its Importance

Unit 2:

Diagnostics Methods Used for Analysis of Blood 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 3:

Diagnostic Methods Used for Urine Analysis Urine Analysis: Physical characteristics: Abnormal constituents

Unit 4:

Non-infectious Diseases diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit

Unit 5:

Infectious Diseases Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis, Malarial parasite (Microscope based and ELISA based)

Unit 6: Clinical Biochemistry LFT, Lipid profiling

Unit 7: Tumours Types (Benign/Malignant), Detection and metastasis: Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).