

THE UNIVERSITY OF BURDWAN



SYLLABUS FOR THREE-YEAR DEGREE COURSE IN ZOOLOGY (GENERAL) UNDERCHOICE BASED CREDIT SYSTEM (CBCS)

(With effect from the session 2017-2018)

**OUTLINE OF THE SEMESTER WISE COURSE STRUCTURE OF B.Sc.
UNDER THE CHOICE BASED CREDIT SYSTEM (CBCS)**

SCHEME FOR CBCS CURRICULUM

SEMESTER	COURSE NAME	COURSE DETAIL	CREDITS
I	Ability Enhancement Compulsory Course –I	Environmental Studies	4
	Core course–I (Zoology)	Animal Diversity	4
	Core course –I Practical	Animal Diversity Lab	2
	Core course –I (Other Subject)		6
	Core course –I (Other Subject)		6
II	Ability Enhancement Compulsory	English communication /M I L	2
	Core course–II (Zoology)	Comparative Anatomy & Developmental Biology of Vertebrates	4
	Core course–II Practical	Comparative Anatomy & Developmental Biology of Vertebrates Lab	2
	Core course–II (Other Subject)		6
	Core course–II (Other Subject)		6
III	Core course–III	Physiology and Biochemistry	4
	Core course–III Practical	Physiology and Biochemistry Lab	2
	Core course–III (Other Subject)		6
	Core course–III (Other Subject)		6
	Skill Enhancement Course–I	Apiculture	2
IV	Core course–IV	Genetics and Evolutionary Biology	4
	Core course–IV Practical	Genetics and Evolutionary Biology Lab	2
	Core course–IV (Other Subject)		6
	Core course–IV (Other Subject)		6
	Skill Enhancement Course-II	Medical Diagnostics	2
V	Skill Enhancement Course- III	Sericulture	2
	Discipline Specific Elective–I (Zoology)	Aquatic Biology or Applied Zoology	4
	Discipline Specific Elective–I Practical	Aquatic Biology or Applied Zoology Lab	2
	Discipline Specific Elective–I (Other Subject)		6
	Discipline Specific Elective–I (Other Subject)		6

VI	Skill Enhancement Course 4	Community Nutrition and Health Statistics	2
	Discipline Specific Elective-2 (Zoology)	Immunology or Insects, Vectors and Diseases	4
	Discipline Specific Elective-2 Practical	Immunology or Insects, Vectors and Diseases Lab	2
	Discipline Specific Elective-II (Other subject)		6
	Discipline Specific Elective-II (Other subject)		6
			122

CREDIT DISTRIBUTION ACROSS COURSES

I	CC- Zoology 1 A (Animal Diversity) CC- Other Subject 2A CC- Other Subject 3A	Environmental Studies	_____	_____
II	CC- Zoology 1B (Comparative Anatomy and Developmental Biology of Vertebrates) CC- Other Subject 2B CC- Other Subject 3B	English Communication/ M I L	_____	_____
III	CC- Zoology 1C (Physiology and Biochemistry) CC- Other Subject 2C CC- Other Subject 3C	_____	SEC-I: Apiculture	_____
IV	CC- Zoology 1D (Genetics and Evolutionary Biology) CC- Other Subject 2D CC- Other Subject 3D	_____	SEC-II: Medical Diagnostics	_____
V	_____	_____	SEC-III Sericulture	DSE-1A Zoology (Applied Zoology or Aquatic Biology) DSE-2A Other Subject DSE- 3A Other Subject
VI	_____	_____	SEC-IV Community Nutrition and Health Statistics	DSE-1B Zoology (Immunology or Insect, Vector and Diseases) DSE-2B Other Subject DSE- 3B Other Subject

Course Type	Number of Courses	Credits		
		Theory	Practical	Theory + Practical
Core course (CC)	12 Papers (4 Papers each in 3 Disciplines of Choice)	4×12=48	2×12=24	72
Discipline specific elective courses (DSE)	6 Papers (2 Papers each in 3 Disciplines of Choice)	4×6=24	2×6=12	36
Ability Enhancement compulsory course (AECC)	2 Papers (Compulsory Language Paper & Environmental Studies)	4×1=4 2×1=2		6
Skill Enhancement Course (SEC)	4 Papers	4×2=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)**(Any two)**DSE 1A: Applied Zoology or
Aquatic BiologyDSE 1B: Immunology or
Insect, Vector and Diseases**SKILL ENHANCEMENT COURSES: ZOOLOGY**

SEC 1: Apiculture

SEC 2: Medical Diagnostics

SEC 3: Sericulture

SEC 4: Community Nutrition and Health Statistics

CORE COURSE I

Credits: 6

ANIMAL DIVERSITY (CREDITS 4)

THEORY	CLASS
Unit-1 Kingdom Protista General characters and classification of Subkingdom Protozoa up to Phylum (Levine et al., 1980); Locomotory Organelles and locomotion in Protozoa	3
Unit-2 Phylum Porifera General characters and classification up to classes; Canal System in <i>Sycon</i>	3
Unit-3 Phylum Cnidaria General characters and classification up to classes; Polymorphism in Hydrozoa	3
Unit-4 Phylum Platyhelminthes General characters and classification up to classes; Life history of <i>Taenia solium</i>	3
Unit-5 Phylum Nematoda General characters and classification up to classes; Life history of <i>Ascaris lumbricoides</i> and its parasitic adaptations	3
Unit-6 Phylum Annelida General characters and classification up to classes; Nephridia in Annelida	3
Unit 7 Phylum Arthropoda General characters and classification up to classes; Vision in insect, Metamorphosis in Insects	5
Unit-8 Phylum Mollusca General characters and classification up to classes; Respiration in <i>Pila</i>	3
Unit-9 Phylum Echinodermata General characters and classification up to classes; Water-vascular system in <i>Asterias</i>	4
Unit-10 Protochordates General features; Feeding in <i>Branchiostoma</i>	2
Unit-11 Agnatha General features and classification up to classes (Young, 1981)	2
Unit-12 Pisces General features and Classification up to Subclasses (Romer, 1959); Osmoregulation in Fishes	3
Unit-13 Amphibia General features and Classification up to living orders (Duellman & Trueb, 1986); Metamorphosis in Toad	3
Unit-14 Reptiles General features and Classification up to living Subclass (Young, 1981); Poisonous and non-poisonous snakes, Biting mechanism in snakes	4
Unit-15 Aves General features and Classification up to orders (Young, 1981); Flight adaptations in birds	3
Unit-16 Mammals Classification up to Subclasses (Young, 1981); Origin & distribution of Cranial nerves in <i>Cavia</i>	3

Note: Classification of Unit 1-9 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*. 6th Ed. Brooks Cole.
3. Brusca, R. C. & Brusca, G. J. (2002). *Invertebrates*. 4th Ed. Sinauer Associates.
4. Chatterjee, A & Chakraborty C.S. *Approach to a Text Book of Zoology* Nirmala Library, Kolkata.
5. Dhama P.S and J.K. Dhama – *Invertebrate Zoology* – S. Chand and Co.
6. Jordan, E. L. & Verma, P. S. (2006). *Invertebrate Zoology & Chordate Zoology*. S. Chand & Company Ltd. New Delhi.
7. Kardong, K.V. (2002). *Vertebrates: Comparative anatomy, function evolution*. Tata McGraw Hill.
8. Kent, G.C. & Carr, R.K. (2001). *Comparative anatomy of the Vertebrates*. 9th Ed. McGraw Hill.
9. Kotpal, R.L., 1988 – 1992. (All Series) Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, – Rastogi Publications, Meerut – 250 002.
10. Romer, A.S. & Parsons, T.S. (1986). *The vertebrate body*. 6th Ed. Saunders College Pub.
11. Ruppert E. E., Fox, R. & Barnes R. D. (2003). *Invertebrate Zoology: a Functional Evolutionary Approach*. 7th Ed. Brooks Cole.
12. Saxena, R.A. & Saxena, S. *Cooperative Anatomy of Vertebrates*. Viva Publication.
13. Sinha, K. S., Adhikari, S., & Ganguly, B. B. *Biology of Animals*. Vol. I, II. New Central Book Agency. Kolkata.
14. Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.

**ANIMAL DIVERSITY
PRACTICAL (CREDITS 2)**

1. Spot identification of the following specimens:

Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Euspongia,, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taenia solium, Male and female Ascaris lumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus, Cucumaria and Antedon, Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo, Exocoetus, Anguilla, Ichthyophis/Ureotyphlus, Salamandra, Bufo, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja, Crocodylus, Gavialis, Passer, Psittacula, Alcedo, Sorex, Pteropus, Funambulus, Suncus

2. **Study of the following permanent slides: Transverse section of male and female *Ascaris***
3. **Identification of poisonous and non-poisonous snakes**
4. **An “animal album” containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.**

Examination Pattern:

	Full Marks: 20
Spot identification (6 from Item 1: 3 each from non-chordate & chordate)	(6 × 2) = 12
Spot identification (1 each from item 2 & 3)	(2 × 2) = 04
Laboratory Note Book -----	= 02
Animal Album -----	= 02

Suggested Readings:

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

CORE COURSE II **Credits: 6**
COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES
(CREDITS 4)

THEORY		CLASS
Unit-1	Integumentary System Derivatives of integument with reference to glands and digital tips	3
Unit-2	Skeletal System Evolution of visceral arches	2
Unit-3	Digestive System Brief account of alimentary canal and digestive glands	4
Unit-4	Respiratory System Brief account of gills, lungs, air sacs and swim bladder	3
Unit-5	Circulatory System Evolution of heart and aortic arches	4
Unit-6	Urinogenital System Evolution of kidney and urinogenital ducts	3
Unit 7	Nervous System Comparative account of brain	2
Unit-8	Sense Organs Classification of receptors, Brief account of auditory receptors in vertebrate	3
Unit-9	Early Embryonic Development Gametogenesis: Spermatogenesis and oogenesis with reference to mammals, vitellogenesis in birds; Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and chick (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula); types of morphogenetic movements; Fate of germ layers; Neurulation in frog embryo.	12
Unit-10	Late Embryonic Development Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation.	6
Unit-11	Control of Development Fundamental processes in development (brief idea) – Gene activation, determination, induction, differentiation, morphogenesis, intercellular communication, cell movements and cell death	8

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 Emcrypygy. 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.
8. Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.

**COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF
VERTEBRATES
PRACTICAL (CREDITS 2)**

1. Osteology:

- a) Identification of limb bones and girdles of *Columba* and *Cavia*
- b) Mammalian skulls: *Cavia* and *Canis*.
2. Frog - Study of developmental stages - whole mounts and sections through permanent slides or photomicrographs – cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
3. Study of the different types of placenta- histological sections through permanent slides or photomicrographs.
4. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.

Examination Pattern:

			Full Marks: 20
Spot identification (5 from item 1)	(5 × 2)	= 10	
Spot identification (4 from item 2, 3 &4)	(4 × 2)	= 08	
Laboratory Note Book -----		=02	

Suggested Readings:

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

CORE COURSE III**Credits: 6****PHYSIOLOGY AND BIOCHEMISTRY
(CREDITS 4)****THEORY****CLASS**

Unit-1	Nerve and muscle 1. Structure of a neuron, Resting membrane potential, Graded potential, Origin of Action potential and its propagation in myelinated and non-myelinated nerve fibres. 2. Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction.	8
Unit-2	Digestion Physiology of digestion in the alimentary canal; Absorption of carbohydrates, proteins, lipids	5
Unit-3	Respiration Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood	5
Unit-4	Excretion Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism	5
Unit-5	Cardiovascular system Composition of blood, Homeostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle	6
Unit-6	Reproduction and Endocrine Glands Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle. Structure and function of pituitary, thyroid, pancreas and adrenal	7
Unit 7	Carbohydrate: Structure and Metabolism Introduction to Carbohydrates, Structure & Types of Carbohydrates, Isomerism, Introduction to Intermediary metabolism: Glycolysis, Krebs cycle, Pentose phosphate pathway, Gluconeogenesis, Electron transport chain	8
Unit-8	Lipid: Structure and Metabolism Introduction to Lipids: Definitions; fats and oils; classes of lipids; Lipoproteins; Biosynthesis and β oxidation of palmitic acid	5
Unit-9	Protein: Structure and metabolism Proteins and their biological functions, functions of amino acids, physicochemical properties of amino acids. Peptides – structure and properties; primary structure of protein, secondary, tertiary and quaternary structures. Transamination, Deamination and Urea Cycle.	5
Unit-10	Enzymes Introduction, Classification of Enzymes, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation	4

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. Deb, A.C.
 5. Guyton, A.C. and Hall, J.E. (2011). *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
 6. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). *Harper's Illustrated Biochemistry*. XXVIII Edition. Lange Medical Books/McGrawHill.
 7. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). *Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.
 8. Sathyanarayana U. and Chakrapani, (2002). Biochemistry –Books & Allied (P) Ltd, Kolkata
 9. Sembulingam and Sembulingam (2012) Essentials of Medical Physiology. 6th Edn. Jaypee Pub, New Delhi
 10. Sherwood, L. (2013). Human Physiology from cells to systems. 8th Edn., Brooks & Cole
 11. Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.
 12. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) *Vander's Human Physiology*, XI Edition., McGraw Hill

**PHYSIOLOGY AND BIOCHEMISTRY
PRACTICAL (CREDITS 2)**

1. Preparation of hemin crystals
2. Identification of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland, small intestine, liver, lung, kidney
3. Qualitative tests to identify functional groups of carbohydrates in given solutions: Glucose (Benedict's test), Sucrose (Iodine test)
4. Quantitative estimation of total protein in given solutions by Lowry's method.
5. Study of activity of salivary amylase under optimum conditions

Examination Pattern:

		Full Marks: 20
One question on Qualitative test (Item No. 1) -----		(4×1) = 04
One question on qualitative test (From Item 3) -----		(4×1) = 04
One question from quantitative test item no. 4		(6×1) = 06
Identification of histological section (From Item No. 2) any two		(3×2) = 04
Laboratory Note Book -----		= 02

CORE COURSE IV

Credits: 6

GENETICS AND EVOLUTIONARY BIOLOGY(CREDITS 4)

THEORY	CLASS
Unit-1 Introduction to Genetics Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information	3
Unit-2 Mendelian Genetics and its Extension Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked inheritance, Extra-chromosomal inheritance	5
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, Somatic cell genetics - an alternative approach to gene mapping	5
Unit-4 Mutations Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations	7
Unit-5 Sex Determination Chromosomal mechanisms of sex determination; dosage compensation (human)	4
Unit-6 History of Life Origin of Life	2
Unit 7 Introduction to Evolutionary Theories Lamarckism, Darwinism, Neo-Darwinism	3
Unit-8 Direct Evidences of Evolution Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse	3
Unit-9 Processes of Evolutionary Change Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection	5
Unit-10 Species Concept Biological species concept (Advantages and Limitations); Modes of speciation (Allopatric, Sympatric)	4
Unit-11 Macro-evolution Macro-evolutionary principles (example: Darwin's Finches)	5
Unit-12 Extinction Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution	4

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.
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. Russell, 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.

GENETICS AND EVOLUTIONARY BIOLOGY

PRACTICAL (CREDITS 2)

1. Study of Mendelian Inheritance and gene interactions using suitable examples. Verify the results using Chi-square test.
2. Study of Linkage, recombination, gene mapping using the data.
3. Study of Human Karyotypes; normal and abnormal (Turner's, Down's and Klinefelter syndrome) from photographs.
4. Study of fossil evidences from plaster cast models /pictures
5. Study of homology and analogy from suitable specimens/ pictures
6. Charts:
 - a) Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors
 - b) Darwin's Finches with diagrams/ cut outs of beaks of different species
7. Visit to any Zoological Museum and submission of report

Examination Pattern:

One question from Item No. 1	-----	(5 × 1) = 05
One question from Item No. 2	-----	(5 × 1) = 05
Identification any three from Item No. 3, 4, 5 & 6		(2 × 3) = 06
Excursion Report _____		= 02
Laboratory Note Book -----		= 02

Full Marks: 20

DISCIPLINE SPECIFIC ELECTIVE COURSES

DSE 1

Credits: 6

APPLIED ZOOLOGY(CREDITS 4)

THEORY	CLASS
Unit-1 Introduction to Host-parasite Relationship Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Zoonosis	3
Unit-2 Epidemiology of Diseases Transmission, Prevention and control of diseases: Tuberculosis, Typhoid	7
Unit-3 Rickettsia and Spirochetes Brief account of <i>Rickettsia prowazekii</i> , <i>Borrelia recurrentis</i> and <i>Treponema pallidum</i> .	3
Unit-4 Parasitic Protozoa Life history and pathogenicity of <i>Entamoeba histolytica</i> , <i>Plasmodium vivax</i> and <i>Trypanosoma gambiense</i>	6
Unit-5 Parasitic Helminthes Life history and pathogenicity of <i>Ancylostoma duodenale</i> and <i>Wuchereria bancrofti</i>	4
Unit-6 Insects of Economic Importance Biology, Control and damage caused by <i>Helicoverpa armigera</i> , <i>Pyrilla perpusilla</i> and <i>Papilio demoleus</i> , <i>Callosobruchus chinensis</i> , <i>Sitophilus oryzae</i> and <i>Tribolium castaneum</i>	8
Unit-7 Insects of Medical Importance Medical importance and control of <i>Pediculus humanus corporis</i> , <i>Anopheles</i> , <i>Culex</i> , <i>Aedes</i> , <i>Xenopsylla cheopis</i>	8
Unit-8 Animal Husbandry Preservation of semen and artificial insemination in cattle	3
Unit-9 Poultry Farming Principles of poultry breeding, Management of breeding stock and broilers, Processing and preservation of eggs	4
Unit-10 Fish Technology Genetic improvements in aquaculture industry; Induced breeding and transportation of fish seed	4

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. (). *Animal husbandry*.
4. Banerjee, G.C. (). *Animal husbandry*.
5. Chatterjee, K. D. (2009). *Parasitology: Protozoology and Helminthology*. XIII Edition, CBS Publishers & Distributors(P) Ltd
6. Dennis, H. (2009). *Agricultural Entomology*. Timber Press (OR).
7. Dunham R.A. (2004). *Aquaculture and Fisheries Biotechnology Genetic Approaches*. CABI publications, U.K.
8. Hafez, E. S. E. (1962). *Reproduction in Farm Animals*. Lea & Fabiger Publisher
9. Kumar and Corton. *Pathological Basis of Diseases*.
10. Paniker, C.K.J., Ghosh, S. [Ed] (2013). *Paniker's Text Book of Medical Parasitology*. Jaypee, New Delhi.
11. 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
12. Park, K. (2007). *Preventive and Social Medicine*. XVI Edition. B.B Publishers.
13. Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall.
14. Ratan Lal Ichhpurjani and Rajesh Bhatia. *Medical Parasitology*, III Edition, Jaypee Brothers Medical Publishers(P)Ltd., New Delhi

**APPLIED ZOOLOGY
PRACTICAL (CREDITS 2)**

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

Examination Pattern:

		Full Marks: 20
Three identification from Item No. 1 and 2	-	----- (3 × 2) = 06
Identification (two) from Item No. 3		----- (2 × 2) = 04
Identification and economic importance (two) from Item No. 4,		(3 × 2) = 06
Field Report _____		= 02
Laboratory Note Book -----		= 02

OR

DSE 1

Credits: 6

AQUATIC BIOLOGY(CREDITS 4)

THEORY	CLASS
Unit-1 Aquatic Biomes Brief introduction to the aquatic biomes: Fresh water ecosystem(lakes, wetlands, streams and rivers), estuaries, intertidal zones, oceanic pelagic zone, marine benthic zone and coral reefs	10
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.	20
Unit-3 Marine Biology Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs, Sea weeds.	10
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.	10

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

**AQUATIC BIOLOGY
PRACTICAL (CREDITS 2)**

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

Examination Pattern:

	Full Marks: 20
One question from Item No. 3	(8 × 1) = 08
Identification of two instruments Item No. 4	(2 × 2) = 04
Identification of two Zooplanktons Item No. 2	(2 × 2) = 04
Project Report	= 02
Laboratory Note Book	= 02

DSE 2

Credits: 6

IMMUNOLOGY(CREDITS 4)

THEORY	CLASS
Unit-1 Overview of the Immune System Introduction to basic concepts in immunology, components of immune system, principles of innate and adaptive immune system	5
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	8
Unit-3 Antigens Basic properties of antigens, B and T cell epitopes, haptens and adjuvants	5
Unit-4 Antibodies Structure, classes and function of antibodies, monoclonal antibodies, antigen antibody interactions as tools for research and diagnosis	8
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	12
Unit-6 Immune system in health and disease Gell and Coombs' classification and brief description of various types of hypersensitivities, Introduction to concepts of autoimmunity and immunodeficiency	10
Unit-7 Vaccines General introduction to vaccines, Types of vaccines	2

SUGGESTED READINGS

1. Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication.
2. Abbas, K. Abul and Lechtman H. Andrew (2011.) Basic Immunology: Functions and Disorders of Immune System. Saunders Elsevier Publication.
3. Delves, Martin, Burton and Roitt (2006). Roitt's Essential Immunology. 11th Edn. Blackwell Pub.
4. Kindt, T.J., Goldsby, R.A., Osborne, B.A. and Kuby, J. (2006). Immunology, VI Edition. W.H. Freeman and Company.
5. Mohanty, SK and Leela, KS (2014). Text book of Immunology. 2nd Edn. Jatpee Pub. N. Delhi
6. Parija, SC (2012). Text book of Microbiology and Immunology. 2nd Edn. Elsevier.
7. Playfair, JHL and Chain, BM (2001) Immunology at a glance. 7th Edn. Blackwell Pub.
8. Shetty, N. (2005). Immunology: Introductory Textbook. 2nd Edn, New Age Internatl. Pub. N. Delhi
9. Virella, G (2007). Medical Immunology 6th Edn. Informa Healthcare.

IMMUNOLOGY (CREDITS 2)**PRACTICAL**

1. Demonstration of lymphoid organs in human through model/ photograph.
2. Histological study 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

Examination Pattern:**Full Marks: 20**

One Experiment from Item No. 3	-----	(10 × 1) = 10
One Experiment from Item No. 4	-----	(6 × 1) = 04
Identification of slides/ photographs (Two)	-----	(2 × 2) = 04
Laboratory Note Book	-----	= 02

OR**DSE 2****Credits: 6****INSECT, VECTORS AND DISEASES(CREDITS 4)**

THEORY	CLASS
Unit-1 Introduction to Insects General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts with respect to feeding habit	6
Unit-2 Concept of Vectors Brief introduction to Vectors (mechanical and biological), Reservoirs, Host-vector relationship, Adaptations as vectors, Host specificity	6
Unit-3 Insects as Vectors Detailed features of insect orders as vectors – Diptera, Siphonoptera, Siphunculata, Hemiptera	8
Unit-4 Dipteran as Disease Vectors Study of important Dipteran vectors – Mosquitoes, Sand fly, Houseflies Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis Control of mosquitoes	14
Unit-5 Siphonaptera as Disease Vectors Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas	6
Unit-6 Siphunculata as Disease Vectors Human louse (Head, Body and Pubic louse) as important insect vectors; Control of human louse	4
Unit-7 Hemiptera as Disease Vectors Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures	6

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

INSECT VECTORS AND DISEASES**PRACTICAL****(CREDITS 2)****List of Practical**

1. Mounting and Study of different kinds of mouth parts of insects
2. Spot identification of following insect vectors through permanent slides/photographs: *Aedes*, *Culex*, *Anopheles*, *Pediculus humanuscapitis*, *Pediculus humanuscorporis*, *Phithiruspubis*, *Xenopsylla cheopis*, *Cimex lectularius*, *Phlebotomus argentipes*, *Musca domestica*
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

Examination Pattern:

		Full Marks: 20
One question from Item No. 1	----- (8 × 1) =	08
Identification of four specimens Item No. 2	----- (1.5 × 4) =	06
Project Report		= 04
Laboratory Note Book -----		= 02

SKILL ENHANCEMENT COURSES

SEC 1
APICULTURE(CREDITS 2)

THEORY	CLASS
Unit 1: Biology of Bees History, Classification and Biology of Honey Bees Social Organization of Bee Colony	4
Unit 2: Rearing of Bees Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth Bee Pasturage; Selection of Bee Species for Apiculture; Methods of Extraction of Honey (Indigenous and Modern)	10
Unit 3: Diseases and Enemies Diseases and Enemies of Honey bees; Control and Preventive measures	5
Unit 4: Bee Economy Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis)	2
Unit 5: Entrepreneurship in Apiculture Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens	4

SUGGESTED READINGS

1. Bisht D.S., *Apiculture*, ICAR Publication.
2. Prost, P. J. (1962). *Apiculture*. Oxford and IBH, New Delhi.
3. Singh S., *Beekeeping in India*, Indian council of Agricultural Research, New Delhi.

SEC 2
MEDICAL DIAGNOSTICS (CREDITS 2)

THEORY	CLASS
Unit 1 Introduction to Medical Diagnostics and its Importance	2
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.)	10
Unit 3 Diagnostic Methods Used for Urine Analysis Urine Analysis: Physical characteristics; Abnormal constituents	4
Unit 4 Non-infectious Diseases Causes, types, symptoms, complications, diagnosis and prevention of Diabetes (Type I and Type II), Hypertension (Primary and secondary), Testing of blood glucose using Glucometer/Kit	6
Unit 5 Infectious Diseases Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis, Malaria (Microscope based and ELISA based)	3
Unit 6 Clinical Biochemistry	3

	LFT, Lipid profiling	
Unit 7	Clinical Microbiology Antibiotic Sensitivity Test	3
Unit 8	Medical Laboratory Technology Tumor detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT scan (using photographs).	3
Unit 9	Visit to Pathological Laboratory and Submission of Project	

SUGGESTED READINGS

1. Cheesbrough M., *A Laboratory Manual for Rural Tropical Hospitals, A Basis for Training Courses*
2. Godkar P.B. and Godkar D.P. *Textbook of Medical Laboratory Technology*, II Edition, Bhalani Publishing House
3. Guyton A.C. and Hall J.E. *Textbook of Medical Physiology*, Saunders
4. Park, K. (2007), *Preventive and Social Medicine*, B.B. Publishers
5. Prakash, G. (2012), *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Co. Ltd.
6. Robbins and Cortan, *Pathologic Basis of Disease*, VIII Edition, Saunders

SEC 3
SERICULTURE (CREDITS 2)

THEORY	CLASS
Unit 1 Introduction Sericulture: Definition, history and present status; Silk route Types of silkworms, Distribution and Races; Exotic and indigenous races; Mulberry and non-mulberry Sericulture	3
Unit 2 Biology of Silkworm Life cycle of <i>Bombyx mori</i> ; Structure of silk gland and secretion of silk	3
Unit 3 Rearing of Silkworms Selection of mulberry variety and establishment of mulberry garden; Rearing house and rearing appliances; Disinfectants: Formalin, bleaching powder, RKO. Silkworm rearing technology: Early age and Late age rearing. Types of mountages; Spinning, harvesting and storage of cocoons	13
Unit 4 Pests and Diseases Pests of silkworm: Uzi fly, demisted beetles and vertebrates Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial Control and prevention of pests and diseases	4
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 various sericulture centres.	2

SUGGESTED READINGS

1. A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.
2. Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
3. Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore

4. Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan 1972.
5. Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986
6. Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
7. Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.

SEC 4

COMMUNITY NUTRITION AND HEALTH STATISTICS (CREDITS 2)

THEORY	CLASS	
Unit 1	Introduction Concept of community, Types of community factors affecting health of community – environmental, social, political, cultural and economical	3
Unit 2	Nutritional assessment of human Clinical findings, nutritional anthropometry, biochemical tests, biophysical methods.	3
Unit 3	Nutritional anthropometry Need and importance, standard for reference, techniques of measuring height, weight, head, chest and arm circumference, interpretation of these measurements. Use of growth chart.	6
Unit 4	Principles of Epidemiology Concept of disease (endemic, epidemic and pandemic, acute and chronic, communicable and non-communicable; zoonosis, epizootic, enzootic, vector-borne and nosocomial), rate of a disease in a population (attack rate, morbidity rate, mortality rate, incidence and prevalence), Nature of infectious and communicable diseases, factors that influence the epidemiology of a disease. Epidemiological methods: descriptive studies, analytical studies and experimental studies Epidemiology, mode of transmission, disease propagation, prevention and treatment of Tuberculosis, Malnutrition and Tuberculosis	12
Unit 5	Health Statistics Statistical Measures and Presentation of Data - Basic concepts of statistics – utility and limitations of Statistics Measures of central tendency-Arithmetic Mean, Weighted Arithmetic Mean, Median, Mode, Quartiles; Measures of Variation, Standard Deviation, Coefficient of Variation, Presentation of data-Bar Diagram, Histogram, Frequency Polygon, Frequency Distribution Curves, Ogives.	10
Unit 6	Probability Concepts and definitions of probability, Additive and Multiplicative laws, Conditional probability. Probability distributions: Discrete – Binomial and Poisson; Continuous-Normal, Applications to hospital environment.	4
Unit 7	Statistical analysis Simple Correlation and Simple Regression. Time Series – components, fitting a trend line by least squares method; Testing of Hypothesis: Null and alternative hypotheses, Chi-Square and t-tests.	4

Unit 8	Analysis of Variance: One-way and two-way classification	2
Unit 9	Health Informatics: Concept and applications	2

SUGGESTED READINGS

1. Gupta S.P., Statistical methods, Sultan Chand, New Delhi, 1993.
2. Health Information of India, Government of India; Hospital Information Review.
3. Hill B.A., Medical statistics, Hodder & Stoughton, London, 1984.
4. John T. Mentzer, Sales Forecasting Management, Response Books, New Delhi, 1998.
5. Levin, R.I. and Rubin. D.S., Statistics for management, Prentice Hall, New Delhi, 1988.
6. Milton S.J., Statistical methods in the biological and health sciences, McGraw Hill, Singapore, 1992.
7. Periodicals: students in health sciences, Prentice Hall, New Delhi, 1996.
8. Sunder Rao, P.N.S. and Richard, J., An introduction to biostatistics: A manual for