

Controller of Examinations
SAMBALPUR UNIVERSITY
JYOTI VIHAR, BURLA
Sambalpur (Odisha), PIN- 768 019



PHONE and Fax: 0663-2430806
e-mail: coesuniv@gmail.com

Urgent

(Both by post and by e- mail)

No. 7782 / Acd.-I

Dated: 26/10/16

To

The Principals,

(All the Affiliated Colleges under Sambalpur University having
Three Year Degree Courses excluding Autonomous Colleges.)

Sub: Syllabus & Implementation of CBCS pattern **Arts/Science/Commerce (Pass and Hons.)** from the **Academic Session 2016-17.**

Ref :- This office letter No 5314/ Acd.-I dated 21.7.16 and letter No. 5970/Acd.-I dated 8.8.16.

Sir,

In continuation to the letters and the subject cited above, I am directed to intimate you that the Vice- Chancellor has been pleased to approve the syllabus for Courses / papers related to **Zoology** for CBCS + 3 courses degree B.Sc. (Both Pass & Hons.) examinations under 6 (15) of O.U. Act -1989 giving it effect from the Academic Session, 2016-17. The detail Courses of Studies is enclosed herewith for your reference and necessary action.

This may kindly be noted that it is the final syllabus for *Zoology* subject/ papers under CBCS pattern. It may be made available to teachers and students concerned. Further you are requested to ensure teaching of the courses in your colleges accordingly.

Any error and omission etc. may kindly be intimated to this office.

. Any queries on the matter may be made through e-mail: coesuniv@gmail.com.
Thanking you,

Yours faithfully,

Encl: *As above*

[Signature]
Controller of Examinations
[Signature]

P.T.O.

Memo No. 7783 /Acad.-I(BOS),

dtd. 26/10/16

Copy forwarded with enclosure for information and necessary action to:

1. The Chairman, Post Graduate Council, Sambalpur University.
2. The H.O.D., P.G. Department of *Life Sciences*, Sambalpur University.
3. The Director, College Development Council, Sambalpur University.
4. The Director, Directorate of Distance and Continuing Education, Sambalpur University.
5. The Co-ordinator, Private Examination Cell, Sambalpur University.
6. Asst. Registrar (Examination), Sambalpur University.
7. Programmer, University Computer Unit, Sambalpur University.
8. Asst. Controller of Examinations, Sambalpur University.
9. Section Officer / Assistant –in- Charge, *e – Governance Cell*, Sambalpur University with request to provide all the materials in the official web- site accordingly. (as + 3 cbcs-syllabus – *Zoology* –Final)
10. Section Officers, Computer Unit, E.G.-I, EG-II, E.C-I, EC-II, EC-VI Sections.
11. Five spare Copies for Academic-I Sections with enclosure.

Memo No. 7784 /Acad.-I(BOS),

f.k.u
26/10/16
Controller of Examinations
Blek

dtd. 26/10/16

Copy forwarded without enclosure for information and necessary action to:

1. *The Dy. Director, e – Governance Cell*, Sambalpur University with request for needful to provide all the materials in the official web- site accordingly .
2. P.A. to the Vice- Chancellor, Sambalpur University.
3. P.A. to the Registrar, Sambalpur University.
4. P.A. to the Controller of Examinations, Sambalpur University.

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(133)

PASS COURSES AT A GLANCE
SUBJECT: ZOOLOGY

DISCIPLINE SPECIFIC CORE-4 PAPERS

Number	Semester	Title of the Course	Credit	
			Theo ry	Prac/ Tuto
DSC-P-ZOO-1	1 st	Animal Diversity	4	2
DSC-P-ZOO-2	2 nd	Comparative Anatomy and Developmental Biology of Vertebrates	4	2
DSC-P-ZOO-3	3 rd	Physiology and Biochemistry	4	2
DSC-P-ZOO-4	4 th	Genetics and Evolutionary Biology	4	2

DISCIPLINE SPECIFIC ELECTIVE-2 PAPERS

Number	Semester	Title of the Course	Credit	
			Theo ry	Prac/ Tuto
DSE-P-ZOO-1	5 th	Aquatic Biology	4	2
DSE-P-ZOO-2	6 th	Immunology	4	2

SKIL ENHANCEMENT COURSES-LIST-A (Any 1 paper)

Number	Semester	Title of the Course	Credit	
			Theory	
SEC-P-ZOO-1	3 rd /4 th /5 th	Apiculture	2	
SEC-P-ZOO-2	3 rd /4 th /5 th	Sericulture	2	

Signature

**CORE COURSE I
ANIMAL DIVERSITY**

THEORY	(CREDITS 4)
Unit 1: Kingdom Protista	4
General characters and classification up to classes; Locomotory Organelles and locomotion in Protozoa	
Unit 2: Phylum Porifera	3
General characters and classification up to classes; Canal System in <i>Sycon</i>	
Unit 3: Phylum Cnidaria	3
General characters and classification up to classes; Polymorphism in Hydrozoa	
Unit 4: Phylum Platyhelminthes	3
General characters and classification up to classes; Life history of <i>Taenia solium</i>	
Unit 5: Phylum Nemathelminthes	5
General characters and classification up to classes; Life history of <i>Ascaris lumbricoides</i> and its parasitic adaptations	
Unit 6: Phylum Annelida	3
General characters and classification up to classes; Metamerism in Annelida	
Unit 7: Phylum Arthropoda	5
General characters and classification up to classes; Vision in Arthropoda, Metamorphosis in Insects	
Unit 8: Phylum Mollusca	4
General characters and classification up to classes; Torsion in gastropods	
Unit 9: Phylum Echinodermata	4
General characters and classification up to classes; Water-vascular system in Asteroidea	
Unit 10: Protochordates	2
General features and Phylogeny of Protochordata	
Unit 11: Agnatha	2
General features of Agnatha and classification of cyclostomes up to classes	
Unit 12: Pisces	4
General features and Classification up to orders; Osmoregulation in Fishes	
Unit 13: Amphibia	4
General features and Classification up to orders; Parental care	
Unit 14: Reptiles	4
General features and Classification up to orders; Poisonous and non-poisonous snakes, Biting mechanism in snakes	
Unit 15: Aves	5
General features and Classification up to orders; Flight adaptations in birds	
Unit 17: Mammals	5
Classification up to orders; Origin of mammals	

ANIMAL DIVERSITY**PRACTICAL****(CREDITS 2)****1. Study of the following specimens:**

Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Hyalonema, and Euplectella, 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, Any six common birds from different orders, Sorex, Bat, Funambulus, Loris

2. Study of the following permanent slides:

T.S. and L.S. of *Sycon*, Study of life history stages of *Taenia*, T.S. of Male and female *Ascaris*

3. Key for Identification of poisonous and non-poisonous snakes**SUGGESTED READINGS**

- Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- Pough H. *Vertebrate life*, VIII Edition, Pearson International.
- Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.
- Parker and Haswell

CORE COURSE II

COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

THEORY	(CREDITS 4)
Unit 1: Integumentary System Derivatives of integument w.r.t. glands and digital tips	4
Unit 2: Skeletal System Evolution of visceral arches	3
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	5
Unit 5: Circulatory System Evolution of heart and aortic arches	4
Unit 6: Urinogenital System Succession of kidney, Evolution of urinogenital ducts	4
Unit 7: Nervous System Comparative account of brain	3
Unit 8: Sense Organs Types of receptors	3
Unit 9: Early Embryonic Development of frog Gametogenesis: Spermatogenesis and oogenesis w.r.t. mammals, vitellogenesis in birds; Fertilization: external (amphibians), internal (mammals), blocks to polyspermy; Early development of frog and humans (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.	10
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

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COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES

PRACTICAL

(CREDITS 2)

1. Osteology:

- a) Disarticulated skeleton of fowl and rabbit
- b) Carapace and plastron of turtle /tortoise
- c) Mammalian skulls: One herbivorous and one carnivorous animal.

2. Frog - Study of developmental stages - whole mounts and sections through permanent slides – 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. Study of placental development in humans by ultrasound scans.

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

SUGGESTED READINGS

- 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.
- Walter, H.E. and Sayles, L.P; *Biology of Vertebrates*, Khosla Publishing House.
- Gilbert, S. F. (2006). *Developmental Biology*, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
- Balinsky, B.I. (2008). *An introduction to Embryology*, International Thomson Computer Press.
- Carlson, Bruce M (1996). *Patten's Foundations of Embryology*, McGraw Hill, Inc.
- Weichert
- Chordate embryology by P.C.Jain

Signature

CORE COURSE III
PHYSIOLOGY AND BIOCHEMISTRY

THEORY	(CREDITS 4)
Unit 1: Nerve and muscle	8
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 basis of muscle contraction	
Unit 2: Digestion	5
Physiology of digestion; Absorption of carbohydrates, proteins, lipids	
Unit 3: Respiration	5
Pulmonary ventilation, Respiratory volumes and capacities, Transport of Oxygen and carbon dioxide in blood	
Unit 4: Excretion	5
Structure of nephron, Mechanism of Urine formation, Counter-current Mechanism	
Unit 5: Cardiovascular system	6
Composition of blood, Hemostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle	
Unit 6: Reproduction and Endocrine Glands	7
Physiology of male reproduction: hormonal control of spermatogenesis; Physiology of female reproduction: hormonal control of menstrual cycle	
Structure and function of pituitary, thyroid, Parathyroid, pancreas and adrenal	
Mechanism of hormone action.	
Unit 7: Carbohydrate Metabolism	8
Glycolysis, Krebs Cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain	
Unit 8: Lipid Metabolism	5
Biosynthesis and β oxidation.	
Unit 9: Protein metabolism	5
Transamination, Deamination and Urea Cycle	
Unit 10: Enzymes	6
Introduction, Mechanism of action, Enzyme Kinetics, Inhibition and Regulation	

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PHYSIOLOGY AND BIOCHEMISTRY

PRACTICAL

(CREDITS 2)

1. Preparation of hemin and hemochromogen crystals
2. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland
3. Study of permanent slides of spinal cord, duodenum, liver, lung, kidney, bone, cartilage
4. Qualitative tests to identify functional groups of carbohydrates in given solutions (Glucose,

Fructose, Sucrose, Lactose)

2. Estimation of total protein in given solutions by Lowry's method.

3. Study of activity of salivary amylase under optimum conditions

SUGGESTED READINGS

- Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008) *Vander's Human Physiology*, XI Edition., McGraw Hill
- Guyton, A.C. and Hall, J.E. (2011). *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). *Biochemistry*. VI Edition. W.H Freeman and Co.
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). *Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.
- 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.
- Laurell Sheerwood: *Essentials of Physiology*
- Schulte and Moyes: *Animal Physiology*



CORE COURSE IV
GENETICS AND EVOLUTIONARY BIOLOGY

THEORY	(CREDITS 4)
Unit 1: Introduction to Genetics	3
Mendel's work on transmission of traits, Genetic Variation, DNA is a genetic material.	
Unit 2: Mendelian Genetics and its Extension	8
Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance	
Unit 3: Linkage, Crossing Over and Chromosomal mapping	9
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	
Unit 4: Mutations	7
Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations,	
Unit 5: Sex Determination	4
Chromosomal mechanisms (Drosophila and Human), dosage compensation	
Unit 6: History of Life	2
Major Events in History of Life	
Unit 7: Introduction to Evolutionary Theories	5
Lamarckism, Darwinism, Neo-Darwinism	
Unit 8: Direct Evidences of Evolution	5
Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse	
Unit 9: Processes of Evolutionary Change	9
Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection, Artificial selection	
Unit 10: Species Concept	6
Biological species concept; Modes of speciation (Allopatric, Sympatric)	
Unit 11: Macro-evolution	5
Macro-evolutionary Principles (example: Darwin's Finches)	
Unit 12: Extinction	6
Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution	

GENETICS AND EVOLUTIONARY BIOLOGY

PRACTICAL

(CREDITS 2)

1. Study of Mendelian Inheritance and gene interactions (Non Mendelian Inheritance) 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).
4. Study of fossil evidences from plaster cast models and 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 Natural History Museum and submission of report

SUGGESTED READINGS

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.
- 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*. Benjamin Cummings.
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.
- Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
- Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). *Evolution*. Cold Spring, Harbour Laboratory Press.
- Hall, B. K. and Hallgrimsson, B. (2008). *Evolution*. IV Edition. Jones and Bartlett Publishers
- Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.

Signature

DISCIPLINE CENTRIC ELECTIVE COURSES

DSE 1

AQUATIC BIOLOGY

THEORY (Credits 4)

UNIT 1: Aquatic Biomes

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

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.

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 Turbidity/transparency, Dissolved Oxygen, Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) in water collected from a nearby lake/ water body.
4. Instruments used in limnology (Secchi disc, Van Dorn Bottle, Conductivity & Turbidity meter, PONAR grab sampler) and their significance.
5. Project Report on visit to Sewage treatment plant/Marine bio-reserve/Fisheries Institutes.

SUGGESTED READINGS

- **Anathakrishnan** : Bioresources Ecology 3rd Edition
- **Goldman** : Limnology, 2nd Edition
- **Odum and Barrett** : Fundamentals of Ecology, 5th Edition
- **Pawlowski** : Physicochemical Methods for Water and Wastewater Treatment, 1st Edition
- **Wetzel** : Limnology, 3rd edition
- **Trivedi and Goyal** : Chemical and biological methods for water pollution studies
- **Welch** : Limnology Vols. I-II
- **P. Michael**: Ecological Method.

DSE-2
IMMUNOLOGY

THEORY	(CREDITS 4)
Unit 1: Overview of the Immune System	10
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	8
Haematopoiesis, Cells of immune system and organs (primary and secondary lymphoid organs) of the immune system	
Unit 3: Antigens	8
Basic properties of antigens, B and T cell epitopes, haptens and adjuvants	
Unit 4: Antibodies	8
Structure, classes and function of antibodies, monoclonal antibodies, antigen antibody interactions as tools for research and diagnosis	
Unit 5: Working of the immune system	12
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	10
Gell and Coombs' classification and brief description of various types of hypersensitivities, Autoimmunity and immunodeficiency	
Unit 7: Vaccines	4
Types of vaccines	

IMMUNOLOGY

PRACTICAL	(CREDITS 2)
1. Estimation of WBC & RBC count, haemoglobin and DC.	
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.	
5. Demonstration of ELISA and Immunoelectrophoresis.	

SUGGESTED READINGS

- Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). *Immunology*, VI Edition. W.H. Freeman and Company.
- David, M., Jonathan, B., David, R. B. and Ivan R. (2006). *Immunology*, VII Edition, Mosby, Elsevier Publication.
- Abbas, K. Abul and Lechtman H. Andrew (2003.) *Cellular and Molecular Immunology*. V Edition. Saunders Publication.



SKILL ENHANCEMENT COURSES

SEC 1 APICULTURE

(CREDITS 2)

Unit 1: Biology of Bees

(4)

History, Classification and Biology of Honey Bees

Social Organization of Bee Colony

Unit 2: Rearing of Bees

(10)

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

(5)

Bee Diseases and Enemies

Control and Preventive measures

Unit 4: Bee Economy

(2)

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

Unit 5: Entrepreneurship in Apiculture

(4)

Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial

Beehives for cross pollination in horticultural gardens

SUGGESTED READINGS

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

**SEC-2
SERICULTURE**

(CREDITS 2)

Unit 1: Introduction

(3)

Sericulture: Definition, history and present status; Silk route

Types of silkworms, Distribution and Races

Exotic and indigenous races

Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm

(3)

Life cycle of *Bombyx mori*

Structure of silk gland and secretion of silk

Unit 3: Rearing of Silkworms

(13)

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

Unit 4: Pests and Diseases

(4)

Pests of silkworm: Uzi fly, dermestic beetles and vertebrates

Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial

Control and prevention of pests and diseases

Unit 5: Entrepreneurship in Sericulture

(2)

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

SUGGESTED READINGS

- Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
- Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
- Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan 1972.
- Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
- Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.
- A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.
- Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.

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HONOURS COURSES AT A GLANCE

SUBJECT: Zoology

DISCIPLINE SPECIFIC CORE (14 PAPERS)

Number	Semester	Title of the Course	Credit	
			Theory	Prac/Tuto
DSC-H-Z00-1	1 st	Non-chordates I: Protista to Pseudocoelomates	4	2
DSC-H-Z00-2		Perspectives in Ecology	4	2
DSC-H-Z00-3	2 nd	Non-chordates II: Coelomates	4	2
DSC-H-Z00-4		Cell Biology	4	2
DSC-H-Z00-5	3 rd	Diversity of Chordates	4	2
DSC-H-Z00-6		Physiology: Controlling and Coordinating	4	2
DSC-H-Z00-7		Fundamentals of Biochemistry	4	2
DSC-H-Z00-8	4 th	Comparative Anatomy of Vertebrates	4	2
DSC-H-Z00-9		Physiology: Life Sustaining Systems	4	2
DSC-H-Z00-10		Biochemistry of Metabolic Processes	4	2
DSC-H-Z00-11	5 th	Molecular Biology	4	2
DSC-H-Z00-12		Principles of Genetics	4	2
DSC-H-Z00-13	6 th	Developmental Biology	4	2
DSC-H-Z00-14		Evolutionary Biology	4	2

DISCIPLINE SPECIFIC ELECTIVE (4 PAPERS)

Number	Semester	Title of the Course	Credit	
			Theory	Prac/Tuto
DSE-H-Z00-1	5 th	Animal Behaviour and Chronobiology	4	2
DSE-H-Z00-2		Fish and Fishries	4	2
DSE-H-Z00-3	6 th	Immunology	4	2
DSE-H-Z00-4		Wild life conservation and Management	4	2

GENERIC ELECTIVE (4 PAPERS)

Number	Semester	Title of the Course	Credit	
			Theory	Prac/Tuto
GE-H-Z00-1	1 st	Human Physiology	4	2
GE-H-Z00-2	2 nd	Environment and Public Health	4	2
GE-H-Z00-3	3 rd	Aquatic Biology	4	2
GE-H-Z00-4	4 th	Food Nutrition and Health	4	2

SKIL ENHANCEMENT COURSES-LIST-A (Any 1 paper)

Number	Semester	Title of the Course	Credit	
			Theory	
SEC-H-Z00-1	3 rd	Apiculture	2	
SEC-H-Z00-2	3 rd	Sericulture	2	

[Signature]

CORE COURSE I
NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES

THEORY	(Credits 4)
Unit 1: Protista, Parazoa and Metazoa	19
General characteristics and Classification up to classes of protozoa.	
Life cycle and pathogenicity of <i>Plasmodium vivax</i> and <i>Entamoeba histolytica</i>	
Reproduction in Protista	
Unit 2: Porifera	7
General characteristics and Classification up to classes	
Canal system and spicules in sponges	1
Unit 3: Cnidaria	2
General characteristics and Classification up to classes	
Polymorphism in Cnidaria	
Coral reefs	
Unit 4: Ctenophora	4
General characteristics and Evolutionary significance	1
Unit 5: Platyhelminthes	0
General characteristics and Classification up to classes	
Life cycle and pathogenicity of <i>Fasciola hepatica</i> and <i>Taenia solium</i>	
Unit 6: Nemathelminthes	8
General characteristics and Classification up to classes	
Life cycle, and pathogenicity of <i>Ascaris lumbricoides</i> and <i>Wuchereria bancrofti</i>	
Parasitic adaptations in helminthes	

NON-CHORDATES I: PROTISTS TO PSEUDOCOELOMATES

PRACTICALS	(Credits 2)
1. Study of whole mount of <i>Euglena</i> , <i>Amoeba</i> and <i>Paramecium</i> , Binary fission and Conjugation in <i>Paramecium</i>	
2. Examination of pond water collected from different places for diversity in protista	
3. Study of <i>Sycon</i> (T.S. and L.S.), <i>Hyalonema</i> , <i>Euplectella</i> , <i>Spongilla</i>	
4. Study of <i>Obelia</i> , <i>Physalia</i> , <i>Millepora</i> , <i>Aurelia</i> , <i>Tubipora</i> , <i>Corallium</i> , <i>Alcyonium</i> , <i>Gorgonia</i> , <i>Metridium</i> , <i>Pennatula</i> , <i>Fungia</i> , <i>Meandrina</i> , <i>Madrepora</i>	
5. One specimen/slide of any ctenophore	
6. Study of adult <i>Fasciola hepatica</i> , <i>Taenia solium</i> and their life cycles (Slides/micro-photographs)	
7. Study of adult <i>Ascaris lumbricoides</i> and its life stages (Slides/micro-photographs)	
8. To submit a Project Report on any related topic on life cycles/coral/ coral reefs.	

SUGGESTED READINGS

- Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition.
- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson.
- Hyman series. Invertebrates
- Parker and Haswel. Text Book of Zoology (Vol.I).

CORE COURSE II PRINCIPLES OF ECOLOGY

THEORY

(Credits 4)

Unit 1: Introduction to Ecology

6

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors (Light and Temperature)

Unit 2: Population

24

Unitary and Modular populations

Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion Exponential and logistic growth, equation and patterns, r and K strategies, Population interactions, Gause's Principle with laboratory and field examples, Competition and Predation, symbiosis, parasitism, mutualism

Unit 3: Community

12

Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example

Unit 4: Ecosystem

14

Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies, Nutrient and biogeochemical cycle with example of Nitrogen & Carbon cycle.

Unit 5: Applied Ecology

4

Ecology in Wildlife Conservation and Management

PRINCIPLES OF ECOLOGY

PRACTICALS

(Credits 2)

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided
2. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO₂
4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary

SUGGESTED READINGS

- Colinviaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
- 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
- Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Pres



CORE COURSE III
NON-CHORDATES II: COELOMATES

THEORY	(Credits 4)
Unit 1: Introduction to Coelomates	2
Evolution of coelom and metamerism	
Unit 2: Annelida	10
General characteristics and Classification up to classes	
Excretion in Annelida	
Unit 3: Arthropoda	17
General characteristics and Classification up to classes	
Respiration in Arthropoda	
Metamorphosis in Insects	
Social life in bees and termites	
Unit 4: Onychophora	4
General characteristics and Evolutionary significance	
Unit 5: Mollusca	
General characteristics and Classification up to classes	
Respiration in Mollusca	
Torsion and detorsion in Gastropoda	
Pearl formation in bivalves	
Evolutionary significance of trochophore larva	
Unit 6: Echinodermata	12
General characteristics and Classification up to classes	
Water-vascular system in Asteroidea	
Larval forms in Echinodermata	
Affinities with Chordates	

NON-CHORDATES II: COELOMATES

PRACTICAL	(Credits 2)
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- Study of following specimens:
Annelids - *Aphrodite*, *Nereis*, *Heteronereis*, *Sabella*, *Serpula*, *Chaetopterus*, *Pheretima*, *Hirudinaria*
Arthropods - *Limulus*, *Palamnaeus*, *Palaemon*, *Daphnia*, *Balanus*, *Sacculina*, *Cancer*, *Eupagurus*, *Scolopendra*, *Julus*, *Bombyx*, *Periplaneta*, termites and honey bees
Onychophora - *Peripatus*
Molluscs - *Chiton*, *Dentalium*, *Pila*, *Doris*, *Helix*, *Unio*, *Ostrea*, *Pinctada*, *Sepia*, *Octopus*, *Nautilus*
Echinodermates - *Pentaceros/Asterias*, *Ophiura*, *Clypeaster*, *Echinus*, *Cucumaria* and *Antedon*
- T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm
- Demonstration of excretory organs of Annelids through computer model/ photographs.
- To submit a Project Report on any related topic to larval forms (crustacean, molluscs and echinoderm)

SUGGESTED READINGS

- Ruppert and Barnes, R.D. (2006). *Invertebrate Zoology*, VIII Edition. Holt Saunders International Edition
- Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson

CORE COURSE IV CELL BIOLOGY

THEORY

(Credits 4)

Unit 1: Overview of Cells

3

Typical animal cell, Cell theory, Differences between Prokaryotic and Eukaryotic cells, General structure of virus, Origin of Eukaryotic cell.

Unit 2: Plasma Membrane

7

Various models of plasma membrane structure

Transport across membranes: Active and Passive transport, Facilitated transport

Cell junctions: Tight junctions, Desmosomes, Gap junctions

Unit 3: Endomembrane System

10

Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

Unit 4: Mitochondria and Peroxisomes

8

Mitochondria: Structure and function, Semi-autonomous nature, TCA cycle, Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis

Unit 5: Cytoskeleton

8

Structure and Functions: Microtubules, Microfilaments and Intermediate filaments

Unit 6: Nucleus

12

Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus

Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)

Unit 7: Cell Division

8

Mitosis, Meiosis, Cell cycle and its regulation

Unit 8: Cell Signaling

4

GPCR and Role of second messenger (cAMP)

CORE COURSE IV CELL BIOLOGY

PRACTICAL

(Credits 2)

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis.
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.
4. Demonstration of permanent slide and/or models:
 - i DNA
 - ii RNA
 - iii Proteins, carbohydrate and lipids

SUGGESTED READINGS

- Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI Edition. John Wiley and Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
- 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.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
- 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.
- Cytology by Cohn.



CORE COURSE V DIVERSITY OF CHORDATA

THEORY	(Credits 4)
Unit 1: Introduction to Chordates	2
General characteristics and outline classification	
Unit 2: Protochordata	8
General characteristics of Hemichordata, Urochordata and Cephalochordata; Study of larval forms in protochordates; Retrogressive metamorphosis in Urochordata	
Unit 3: Origin of Chordata	3
Dipleurula concept and the Echinoderm theory of origin of chordates Advanced features of vertebrates over Protochordata	
Unit 4: Agnatha	2
General characteristics and classification of cyclostomes up to class	
Unit 5: Pisces	8
General characteristics of Chondrichthyes and Osteichthyes, classification up to order Migration, Osmoregulation and Parental care in fishes	
Unit 6: Amphibia	6
Origin of <i>Tetrapoda</i> (Evolution of terrestrial ectotherms); General characteristics and classification up to order; Parental care in Amphibians	
Unit 7: Reptilia	7
General characteristics and classification up to order. Poison apparatus and Biting mechanism in snakes	
Unit 8: Aves	8
General characteristics and classification up to order <i>Archaeopteryx</i> -- a connecting link; Flight adaptations, Migration in birds	
Unit 9: Mammals	8
General characters and classification up to order; Affinities of Prototheria and Metatheria, Adaptive radiation	
Unit 10: Zoogeography	8
Zoogeographical realms, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, distribution of vertebrates in different realms	

DIVERSITY OF CHORDATA

PRACTICAL	(Credits 2)
1. Protochordata	
<i>Balanoglossus</i> , <i>Herdmania</i> , <i>Branchiostoma</i> , Colonial Urochordata Sections of <i>Balanoglossus</i> through proboscis and branchiogenital regions, Sections of <i>Amphioxus</i> through pharyngeal, intestinal and caudal regions. Permanent slide of <i>Herdmania</i> spicules	
2. Agnatha	
<i>Petromyzon</i> , <i>Myxine</i>	
3. Fishes	
<i>Scoliodon</i> , <i>Sphyrna</i> , <i>Pristis</i> , <i>Torpedo</i> , <i>Chimaera</i> , <i>Mystus</i> , <i>Heteropneustes</i> , <i>Labeo</i> , <i>Exocoetus</i> , <i>Echeneis</i> , <i>Anguilla</i> , <i>Hippocampus</i> , <i>Tetrodon</i> / <i>Diodon</i> , <i>Anabas</i> , Flat fish	

4. Amphibia

Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra

5. Reptilia

Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus, Identification of poisonous and non-poisonous snakes

6. Aves

Study of six common birds from different orders. Types of beaks and claws

7. Mammalia

Sorex, Bat (Insectivorous and Frugivorous), *Funambulus*, *Loris*, *Herpestes*, *Erinaceus*.

Study of scales of fishes and feathers of birds.

Power point presentation on study of any two animals from two different classes by students (may be included if dissections not given permission)

Classification from Young, J. Z. (2004) & Parker and Haswell to be followed.

SUGGESTED READINGS

- Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.
- Pough H. *Vertebrate life*, VIII Edition, Pearson International.
- Darlington P.J. *The Geographical Distribution of Animals*, R.E. Krieger Pub Co.
- Hall B.K. and Hallgrimsson B. (2008). *Strickberger's Evolution*. IV Edition. Jones and Bartlett Publishers Inc.

Shrutiya

CORE COURSE VI

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS THEORY

(Credits 4)

Unit 1: Tissues

6

Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue

Unit 2: Bone and Cartilage

4

Structure and types of bones and cartilages, Ossification, bone growth and resorption

Unit 3: Nervous System

10

Structure and function of vertebrate neuron, resting membrane potential, Origin of action potential and its propagation across the nerve fibers;

Types of synapse, Synaptic transmission, Reflex action and its types

Unit 4: Muscle

12

Ultra structure and function of skeletal muscle; Molecular and chemical basis of muscle contraction; Characteristics of muscle twitch; Motor unit, summation and tetanus

Unit 5: Reproductive System

10

Histology of testis and ovary; Physiology of female reproduction; Ovarian cycle.

Unit 6: Endocrine System

18

Endocrine glands - pituitary, thyroid, pancreas and adrenal hormones; Placental hormones. Mechanism of hormone action.

ANIMAL PHYSIOLOGY: CONTROLLING AND COORDINATING SYSTEMS PRACTICALS

(Credits 2)

1. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
2. Study of permanent slides/photographs/computer models of Squamous epithelium, Striated muscle fibres and nerve cells
3. Study of permanent slides of Mammalian skin, Cartilage, Bone, Spinal cord, Nerve cell, Pituitary, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid
4. Microtomy: Preparation of permanent slide.

SUGGESTED BOOKS

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons
- Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.

**CORE COURSE VII
FUNDAMENTALS OF BIOCHEMISTRY**

THEORY	(CREDITS 4)
Unit 1: Carbohydrates	8
Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates	
Unit 2: Lipids	8
Structure and Significance of saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids.	
Unit 3: Proteins	14
Amino acids: Structure, Classification and General properties, Physiological importance of essential and non-essential amino acids	
Proteins: Structure of proteins, Bonds stabilizing protein structure;	
Immunoglobulins: Basic Structure, Classes and Function, Antigenic Determinants	
Unit 4: Nucleic Acids	12
Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids	
Cot Curves, Types of DNA and RNA	
Unit 5: Enzymes	18
Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of K_m and V_{max} , Lineweaver-Burk plot; Enzyme inhibition; Allosteric enzyme; Regulation of enzyme action	

FUNDAMENTALS OF BIOCHEMISTRY

PRACTICAL	(CREDITS 2)
1. Qualitative tests of functional groups in carbohydrates, proteins and lipids.	
2. Paper chromatography of amino acids.	
3. Action of salivary amylase under optimum conditions.	
4. Effect of pH, temperature and inhibitors on the action of salivary amylase.	
5. Demonstration of proteins separation by SDS-PAGE.	

SUGGESTED READING

- 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.
- Watson, J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M. and Losick, R. (2008). *Molecular Biology of the Gene*, VI Edition, Cold Spring Harbor Lab. Press, Pearson Pub.

Adm

CORE COURSE VIII
COMPARATIVE ANATOMY OF VERTEBRATES

THEORY	(CREDITS 4)
Unit 1: Integumentary System	8
Structure, functions and derivatives of integument	
Unit 2: Skeletal System	8
Overview of axial and appendicular skeleton, Jaw suspensorium, Visceral arches	
Unit 3: Digestive System	8
Alimentary canal and associated glands	
Unit 4: Respiratory System	8
Skin, gills, lungs and air sacs; Accessory respiratory organs	
Unit 5: Circulatory System	8
Evolution of heart and aortic arches	
Unit 6: Urinogenital System	6
Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri	
Unit 7: Nervous System	8
Comparative account of brain	
Autonomic nervous system, Spinal cord, Cranial nerves in vertebrates	
Unit 8: Sense Organs	6
Classification of receptors, conic and phasic receptors, receptor potential.	

COMPARATIVE ANATOMY OF VERTEBRATES

PRACTICAL	(CREDITS 2)
1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs	
2. Disarticulated skeleton of Frog, <i>Varanus</i> , Fowl, Rabbit	
3. Carapace and plastron of turtle /tortoise	
4. Mammalian skulls: One herbivorous and one carnivorous animal	
5. Study of structure of any two organs (heart, lung, kidney, eye and ear) from video recording (may be included if dissection not permitted)	
6. Project on skeletal modifications in vertebrates (may be included if dissection not permitted)	

SUGGESTED READINGS

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

CORE COURSE IX
ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

THEORY

(Credits 4)

Unit 1: Physiology of Digestion

14

Structural organization and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, Hormonal control of secretion of enzymes in Gastrointestinal tract. (Mammal)

Unit 2: Physiology of Respiration

12

Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Respiratory pigments, Dissociation curves and the factors influencing it; Carbon monoxide poisoning; Control of respiration. (Mammal)

Unit 3: Renal Physiology

8

Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance. (Mammal)

Unit 4: Blood

14

Components of blood and their functions; Structure and functions of haemoglobin
 Haemostasis: Blood clotting system, Kallikrein-Kininogen system, Complement system & Fibrinolytic system, Haemopoiesis
 Blood groups: Rh factor, ABO and MN. (Mammal)

Unit 5: Physiology of Heart

12

Structure of mammalian heart; Coronary circulation; Structure and working of conducting myocardial fibers. Origin and conduction of cardiac impulses Cardiac cycle; Cardiac output and its regulation, Frank-Starling Law of the heart, nervous and chemical regulation of heart rate. Electrocardiogram, Blood pressure and its regulation. (Mammal)

ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

PRACTICALS

(CREDITS 2)

1. Determination of ABO Blood group
2. Enumeration of red blood cells and white blood cells using haemocytometer
3. Estimation of haemoglobin using Sahli's haemoglobinometer
4. Preparation of haemin and haemochromogen crystals
5. Recording of blood pressure using a sphygmomanometer
6. Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver, trachea, lung, kidney

SUGGESTED READINGS

- Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hecourt Asia PTE Ltd. W.B. Saunders Company.
- Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons,
- Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
- Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills

Shunika

CORE COURSE X
BIOCHEMISTRY OF METABOLIC PROCESSES

THEORY	(CREDITS 4)
Unit 1: Overview of Metabolism	10
Catabolism vs Anabolism, Stages of catabolism, Compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms	
Unit 2: Carbohydrate Metabolism	16
Sequence of reactions and regulation of glycolysis, Citric acid cycle, Phosphate pentose pathway.	
Unit 3: Lipid Metabolism	14
β -oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms.	
Unit 4: Protein Metabolism	10
Catabolism of amino acids: Transamination, Deamination, Urea cycle.	
Unit 5: Oxidative Phosphorylation	10
Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System	

BIOCHEMISTRY OF METABOLIC PROCESS

PRACTICALS	(CREDITS 2)
1. Estimation of total protein in given solutions by Lowry's method.	
2. Detection of SGOT and SGPT or GST and GSH in serum/ tissue	
3. To study the enzymatic activity of Trypsin and Lipase.	
4. Study of biological oxidation (SDH).	
5. Qualitative and quantitative estimation of carbohydrate.	
6. Dry Lab: To trace the labelled C atoms of Acetyl-CoA till they evolve as CO ₂ in the TCA cycle	

SUGGESTED READINGS

- Cox, M.M and Nelson, D.L. (2008). *Lehninger 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.

CORE COURSE XI MOLECULAR BIOLOGY

THEORY	(CREDITS 4)
Unit 1: Nucleic Acids	4
Salient features of DNA and RNA	
Watson and Crick model of DNA	
Unit 2: DNA Replication	12
DNA Replication in prokaryotes and eukaryotes, mechanism of DNA replication, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Replication of circular and linear <i>ds</i> -DNA, replication of telomeres	
Unit 3: Transcription	10
RNA polymerase, mechanism of transcription in prokaryotes and eukaryotes,	
Unit 4: Translation	12
Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Process of protein synthesis in prokaryotes and eukaryotes: Ribosome structure and assembly, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Inhibitors of protein synthesis.	
Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA	6
Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing.	
Unit 6: Gene Regulation	10
Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from <i>lac</i> operon and <i>trp</i> operon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing.	
Unit 7: DNA Repair Mechanisms	3
DNA repair (Excision, mismatch, recombination)	
Unit 8: Regulatory RNAs	3
Ribo-switches, RNA interference, miRNA, siRNA	

MOLECULAR BIOLOGY

PRACTICAL	(CREDITS 2)
1. Study of Polytene chromosomes through slide.	
2. Preparation of liquid culture medium (LB).	
3. Preparation of solid culture medium (LB) and growth of <i>E. coli</i> by spreading and streaking	
4. Demonstration of antibiotic sensitivity/resistance test of <i>E. coli</i> and interpretation of results.	
5. Quantitative estimation of DNA using diphenylamine reagent.	
6. Quantitative estimation of RNA using orcinol reagent.	
7. Study and interpretation of electron micrographs/ photograph showing	
(a) DNA replication	
(b) Transcription	
(c) Split genes	



SUGGESTED READINGS

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

CORE COURSE XII PRINCIPLES OF GENETICS

THEORY	(CREDITS 4)
Unit 1: Mendelian Genetics and its Extension	8
Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex-influenced and sex-limited characters inheritance.	
Unit 2: Linkage, Crossing Over and Chromosomal Mapping	12
Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination, Recombination frequency as a measure of linkage intensity.	
Unit 3: Mutations	10
Types of gene mutations (Classification), Chromosomal aberrations Effects of UV light and chemical mutagens	
Unit 4: Sex Determination	4
Chromosomal mechanisms of sex determination in <i>Drosophila</i> and Man	
Unit 5: Extra-chromosomal Inheritance	6
Criteria for extra-chromosomal inheritance, Antibiotic resistance in <i>Chlamydomonas</i> , Mitochondrial mutations in <i>Saccharomyces</i> ,	
Unit 6: Polygenic Inheritance	3
Polygenic inheritance with suitable examples; simple numericals based on it.	
Unit 7: Recombination in Bacteria and Viruses	9
Conjugation, Transformation, Transduction, Complementation test in Bacteriophage	
Unit 8: Transposable Genetic Elements	8
Transposons in bacteria, Ac-Ds elements in maize and P elements in <i>Drosophila</i> , Transposons in humans	

PRINCIPLES OF GENETICS

PRACTICALS	(CREDITS 2)
<ol style="list-style-type: none"> 1. To study the Mendelian laws and gene interactions. 2. Chi-square analyses using seeds/beads/<i>Drosophila</i>. 3. Linkage maps based on data from conjugation, transformation and transduction. 4. Linkage maps based on data from <i>Drosophila</i> crosses. 5. Study of human karyotype through slides (normal and abnormal). 6. Pedigree analysis of some human inherited traits. 	

SUGGESTED READINGS

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India
- 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*. III Edition. Benjamin Cummings
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co
- Fletcher H. and Hickey I. (2015). *Genetics*. IV Edition. GS, Taylor and Francis Group, New York and London.

**CORE COURSE XIII
DEVELOPMENTAL BIOLOGY**

THEORY **(CREDITS 4)**

Unit 1: Introduction **4**

Historical perspective and basic concepts:

Differentiation and growth, Differential gene expression,

Cytoplasmic determinants and asymmetric cell division

Unit 2: Early Embryonic Development **28**

Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External and Internal):

Planes and patterns of cleavage; Types of Blastula;

Fate maps; Early development of frog and chick up to gastrulation; Embryonic induction and organizers

Unit 3: Late Embryonic Development **8**

Fate of Germ Layers; Extra-embryonic membranes in birds; Implantation of embryo in humans, Placenta (Structure, types and functions)

Unit 4: Post Embryonic Development **12**

Metamorphosis: Changes, hormonal regulations in amphibians;

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

Unit 5: Implications of Developmental Biology **8**

Teratogenesis: Teratogenic agents and their effects on embryonic development; *In vitro* fertilization, Stem cell (ESC), Amniocentesis

DEVELOPMENTAL BIOLOGY

PRACTICALS **(CREDITS 2)**

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
2. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)
3. Study of different sections of placenta (photomicrograph/ slides)

SUGGESTED READINGS

- Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA
- Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press
- Carlson, R. F. Patten's Foundations of Embryology
- Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
- Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

**CORE COURSE XIV
EVOLUTIONARY BIOLOGY**

THEORY **(CREDITS 4)**

Unit 1: **7**

Life's Beginnings: Chemogeny, RNA world, Biogeny, Origin of photosynthesis, Evolution of eukaryotes

Unit 2: **4**

Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism

Unit 3: **10**

Evidences of Evolution: Fossil record (types of fossils, transitional forms, geological time scale, evolution of horse, Molecular (universality of genetic code and protein synthesizing machinery, three domains of life, neutral theory of molecular evolution,

Unit 4: **8**

Sources of variations: Heritable variations and their role in evolution

Unit 5: **13**

Population genetics: Hardy-Weinberg Law; Evolutionary forces upsetting H-W equilibrium; Natural selection, Genetic Drift; Role of Migration and Mutation in changing allele frequencies

Unit 6: **7**

Product of evolution: Micro evolutionary changes (inter-population variations, clines, races, Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation / macroevolution (exemplified by Galapagos finches

Unit 7: **2**

Extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction

Unit 8: **6**

Origin and evolution of man and horse.

EVOLUTIONARY BIOLOGY

PRACTICALS **(CREDITS 2)**

1. Study of fossils from models/ pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi square analysis
4. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies

SUGGESTED READINGS

- Ridley, M (2004) Evolution III Edition Blackwell publishing
- Hall, B.K. and Hallgrimson, B (2008). Evolution IV Edition. Jones and Barlett Publishers.
- Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.
- Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
- Snustad. S Principles of Genetics.
- Pevsner, J (2009). Bioinformatics and Functional Genomics. II Edition Wiley-Blackwell



DISCIPLINE SPECIFIC ELECTIVE COURSES

DSE 1

ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

THEORY (Credits 4)

Unit 1: Introduction to Animal Behaviour

Origin and history of Ethology; Brief profiles and contribution of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen, Proximate and ultimate causes of behaviour.

Unit 2: Patterns of Behaviour

Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learnt Behaviour; Associative learning, conditioned and unconditioned reflex, Habituation, Imprinting.

Unit 3: Social and Sexual Behaviour

Social Behaviour: Concept of Society; Communication and the senses; Altruism; Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance. Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Sexual conflict in parental care.

Unit 4: Introduction to Chronobiology

Historical developments in chronobiology; Adaptive significance of biological clocks

Unit 5: Biological Rhythm

Types and characteristics of biological rhythms: Short- and Long- term rhythms; Circadian rhythms; Tidal rhythms and Lunar rhythms; Concept of synchronization and masking; Photic and non-photic zeitgebers; Circannual rhythms; Photoperiod and regulation seasonal reproduction of vertebrates; Role of melatonin.

ANIMAL BEHAVIOUR AND CHRONOBIOLOGY

PRACTICAL

(Credits 2)

1. To study nests and nesting habits of the birds and social insects.
2. To study the behavioural responses of wood lice to dry and humid conditions.
3. To study geotaxis behaviour in earthworm.
4. To study the phototaxis behaviour in insect larvae.
5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of animals and prepare a short report.
6. Study and actogram construction of locomotor activity of suitable animal models.
7. Study of circadian functions in humans.

SUGGESTED READINGS

- David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.
- Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour, Cambridge, University Press, UK.
- John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
- Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
- Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
- Insect Clocks D.S. Saunders, C.G.H. Steel, X., Afopoulou (ed.)R.D. Lewis. (3rd Ed) 2002 Barenz and Noble Inc. New York, USA
- Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

DSE 2

FISH AND FISHERIES

THEORY

(Credits 4)

UNIT 1: Introduction and Classification:

6

General description of fish; Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction.

UNIT 2: Morphology and Physiology:

18

Types of fins and their modifications; Locomotion in fishes; Hydrodynamics; 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 fishes); Electric organs; Bioluminescence; Mechanoreceptors; Schooling; Migration

UNIT 3: Fisheries

12

Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish; Fishing crafts and Gears; Depletion of fisheries resources; Fisheries law and regulations

Unit 4: Aquaculture

20

Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products

UNIT 5: Fish in research

4

Transgenic fish, Zebrafish as a model organism in research

FISH AND FISHERIES PRACTICAL

(CREDITS 2)

1. Study of *Petromyzon*, *Myxine*, *Pristis*, *Chimaera*, *Exocoetus*, *Hippocampus*, *Gambusia*, *Labeo*, *Heteropneustes*, *Anabas*
2. Study of different types of scales (through permanent slides/ photographs).
3. Study of crafts and gears used in Fisheries
4. Water quality criteria for Aquaculture: Assessment of pH, conductivity, Total solids, Total dissolved solids
5. Study of air breathing organs in *Channa*, *Heteropneustes*, *Anabas* and *Clarias*
6. Demonstration of induced breeding in Fishes (video)
7. Project Report on a visit to any fish farm/ pisciculture unit/Zebrafish rearing Lab.

SUGGESTED READINGS

- Q Bone and R Moore, Biology of Fishes, Talyor 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

DSE 3 IMMUNOLOGY

THEORY	(Credits 4)
Unit 1: Overview of Immune System	10
Historical perspective of Immunology, Early theories of Immunology, Cells and organs of the Immune system	
Unit 2: Innate and Adaptive Immunity	10
Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity, Immune dysfunctions (Rheumatoid Arthritis and AIDS).	
Unit 3: Antigens	8
Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes	
Unit 4: Immunoglobulins	10
Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays (ELISA and RIA), Polyclonal sera, Hybridoma technology: Monoclonal antibodies in therapeutics and diagnosis	
Unit 5: Major Histocompatibility Complex	6
Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation	
Unit 6: Cytokines	4
Properties and functions of cytokines, Therapeutics Cytokines	
Unit 7: Complement System	4
Components and pathways of complement activation.	
Unit 8: Hypersensitivity	3
Gell and Coombs' classification and brief description of various types of hypersensitivities	
Unit 9: Vaccines	5
Types of vaccines.	

IMMUNOLOGY

PRACTICAL	(Credits 2)
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1. Estimation of WBC & RBC count, haemoglobin and DC.
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.
5. Demonstration of ELISA and Immunoelectrophoresis.

SUGGESTED READINGS

- Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). *Immunology*, VI Edition. W.H. Freeman and Company.
- David, M., Jonathan, B., David, R. B. and Ivan R. (2006). *Immunology*, VII Edition, Mosby, Elsevier Publication.
- Abbas, K. Abul and Lichtman H. Andrew (2003.) *Cellular and Molecular Immunology*. V Edition. Saunders Publication.

DSE 4

WILD LIFE CONSERVATION AND MANAGEMENT

THEORY

(CREDITS 4)

Unit 1: Introduction to Wild Life

Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.

Unit 2: Evaluation and management of wild life

Habitat analysis, Physical parameters: Topography, Geology, Soil and water;
Biological Parameters: food, cover, forage, browse and cover estimation;
Standard evaluation procedures.

Unit 3: Management of habitats

Setting back succession; Grazing logging; Mechanical treatment; Advancing the successional process; Cover construction; Preservation of general genetic diversity; Restoration of degraded habitats

Unit 4: Population estimation

Population density, Natalty, Birth rate, Mortality, fertility schedules and sex ratio computation; Faecal analysis of ungulates and carnivores.

Unit 5: Management planning of wild life in protected areas

Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbation.

Unit 7: Management of excess population

Common diseases of wild animal

Unit 8: Protected areas

National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.

WILD LIFE CONSERVATION AND MANAGEMENT

PRACTICALS

(CREDITS 2)

1. Identification of flora, mammalian fauna, avian fauna, herpeto-fauna (specimen)
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)
3. Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.
4. Demonstration of different field techniques for flora and fauna
5. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences)
6. Submission of report (field study to national park/ reserve forest/ century)

SUGGESTED READINGS

- 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.

GENERIC ELECTIVE COURSES

GE 1

HUMAN PHYSIOLOGY

THEORY

(CREDITS 4)

Unit 1: Digestion and Absorption of Food

12

Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins; Nervous and hormonal control of digestion (*in brief*)

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

10

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

Unit 3: Respiratory Physiology

6

Ventilation, External and internal Respiration, Transport of oxygen and carbon dioxide in blood, Factors affecting transport of gases.

Unit 4: Renal Physiology

8

Functional anatomy of kidney, Mechanism and regulation of urine formation,

Unit 5: Cardiovascular Physiology

10

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

Unit 6: Endocrine and Reproductive Physiology

14

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

HUMAN PHYSIOLOGY

PRACTICAL

(CREDITS 2)

1. Preparation of temporary mounts: Neurons and Blood film.
2. Preparation of haemin and haemochromogen crystals.
3. Estimation of haemoglobin using Sahli's haemoglobinometer.
4. Examination of permanent histological sections of mammalian oesophagus, stomach, duodenum, rectum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary.

SUGGESTED READINGS

- Tortora, G.J. and Derrickson, B.H. (2009). *Principles of Anatomy and Physiology*, XII Edition, John Wiley and Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. (2008). *Vander's Human Physiology*, XI Edition, McGraw Hill.
- Guyton, A.C. and Hall, J.E. (2011). *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
- Marieb, E. (1998). *Human Anatomy and Physiology*, IV Edition, Addison-Wesley.
- Kesar, S. and Vashisht, N. (2007). *Experimental Physiology*, Heritage Publishers.
- Prakash, G. (2012). *Lab Manual on Blood Analysis and Medical Diagnostics*, S. Chand and Company Ltd.

GE 2**ENVIRONMENT AND PUBLIC HEALTH****THEORY****(Credits 4)****UNIT I: Introduction**

Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.

UNIT II Climate Change

Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health

Unit III Pollution

Air, water, noise pollution sources and effects, Pollution control

Unit IV Waste Management Technologies

Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, Nuclear waste handling and disposal, Waste from thermal power plants, Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.

Unit 5 Diseases

Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid

ENVIRONMENT AND PUBLIC HEALTH**PRACTICAL****(Credits 2)**

1. To determine pH, Cl, SO₄, NO₃ in soil and water samples from different locations.

SUGGESTED BOOKS

- Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
- Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
- Kofi Asante Duah "Risk Assessment in Environmental management", John Wiley and sons, Singapore, 1998.
- Kasperson, J.X. and Kasperson, R.E. and Kasperson, R.E., Global Environmental Risks, V.N. University Press, New York, 2003.
- Joseph F Louvar and B Diane Louver Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey 1997.



GE 3
AQUATIC BIOLOGY

THEORY (Credits 4)

UNIT 1: Aquatic Biomes

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

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.

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 Turbidity/transparency, Dissolved Oxygen, Free Carbon dioxide, Alkalinity (carbonates & bicarbonates) 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 visit to a Sewage treatment plant/Marine bio-reserve/Fisheries Institutes.

SUGGESTED READINGS

- Anathakrishnan : Bioresources Ecology 3rd Edition
- Goldman : Limnology, 2nd Edition
- Odum and Barrett : Fundamentals of Ecology, 5th Edition
- Pawlowski: Physicochemical Methods for Water and Wastewater Treatment, 1st Edition
- Wetzel : Limnology, 3rd edition
- Trivedi and Goyal : Chemical and biological methods for water pollution studies
- Welch : Limnology Vols. I-II

GE 4
FOOD, NUTRITION AND HEALTH

THEORY**(Credits 4)****Unit 1: Basic concept of food and nutrition****10**

Food Components and food-nutrients

Concept of a balanced diet, nutrient needs and dietary pattern for various groups-adults, pregnant and nursing mothers, infants, school children, adolescents and elderly

Unit 2: Nutritional Biochemistry:**20**

Carbohydrates, Lipids, Proteins- Definition, Classification, their dietary source and role

Vitamins- Fat-soluble and Water-soluble vitamins- their dietary source and importance

Minerals- Iron, calcium, phosphorus, iodine, selenium and zinc: their functions

Unit 3: Health**15**

Introduction to health- Definition and concept of health

Major nutritional Deficiency diseases- Protein Energy Malnutrition (kwashiorkor and marasmus), Vitamin A deficiency disorders, Iron deficiency disorders, Iodine deficiency disorders- their causes, symptoms, treatment, prevention and government programmes, if any.

Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary and lifestyle modifications

Social health problems- smoking, alcoholism, drug dependence and AIDS - their causes, treatment and prevention

Common ailments- cold, cough, and fevers, their causes and treatment

Unit 4: Food hygiene:**15**

Potable water- sources and methods of purification at domestic level

Food and Water borne infections: **Bacterial infection:** Cholera, typhoid fever, dysentery; **Viral infection:** Hepatitis, Poliomyelitis, **Protozoan infection:** amoebiasis, giardiasis; **Parasitic infection:** taeniasis and ascariasis their transmission, causative agent, sources of infection, symptoms and prevention

Food spoilage: Causes of food spoilage and their preventive measures

FOOD, NUTRITION AND HEALTH

PRACTICAL**(Credits 2)**

1. To detect adulteration in a) Ghee b) Sugars c) Tea leaves and d) Turmeric
3. Estimation of Lactose in milk
4. Ascorbic acid estimation in food by titrimetry
5. Estimation of Calcium in foods by titrimetry
6. Study of the stored grain pests from slides/ photograph (*Sitophilus oryzae*, *Trogoderma granarium*, *Callosobruchus chinensis* and *Tribolium castaneum*): their identification, habitat and food sources, damage caused and control. Preparation of temporary mounts of the grain pests.
7. Project- Undertake computer aided diet analysis and nutrition counseling for different age groups.

OR

Identify nutrient rich sources of foods (**fruits and vegetables**), their seasonal availability and price.

OR

Study of nutrition labeling on selected foods



SUGGESTED BOOKS

- Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; Fifth Ed; 2007; New Age International Publishers
- Srilakshmi B. Nutrition Science; 2002; New Age International (P) Ltd.
- Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International (P) Ltd.
- Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO.
- Bamji MS, Rao NP, and Reddy V. Text Book of Human Nutrition; 2009; Oxford & IBH Publishing Co. Pvt Ltd.
- Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill.
- Lakra P, Singh MD. Textbook of Nutrition and Health; First Ed; 2008; Academic Excellence.
- Manay MS, Shadaksharaswamy. Food-Facts and Principles; 1998; New Age International (P) Ltd.
- Gibney et al. Public Health Nutrition; 2004; Blackwell Publishing

SKILL ENHANCEMENT COURSES

SEC 1

APICULTURE

(CREDITS 2)

Unit 1: Biology of Bees

(4)

History, Classification and Biology of Honey

Bees Social Organization of Bee Colony

Unit 2: Rearing of Bees

(10)

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

(5)

Bee Diseases and Enemies

Control and Preventive measures

Unit 4: Bee Economy

(2)

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

Unit 5: Entrepreneurship in Apiculture

(4)

Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial

Beehives for cross pollination in horticultural gardens

SUGGESTED READINGS

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

SEC – 2
SERICULTURE

(CREDITS 2)

Unit 1: Introduction

(3)

Sericulture: Definition, history and present status; Silk route

Types of silkworms, Distribution and Races

Exotic and indigenous races

Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm

(3)

Life cycle of *Bombyx mori*

Structure of silk gland and secretion of silk

Unit 3: Rearing of Silkworms

(13)

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

Unit 4: Pests and Diseases

(4)

Pests of silkworm: Uzi fly, dermestid beetles and vertebrates

Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial

Control and prevention of pests and diseases

Unit 5: Entrepreneurship in Sericulture

(2)

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

SUGGESTED READINGS

- Manual on Sericulture; Food and Agriculture Organisation, Rome 1976
- Handbook of Practical Sericulture: S.R. Ullal and M.N. Narasimhanna CSB, Bangalore
- Silkworm Rearing and Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn. & Pub. Govt. Press, Bangalore
- Appropriate Sericultural Techniques; Ed. M. S. Jolly, Director, CSR & TI, Mysore.
- Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd., Tokyo, Japan 1972.
- Manual of Silkworm Egg Production; M. N. Narasimhanna, CSB, Bangalore 1988.
- Silkworm Rearing; Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome 1988.
- A Guide for Bivoltine Sericulture; K. Sengupta, Director, CSR & TI, Mysore 1989.
- Improved Method of Rearing Young age silkworm; S. Krishnaswamy, reprinted CSB, Bangalore, 1986.