

ZOOLOGY HONOURS

CBCS SYLLABUS

(2018)

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1. Introduction

The syllabus for Zoology at undergraduate level using the Choice Based Credit system has been framed in compliance with model syllabus given by UGC.

The main objective of framing this new syllabus is to give the students a holistic understanding of the subject giving substantial weightage to both the core content and techniques used in Zoology.

Keeping in mind and in tune with the changing nature of the subject, adequate emphasis has been given on new techniques and understanding of the subject.

The syllabus has also been framed in such a way that the basic skills of subject are taught to the students, and everyone might not need to go for higher studies and the scope of securing a job after graduation will increase.

There is wide deviation in the infrastructure, be it physical or in human resource, in the form of teachers' expertise and ability and aspiration of the students. Hence, University is free to choose the Electives as per their infrastructural strengths and offer at least 6 to 7 electives

While the syllabus is in compliance with UGC model curriculum, it is necessary that Zoology students should learn "Immunology" as one of the core courses rather than as elective. Also, an important discipline specific elective on "Microbiology" has been added.

Project Work may be introduced instead of the 4th Elective with a credit of 6 split into 2+4, where 2 credits will be for continuous evaluation and 4 credits reserved for the merit of the dissertation.

2. Scheme for CBCS Curriculum

2.1. Credit Distribution across Courses

Course Type	Number of Courses	Credits		
		Theory	Practical	Theory + Practical
Core Courses (CC)	14	$14 \times 4 = 56$	$14 \times 2 = 28$	84
Discipline Specific Electives (DSE)	4	$4 \times 4 = 16$	$4 \times 2 = 8$	24
Generic Electives (GE)	4	$4 \times 4 = 16$	$4 \times 2 = 8$	24
Ability Enhancement Compulsory Courses (AECC)	2	$2 \times 2 = 4$		4
Skill Enhancement Courses (SEC)	2	$2 \times 2 = 4$		4
Totals	26	96	44	140

2.2. Scheme for CBCS Curriculum (Zoology Honours)

YE AR	SEM ES TER	CORE COURSE (CC) (14T+14L) (Credit 14x4+ 14x2)	ABILITY ENHANSMENT COMPULSORY COURSE (AECC)(2T) (Credit 2x2)	SKILL ENHANSMENT COMPULSORY COURSE (SEC)(2T) (Credit 2x2)	DISCIPLINE SPECIFIC ELECTIVES (DSE) (4T+4L) (Credit 4x4+ 4x2)	GENERIC ELECTIVES (GE) (4T+4L) (Credit 4x4+ 4x2) (For other Disciplines)	TOTAL CREDI TS
1	I	CC-1 NON-CHORDATE I CC-2 ECOLOGY	AECC-1 ENVIRONMENTAL SCIENCE			GE1 PAPER-1 * Gr.A-ANIMAL DIVERSITY Gr. B-INSECT VECTORS Gr.C-AQUATIC BIOLOGY	20
	II	CC-3 NON-CHORDATE II CC-4 CELL BIOLOGY	AECC-2 ENGLISH COMMUNICATION/ MAJOR INDIAN LANGUAGE			GE1 PAPER-2* Gr.A-HUMAN PHYSIOLOGY Gr.B-FOOD NUTRITION & HEALTH Gr.C-ENVIRONMENT AND PUBLIC HEALTH Gr.D-ANIMAL CELL BIOTECHNOLOGY	20
2	II I	CC-5 CHORDATES		SEC PAPER-1 * Gr.A- APICULTURE Gr.B-AQUADIUM FISH KEEPING		GE2 PAPER-1 * Gr.A-ANIMAL DIVERSITY Gr. B-INSECT VECTORS Gr.C-AQUATIC BIOLOGY	26
		CC-6 ANIMAL PHYSIOLOGY: CONTROLLING & COORDINATING SYSTEM					
		CC-7 GENETICS					
	I V	CC-8 COMPARATIVE ANATOMY OF VERTEBRATES		SEC PAPER- 2 * Gr.A- SERICULTURE Gr.B-MEDICAL DIAGNOSTIC TECHNIQUES		GE2 PAPER-2* Gr.A-HUMAN PHYSIOLOGY Gr.B-FOOD NUTRITION & HEALTH Gr.C-ENVIRONMENT AND PUBLIC HEALTH Gr.D-ANIMAL CELL BIOTECHNOLOGY	26
CC-9 ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS							
CC-10 FUNDAMENTALS OF BIOCHEMISTRY							
3	V	CC-11 MOLECULAR BIOLOGY			DSE PAPER-1* Gr.A- REPRODUCTIVE BIOLOGY, Gr. B-ENDOCRINOLOGY		24
		CC-12 IMMUNOLOGY					
	I	CC-13 DEVELOPMENTAL BIOLOGY			DSE PAPER-3 * Gr.A- MICROBIOLOGY Gr.B-PARASITOLOGY		24
		CC-14 EVOLUTIONARY BIOLOGY AND BIOSTATISTICS					
TOTAL		56+28=84	4	4	16+8=24	16+8=24	140

*Students have to select any one group for the respective course

2.3. Credit Distribution across Semester

Semester	Course Name	Course Detail	Credits
I	Ability Enhancement Compulsory Course-I	Environmental Science	2
	Core course-I	Non-chordates I	4
	Core course-I Practical	Non-chordates I Lab	2
	Core course-II	Ecology	4
	Core course-II Practical	Ecology Lab	2
	Generic Elective-1 (Paper-1)	Animal diversity / Insect Vectors/Aquatic Biology	4
	Generic Elective-1 (Paper-1) Practical	Animal diversity Lab / Insect Vectors/ Aquatic Biology Lab	2
	II	Ability Enhancement Compulsory Course-II	English/ Bengali/ MIL
Core course-III		Non-chordates II	4
Core course-III Practical		Non-chordates II Lab	2
Core course-IV		Cell Biology	4
Core course-IV Practical		Cell Biology Lab	2
Generic Elective-1 (Paper-2)		Human Physiology/ Food Nutrition & Health/ Environment & Public Health/ Animal Cell Biotechnology	4
Generic Elective-1 (Paper-2) Practical		Human Physiology/ Food Nutrition & Health/ Environment & Public Health/ Animal Cell Biotechnology Lab	2
III		Core course-V	Chordates
	Core course-V Practical	Chordates Lab	2
	Core course-VI	Animal Physiology: Controlling and Coordinating Systems	4
	Core course - VI Practical	Animal Physiology: Controlling and Coordinating Systems Lab	2
	Core course-VII	Genetics	4
	Core course-VII Practical	Genetics Lab	2
	Skill Enhancement Course-Paper1	Aquaculture/ Aquarium Fish Keeping	2
	Generic Elective-2 (Paper-1)	Animal diversity / Insect Vectors/Aquatic Biology	4
	Generic Elective-2 (Paper-1) Practical	Animal diversity / Insect Vectors/Aquatic Biology Lab	2

IV	Core course–VIII	Comparative Anatomy of Vertebrates	4
	Core course–VIII Practical	Comparative Anatomy of Vertebrates Lab	2
	Core course–IX	Animal Physiology: Life Sustaining Systems	4
	Core course–IX Practical	Animal Physiology: Life Sustaining Systems Lab	2
	Core course–X	Fundamentals of Biochemistry	4
	Core course–X Practical	Fundamentals of Biochemistry Lab	2
	Skill Enhancement Course- Paper 2	Sericulture/ Medical Diagnostic Techniques	2
	Generic Elective–2 (Paper-2) Human Physiology/ Food Nutrition & Health/Environment & Public Health/ Animal Cell Biotechnology		4
	Generic Elective–2 (Paper-2) Practical Human Physiology/ Food Nutrition & Health/ Environment & Public Health/ Animal Cell Biotechnology Lab 2		
	V	Core course–XI	Molecular Biology
Core course–XI Practical		Molecular Biology Lab	2
Core course–XII		Immunology	4
Core course–XII Practical		Immunology Lab	2
Discipline Specific Elective–Paper 1		Endocrinology /Reproductive Biology	4
Discipline Specific Elective– Paper 1 Practical		Endocrinology Lab / Reproductive Biology Lab	2
Discipline Specific Elective–Paper2		Animal Behaviour and Chronobiology/ Wildlife Conservation and Management	4
Discipline Specific Elective–Paper 2 Practical		Animal Behaviour and Chronobiology /Wildlife Conservation and Management Lab	2
VI	Core course–XIII	Developmental Biology	4
	Core course–XIII Practical	Developmental Biology Lab	2
	Core course–XIV	Evolutionary Biology and Biostatistics	4
	Core course–XIV Practical	Evolutionary Biology and Biostatistics Lab	2
	Discipline Specific Elective–Paper 3	Microbiology/Parasitology	4
	Discipline Specific Elective–Paper 3 Practical	Microbiology Lab/Parasitology Lab	2
	Discipline Specific Elective–Paper 4	Animal Biotechnology/ Fish and Fisheries/Biology of Insects	4
	Discipline Specific Elective- Paper 4 Practical	Animal Biotechnology/ Fish and Fisheries/Biology of Insects Lab	2

SEMESTER-I

1. CC1- Non-Chordates I (THEORY)

Non-Chordates I		
	4 Credits	Class
Unit 1: Basics of Animal Classification		4
<p>Definitions: Classification, Systematics and Taxonomy; Levels of Taxonomy: Alpha, Beta & Gamma Taxonomy; Taxonomic Hierarchy, Taxonomic types: Primary, Secondary (Definition)</p> <p>Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy kingdom concept of classification (Whittaker and Carl Woese)</p>		
Unit 2: Protista and Metazoa		15
<p>Protozoa</p> <p>General characteristics and Classification up to phylum (according to Levine et. al., 1981), Locomotion in <i>Euglena</i>, <i>Paramoecium</i> and <i>Amoeba</i>; Conjugation in <i>Paramoecium</i>.</p> <p>Life cycle and pathogenicity of <i>Plasmodium vivax</i> and <i>Entamoeba histolytica</i></p> <p>Metazoa</p> <p>Evolution of symmetry and segmentation of Metazoa</p>		
Unit 3: Porifera		6
<p>General characteristics and Classification up to classes; Cell types, Spicules and Canal system in sponges</p>		
Unit 4: Cnidaria		10
<p>General characteristics and Classification up to classes Metagenesis in <i>Obelia</i></p> <p>Polymorphism in Cnidaria</p> <p>Corals and coral reef diversity, function & conservation</p>		
Unit 5: Ctenophora		2

General characteristics	
Unit 6: Platyhelminthes	6
General characteristics and Classification up to classes Life cycle of <i>Fasciola hepatica</i> and <i>Taenia solium</i>	
Unit 7: Nematoda	7
General characteristics and Classification up to classes Life cycle, of <i>Ascaris lumbricoides</i> and <i>Wuchereria bancrofti</i> Parasitic adaptations in helminthes	
Reference Books	
▶ Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition. ▶ Invertebrates by Brusca & Brusca. Second edition, 2002.	

Classification for metazoans to be followed from: Rupert and Barnes, 1994, 6th Edition.

2. CC1 –Non-Chordates I (Lab)

Non-Chordates I	
	2 credits
List of Practical	
<ol style="list-style-type: none"> Preparation of whole mount of <i>Euglena/ Amoeba / Paramoecium</i> Identification with reasons: <i>Amoeba, Euglena, Tetranucleate stage of Entamoeba, Opalina, Paramecium, trophozoite stage/ signet ring stage of Plasmodium</i> (from the prepared slides) Identification with reasons: <i>Sycon, Neptune's Cup, Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora</i> Spot identification of adult <i>Fasciola hepatica, Taenia solium</i> and <i>Ascaris lumbricoides</i> Staining/mounting of any protozoa/helminth from gut of cockroach 	

3. CC2 –Ecology (THEORY)

Ecology		
	4 Credits	Class
Unit 1: Introduction to Ecology		4
History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of Physical factors (light and temperature), The Biosphere - Introduction.		
Unit 2: Population		20
<p>Unitary and Modular populations</p> <p>Unique and group attributes of population: Demographic factors, life tables, fecundity tables (Definitions), survivorship curves, dispersal and dispersion.</p> <p>Exponential and logistic growth, equation and patterns, r and k strategies Population regulation - density-dependent and independent factors</p> <p>Population Interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition.</p>		
Unit 3: Community		11
<p>Community characteristics: species diversity, abundance, , dominance, richness,</p> <p>Vertical stratification, Ecotone and edge effect. Ecological succession with one example</p>		
Unit 4: Ecosystem		10
<p>Types of ecosystem with an 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</p> <p>Nutrient and biogeochemical cycle with an example of Nitrogen cycle</p> <p>Human modified ecosystem</p>		
Unit 5: Applied Ecology		5
<p>Wildlife Conservation (in-situ and ex-situ conservation).</p> <p>Management strategies for tiger conservation; Wild life protection act (1972)</p>		

Reference Books	
▶	Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
▶	Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
▶	Robert Leo Smith Ecology and field biology Harper and Row publisher
▶	Ecology: Theories & Application (2001). 4th Edition by Peter Stilling.
▶	Ecology by Cain, Bowman & Hacker. 3rd edition. Sinauer associates

4. CC2–Ecology (Lab)

Ecology	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 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: zooplankton, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand (Dark bottle method) and free CO₂ 4. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary 	

5. GE 1 PAPER 1 (Group-A) -Animal Diversity (THEORY)

Animal Diversity		
	4 Credits	Class
Unit 1: Protista		3
Protozoa General characters of Protozoa; Life cycle of <i>Plasmodium</i>		
Unit 2: Porifera		3
General characters and canal system in Porifera		
Unit 3: Radiata		3
General characters of Cnidarians and polymorphism		
Unit 4: Aceolomates		2
General characters of Platyhelminthes		
Unit 5: Pseudocoelomates		3
General characters of Nematoda		
Unit 6: Annelida		3
General characters of Annelida Metamerism		
Unit 7: Arthropoda		4
General characters Social life in Honey bees.		
Unit 8: Mollusca		4

General characters of mollusc Pearl Formation	
Unit 9: Echinodermata	4
General characters of Echinodermata Water Vascular system in Starfish	
Unit 10: Protochordata	2
Salient features	
Unit 11: Pisces	3
General Characters Migration of Fish	
Unit 12: Amphibia	4
General characters, Parental care	
Unit 13: Reptilia	4
General Characters, Differences between poisonous and non-poisonous snakes, poison apparatus, venom and anti-venom	
Unit 14: Aves	4
General Characters Flight adaptations	
Unit 15: Mammalia	4
General Characters, Integumentary glands	
Reference Books	
<ul style="list-style-type: none"> ▶ Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA. ▶ Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole ▶ Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd. 	

- ▶ Kardong, K. V. (2002). *Vertebrates Comparative Anatomy. Function and Evolution*. Tata McGraw Hill Publishing Company. New Delhi.
- ▶ Raven, P. H. and Johnson, G. B. (2004). *Biology*, 6th edition, Tata McGraw Hill Publications. New Delhi.

6. GE 1 PAPER 1 (Group-A) –Animal Diversity (Lab)

Animal Diversity

2 Credits

List of Practical

1. Spot identification (specimen/ photographs/ permanent slides):
 - a. Non Chordates: *Euglena, Paramecium, Sycon, Physalia, Metridium, Taenia, Ascaris, Nereis, Leech, Peripatus, Limulus, Hermitcrab, Daphnia, Millipede, Centipede, Beetle, Chiton, Octopus, Asterias, Antedon and Balanoglossus,*
 - b. Chordates: *Amphioxus, Petromyzon, Scoliodon, Hippocampus, Labeo, Ichthyophis/Uraeotyphlus, Salamander, Draco, Naja, Viper, Archaeopteryx,* any three common birds-(Crow, duck, Owl), Squirrel and Bat.
2. Identification of following specimen through Slides/ photographs:
Cross section of *Sycon*, and *Ascaris* (male and female). T. S. of Earthworm passing through typhlosolar intestine. Bipinnaria and Pluteus larva.
3. Temporary mounts of:
 - a. Cyclophs/ Daphnia.
 - b. Unstained mounts of Placoid, cycloid and ctenoid scales.
4. Dissections of:
 - a. Digestive system of Cockroach
5. Study of gut parasite of cockroach.

7. GE 1 PAPER 1 (Group-B) -Insect Vectors and Diseases (THEORY)

Insect Vectors and Diseases		
	4 Credits	Class
Unit 1: Introduction to Insects		2
General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts (with reference to feeding)		
Unit 2: Concept of Vectors		4
Brief introduction to Carriers and Vectors (mechanical and biological vectors),Reservoirs, Host-vector relationship, Adaptations as vectors, Host specificity		
Unit 3: Insects as Vectors		6
Detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera		
Unit 4: Dipteran as Disease Vectors		20
Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis Control of mosquitoes Study of sand fly-borne diseases –Leishmaniasis,(visceral and cutaneous), phlebotomus fever; Control of Sand fly Study of house fly as important mechanical vector, Myiasis, Control of house fly		
Unit 5: Siphonaptera as Disease Vectors		6
Fleas as important insect vectors; Host-specificity, Study of Flea-borne diseases – Plague, Typhus fever; Control of fleas		
Unit 6: Siphunculata as Disease Vectors		6
Human louse (Head, Body and Pubic louse) as important insect vectors; Control of human louse		
Unit 7: Hemiptera as Disease Vectors		6

Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures	
Reference Books	
<ul style="list-style-type: none"> ▶ Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK ▶ Chapman, R.F. (1998). The Insects: Structure and Function. IV Edition, Cambridge University Press, UK ▶ Pedigo L.P. (2002). Entomology and Pest Management. Prentice Hall Publication ▶ Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell ▶ Mosquito (2000) Chandra G, Sribhumi Publication Co. Kolkata ▶ Medical Entomology, Hati A. K Allied Book Agency, Kolkata 	

8. GE 1 PAPER 1 (Group-B) –Insect Vectors and Diseases (Lab)

Insect Vectors and Diseases	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Identification of different kinds of mouth parts of insects (Slides/ photographs) 2. Identification of following insect vectors through permanent slides/ photographs: <i>Aedes</i>, <i>Culex</i>, <i>Anopheles</i>, <i>Pediculus humanus capitis</i>, <i>Pediculus humanus corporis</i>, <i>Phthirus pubis</i>, <i>Xenopsylla cheopis</i>, <i>Cimex lectularius</i>, <i>Phlebotomus argentipes</i>, <i>Musca domestica</i> 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 	

9 . GE 1 PAPER 1 (Group-C)-Aquatic Biology (THEORY)

Aquatic Biology		
	4 Credits	Class
Unit 1: Aquatic Biomes		10
Brief introduction to 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		20
Lakes: Lake as an Ecosystem, 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: Physico-chemical environment, Adaptation of hill- stream fishes.		
Unit 3: Marine Biology		10
Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs		
Unit 4: Management of Aquatic Resources		10
Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD.		
Reference Books		
<ul style="list-style-type: none"> ▶ 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 		

10. GE 1 PAPER 1 (Group-C)–Aquatic Biology (Lab)

Aquatic Biology	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Determine the area of a pond using graphimetric and gravimetric method.2. Identification of the important zooplanktons present in a pond ecosystem.3. Determine the amount of Dissolved Oxygen, and Free Carbon dioxide, Totoal 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.	

(OUT OF THREE GROUPS OF GE 1 PAPER 1 STUDENTS HAVE TO SELECT ANY ONE GROUP)

SEMESTER-II

11. CC3–Non-Chordates II (THEORY)

Non-Chordates II		
	4 Credits	Class
Unit 1: Introduction		2
Evolution of coelom and metamerism		
Unit 2: Annelida		10
General characteristics and Classification up to classes Excretion in Annelida through nephridia, locomotion in <i>Nereis</i> Metamerism in Annelida.		
Unit 3: Arthropoda		16
General characteristics and Classification up to classes Vision in Insecta only. Tracheal Respiration in Arthropoda (Gills in prawn and trachea in cockroach) in cockroach Metamorphosis in Lepidopteran Insects.		
Unit 4: Onychophora		2
General characteristics and Evolutionary significance; and affinities of <i>Peripatus</i> .		
Unit 5: Mollusca		10
General characteristics and Classification up to classes Nervous system and torsion and detorsion in Gastropoda Respiration in <i>Pila</i> sp; Evolutionary significance of trochophore larva.		
Unit 6: Echinodermata		8
General characteristics and Classification up to classes Water-vascular system in Echinodermata, Larval forms in Echinodermata, Affinities with Chordates		

Unit 7: Hemichordata	2
General characteristics of phylum Hemichordata. Relationship with non-chordates and chordates	
Reference Books	
▶ Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition	
▶ The Invertebrates: A New Synthesis, III Edition, Blackwell Science	

Note: Classification to be followed from Rupert and Barnes, 1994, 6th Edition / Brusca and Brusca 2003.

12. CC 3–Non-Chordates II (Lab)

Non-Chordates II	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Identification with reasons: <ol style="list-style-type: none"> a. Annelids - <i>Aphrodite, Nereis/Heteronereis, Sabella, Chaetopterus, Pheretima, Hirudinaria</i> b. Arthropods - <i>Limulus, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta</i>, termites and honey bees <i>Onychophora - Peripatus</i> c. Molluscs - <i>Chiton, Dentalium, Pila, Doris, Helix, Unio, Ostrea, Sepia, Octopus, Nautilus</i> d. Echinodermates - <i>Pentaceros/Asterias, Ophiura, Clypeaster (Sand Dollars), Echinus, Cucumaria</i> and <i>Antedon</i> e. Hemichordates- <i>Balanoglossus</i> 2. Study of digestive system, septal nephridia, pharyngeal nephridia of earthworm (chart/model) 3. Identification of T.S. through pharynx, gizzard, and typhlosolar intestine of earthworm 4. Mounting of mouth parts and dissection of digestive system and nervous system of <i>Periplaneta</i> 5. To submit a Project Report on any related topic to larval forms (crustacean, mollusc and echinoderm) 	

13. CC 4 - Cell Biology (THEORY)

Cell Biology		
	4 Credits	Class
Unit 1: Overview of Cells		2
Basic structure of Prokaryotic and Eukaryotic cells, Viruses, Viroid, Prion and Mycoplasma		
Unit 2: Plasma Membrane		6
Ultra structure and composition of Plasma membrane: Fluid mosaic model Transport across membrane: Active and Passive transport, Facilitated transport Cell junctions: Tight junctions, Gap junctions, Desmosomes		
Unit 3: Cytoplasmic organelles I		5
Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes Protein sorting and mechanisms of vesicular transport		
Unit 4: Cytoplasmic organelles II		6
Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis, Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis Peroxisomes: Structure and Functions Centrosome: Structure and Functions		
Unit 5: Cytoskeleton		5
Types and function of cytoskeleton, structure of microtubules and microfilaments Accessory proteins of microfilament & microtubule A brief idea about molecular motors		
Unit 6: Nucleus		8
Structure of Nucleus: Nuclear envelope, Nucleolus Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)		

Unit 7: Cell Division	10
Cell cycle and its regulation, Cancer (Concept of oncogenes and tumor suppressor genes) . Mitosis and Meiosis: Basic process and their significance	
Unit 8: Cell Signaling	8
Cell signalling transduction pathways; Types of signaling molecules and receptors GPCR and Role of second messenger (cAMP), Protein kinase and Ca ⁺² Apoptosis and Necrosis- brief idea	
Reference Books	
<ul style="list-style-type: none"> ▶ Lewin's Cells – 3rd Edition – Cassimeris/Lingappa/Plopper – Johns & Bartlett Publishers ▶ Biology of Cancer by Robert. A. Weinberg. 2nd edition. ▶ Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA. ▶ Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London. 	

14. CC 4–Cell Biology (Lab)

Cell Biology	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis (protocol and identification through photographs) 2. Study of various stages of meiosis from grasshopper testis (Squash preparation) (protocol and identification through photographs) 3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells. (protocol and identification through photographs) 4. Preparation of permanent slide to demonstrate DNA by Feulgen reaction 5. Cell viability study by Trypan Blue staining (use spleen) (protocol and identification through photographs) 	

15. GE 1 PAPER 2 (Group- A) -Human Physiology (THEORY)

Human Physiology		
	4 Credits	Class
Unit 1: Digestion and Absorption of Food		8
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		6
Functional anatomy of kidney, Mechanism and regulation of urine formation,		
Unit 5: Cardiovascular Physiology		8
Structure of heart, Coordination of heartbeat, Cardiac cycle, ECG		
Unit 6: Endocrine and Reproductive Physiology		12
Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes), Brief account of spermatogenesis and oogenesis, Menstrual cycle		
Reference Books		
▶	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	

<p>Asia Pvt. Ltd/ W.B. Saunders Company.</p> <ul style="list-style-type: none"> ▶ 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. 	
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16. GE 1 PAPER 2 (Group- A) –Human Physiology (Lab)

Human Physiology	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Preparation of temporary slides: Neurons /Blood film. 2. ABO blood group typing. 3. Estimation of haemoglobin using Sahli's haemoglobinometer. 4. Identification of permanent histological sections of mammalian oesophagus, stomach, duodenum/ileum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary. 	

17. GE 1 PAPER 2 (Group- B) -Food, Nutrition and Health (THEORY)

Food, Nutrition and Health		
	4 Credits	Class
Unit 1: Basic concept of food and nutrition		6
Food Components and food-nutrients Concept of a balanced diet, nutrient needs and dietary pattern for various groups- adults, pregnant and lactating mothers, infants, school children, adolescents and elderly		
Unit 2: Nutritional Biochemistry		16
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 biological functions		
Unit 3: Health		14
Introduction to health- Definition, concept of health and disease 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 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 Acquired Immuno Deficiency Syndrome (AIDS) - their causes, treatment and prevention Common ailments- cold, cough, and fevers, their causes and treatment		
Unit 4: Food hygiene and Community health		14
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; Helminths infection: Taeniasis, Ascariasis, Vector borne diseases: Malaria and Dengue, their transmission, causative agent,		

sources of infection, symptoms and prevention	
Brief account of food spoilage: Causes of food spoilage and their preventive measures	
Reference Books	
<ul style="list-style-type: none"> ▶ 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 	

18. GE 1 PAPER 2 (Group- B) – Food Nutrition and Health (Lab)

Food Nutrition and Health	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. To detect adulteration in Ghee/ Sugars/ Tea leaves/ Turmeric/ milk 2. Gram staining of bacteria. 3.. Study of the stored grain pests (<i>Sitophilus oryzae</i>, <i>Trogoderma granarium</i>) and mosquito vectors (<i>Anopheles</i>, <i>Culex</i> and <i>Aedes</i>) from slides/ photograph. Identification, habitat and food sources, damage caused and control. 4. Preparation of temporary mounts of the above stored grain pests. 5. Project- Undertake computer aided diet analysis and Anthropometric nutritional assessment for different age groups. <p style="margin-left: 20px;">OR</p> <p style="margin-left: 20px;">Identify nutrient rich sources of foods (fruits and vegetables), their seasonal availability and price</p> <p style="margin-left: 20px;">OR</p> <p style="margin-left: 20px;">Study of nutrition labelling on selected foods</p>	

19. GE 1 PAPER 2 (Group- C) -Environment and Public Health (THEORY)

Environment and Public Health		
	4 Credits	Class
Unit 1: Introduction		10
Sources of Environmental hazards, Hazard identification and accounting, Fate of toxic and persistent substances in the environment, Biomagnification.		
Unit 2: Climate Change		10
Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health		
Unit 3: Pollution		5
Air, water, noise pollution sources and effects, Pollution control		
Unit 4: Waste Management Technologies		15
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.		
Unit 5: Diseases		10
Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid, filariasis		
Reference Books		
<ul style="list-style-type: none"> ▶ 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. 		

20. GE 1 PAPER 2 (Group- C)–Environment and Public Health Lab

Environment and Public Health	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. To determine pH, Cl, Hardness in water samples from different locations2. Visit to Auto/vehicle (Emission) pollution testing centre.	

21. GE 1 PAPER 2 (Group- D)--Animal Cell Biotechnology (THEORY)

Animal Cell Biotechnology		
	4 Credits	Class
Unit 1: Introduction		2
Concept and Scope of Biotechnology		
Unit 2: Techniques in Gene manipulation		15
Recombinant DNA technology, Isolation of genes, Restriction endonucleases		
Cloning Vectors: Plasmids, Phage vectors, Cosmids, Phagemids,		
Construction of Genomic libraries and cDNA libraries		
Transformation techniques: microbial and animals: Cloning in mammalian cells, Integration of DNA into mammalian genome- Electroporation and Calcium Phosphate Precipitation method.		
Unit 3: Animal cell Culture		9
Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures.		
Basic idea of agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, DNA sequencing: (Sanger method), Polymerase chain reaction, DNA Fingerprinting.		
Unit 4: Fermentation		8
Different types of Fermentation: Submerged & Solid state; batch, Fed batch & Continuous; Stirred tank, Air Lift, Fixed Bed and Fluidized.		
Downstream Processing: Filtration, centrifugation, extraction, chromatography, spray drying and lyophilization.		
Unit 5: Transgenic Animal Technology		6

Production of transgenic animals: nuclear transplantation, Retroviral method, DNA microinjection method, Dolly and Polly.	
Unit 6: Application in Health	6
Development of recombinant Vaccines, Hybridoma technology, Gene Therapy (ADA). Production of recombinant Proteins: Insulin.	
Unit 7: Bio safety Physical and Biological containment	4
Bio safety Physical and Biological containment	
Reference Books	
<ul style="list-style-type: none"> ▶ Animal Cells Culture and Media, D.C. Darling and S.J. Morgan, 1994. BIOS Scientific Publishers Limited. ▶ Methods in Cell Biology, Volume 57, Jennie P. Mathur and David Barnes, 1998. Animal Cell Culture Methods Academic Press. ▶ P.K. Gupta: Biotechnology and Genomics, Rastogi publishers (2003). ▶ B.D. Singh: Biotechnology, Kalyani publishers, 1998 (Reprint 2001). ▶ T.A. Brown: Gene cloning and DNA analysis: An Introduction, Blackwell Science (2001). ▶ Bernard R. Click & Jack J. Pasternak: Molecular Biotechnology, ASM Press, Washington (1998). ▶ Methods in Gene Biotechnology, W. Wu, M.J. Welsh, P.B. Kaufman & H.H. Zhang, 1997, CRC Press, New York ▶ Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA 	

22. GE 1 PAPER 2 (Group- D) –Animal Cell Biotechnology (Lab)

Animal Cell Biotechnology	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Packing and sterilization of glass and plastic wares etc for cell culture. 2. Preparation of bacterial culture media. 3. Preparation of genomic DNA from E. coli/animals/ human. 4. DNA quantitation using agarose gel electrophoresis (by using lambda DNA as standard). 5. Restriction digestion of lambda (λ) DNA using EcoRI/ Hind III. 6. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, (Through photographs) 	
(OUT OF FOUR GROUPS OF GE 1 PAPER 2 STUDENTS HAVE TO SELECT ANY ONE GROUP)	

SEMESTER-III

23. CC 5 – Chordates (THEORY)

Chordates		
	4 Credits	Class
Unit 1: Introduction to Chordates		2
General characteristics and outline classification of Phylum Chordata (upto class level)		
Unit 2: Protochordata		6
General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes. Retrogressive metamorphosis in <i>Ascidia</i> . General organization and Feeding in <i>Branchiostoma</i>		
Unit 3: Origin of Chordata		2
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 order, Metamorphosis in Lamprey, Zoological importance of ammocoete larva		
Unit 5: Pisces		6
General characteristics and classification of Chondrichthyes and Osteichthyes up to Subclasses Accessory respiratory organ, migration and parental care in fishes Swimbladder in fishes.		
Unit 6: Amphibia		6
General characteristics and classification up to living Orders. Parental care in Amphibia, Metamorphosis in toad, Neoteny and paedogenesis		
Unit 7: Reptilia		8
General characteristics and classification up to living Orders. Poison apparatus and Biting mechanism in poisonous Snakes		

Unit 8: Aves	8
<p>General characteristics and classification up to Sub-Classes</p> <p>Exoskeleton, migration and double respiration in Birds</p> <p>Principles and aerodynamics of flight</p>	
Unit 9: Mammals	8
<p>General characters and classification up to living orders</p> <p>Affinities of Prototheria</p> <p>Exoskeletal derivatives of mammals</p> <p>Adaptive radiation in mammals with reference to locomotory appendages</p> <p>Echolocation in Micro chiropterans and Cetaceans</p>	
Unit 10: Zoogeography	2
<p>Zoogeographical realms, Plate tectonic and Continental drift theory, distribution of birds and mammals in different realms</p>	
Reference Books	
<ul style="list-style-type: none"> ▶ 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. ▶ Parker, T. J. & Haswell, W. (1972). Text Book of Zoology, Volume II: Marshall and Willam (Eds.) 7th Ed. Macmillan Press, London. ▶ Kardong, K. V. (2002). Vertebrates: Comparative anatomy, function evolution. Tata McGraw Hill. ▶ Kent, G. C. & Carr, R. K. (2001). Comparative anatomy of the Vertebrates. 9th Ed. McGraw Hill. ▶ Nelson, J.S., (2006) : Fishes of the World, 4th Edn., Wiley. ▶ Romer, A. S. & Parsons, T. S. (1986). The vertebrate body. 6th Ed. Saunders College Publishing. ▶ Jordan, E.L. & Verma, P.S. (2003). Chordate Zoology. S. Chand & Company Ltd. New Delhi. ▶ Sinha, K. S., Adhikari, S., Ganguly, B. B. & Bharati Goswami, B. D. (2001). Biology of Animals. Vol. II. New Central Book Agency (p) Ltd. 	

Note: Classifications for Protochordata, Agnatha, Reptilia, Aves and Mammalia to be followed from Young (1981), for Pisces to be followed from Romer (1959), for Amphibia to be followed from Duellman and Trueb (1986)/ Young (1981).

24. CC 5–Chordates (Lab)

Chordates	
	2 Credits
List of Practical	
<p>Identification with reasons:</p> <ol style="list-style-type: none"> 1. Protochordata <i>Herdmania, Branchiostoma</i> 2. Agnatha <i>Petromyzon, Myxine</i> 3. Fishes <i>Scoliodon, Sphyrna, Torpedo, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetradon/ Diodon-, Anabas, Flat fish</i> 4. Amphibia <i>Necturus, Axolotl,- Tylotriton, Bufo, Hyla</i> 5. Reptilia <i>Chelone, Trionyx,- Hemidactylus,- Varanus, Uromastix, Chamaeleon- Draco, Bungarus,- Vipera, Naja, Hydrophis, - Crocodylus.</i> Key for Identification of poisonous and non-poisonous snakes 6. Mammalia: Bat (Insectivorous and Frugivorous), <i>Funambulus</i> 7. Mounting of pecten from Fowl head 8. Dissection of brain and pituitary of Tilapia/carp. 	

25. CC 6 - Animal Physiology: Controlling & Coordinating Systems (THEORY)

Animal Physiology: Controlling & Coordinating Systems		
	4 Credits	Class
Unit 1: Tissues		4
Structure, location, classification and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue		
Unit 2: Bone and Cartilage		4
Structure and structural types of bones and cartilages, Ossification		
Unit 3: Nervous System		10
Structure and types of neuron, resting membrane potential, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers; Types of synapse, Synaptic transmission and Neuromuscular junction; Reflex action and its types		
Unit 4: Muscular system		10
Histology of different types of muscle; Ultra structure of skeletal muscle; Molecular and chemical basis of skeletal muscle contraction; Characteristics of muscle fibre: muscle twitch, tetanus.		
Unit 5: Reproductive System		6
Histology of testis and ovary		
Roles of Hormones in Reproduction including placental hormones		
Unit 6: Endocrine System		16
Histology and function of pituitary, thyroid, pancreas and adrenal		
Classification of hormones; Mechanism of Hormone action		
Signal transduction pathways for Steroidal, Protein and peptide hormones		
Hypothalamus (neuroendocrine gland) - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system		

Reference Books	
▶	Histology: A Text and Atlas. Sixth Edition. Ross & Pawlina. Lippincott Williams & Wilkins.
▶	Eckert Animal Physiology by David Randall and Warren Burggren. 4th edition. W. H. Freeman.

26. CC 6–Animal Physiology: Controlling & Coordinating Systems (Lab)

Animal Physiology: Controlling & Coordinating Systems	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex),/Recording of simple muscle twitch with electrical stimulation (or Virtual) 2. Preparation of temporary mounts: Squamous epithelium, / Striated muscle fibres 3. Identification 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 of any five mammalian (Goat/white rat) tissues 	

27. CC 7 – Genetics (THEORY)

Genetics		
	4 Credits	Class
Unit 1: Mendelian Genetics and its Extension		10
Principles of inheritance, Incomplete dominance and co-dominance, Epistasis Multiple alleles, Lethal alleles, Pleiotropy, Sex-linked, sex- influenced and sex-limited inheritance, Polygenic Inheritance.		
Unit 2: Linkage, Crossing Over and Chromosomal Mapping		10
Linkage and Crossing Over, molecular mechanism of crossing over (Holliday model), Measuring Recombination frequency and linkage intensity using three factor crosses, Interference and coincidence		
Unit 3: Mutations		10
Types of gene mutations (Classification), Types of chromosomal aberrations (Classification with one suitable example of each), Non-disjunction and variation in chromosome number; Molecular basis of mutations in relation to UV light and chemical mutagens		
Unit 4: Sex Determination		8
Mechanisms of sex determination in <i>Drosophila</i> Sex determination in mammals Dosage compensation in <i>Drosophila</i> & Human		
Unit 5: Extra-chromosomal Inheritance		4
Criteria for extra chromosomal inheritance, Antibiotic resistance in <i>Chlamydomonas</i> , Kappa particle in <i>Paramecium</i> Shell spiralling in snail		
Unit 6: Recombination in Bacteria and Viruses		6
Conjugation, Transformation, Transduction, Complementation test in Bacteriophage		

Reference Books

- ▶ Developmental biology by Scott. F. Gilbert, 9th edition.
- ▶ Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc
- ▶ Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings
- ▶ Russell, P. J. (2009). Genetics- A Molecular Approach.III Edition. Benjamin Cummings
- ▶ Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B.

28. CC 7–Genetics (Lab)

Genetics

2 Credits

List of Practical

1. Chi-square analyses
2. Linkage maps based on conjugation
3. Identification of chromosomal aberration in *Drosophila* and man from photograph
4. Pedigree analysis of some human inherited traits

29. SEC Paper 1 (Group-A) –Apiculture (THEORY)

Apiculture		
	2 Credits	Class
Unit 1: Biology of Bees		2
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		6
Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens		
Reference Books		
▶ 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.		

30. SEC Paper 1 (Group-B)-Aquarium Fish Keeping (THEORY)

Aquarium Fish Keeping		
	2 Credits	Class
Unit 1: Introduction to Aquarium Fish Keeping		2
The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes		
Unit 2: Biology of Aquarium Fishes		10
Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish		
Unit 3: Food and feeding of Aquarium fishes		7
Use of live fish feed organisms. Preparation and composition of formulated fish feeds, Aquarium fish as larval predator		
Unit 4: Fish Transportation		3
Live fish transport - Fish handling, packing and forwarding techniques.		
Unit 5: Maintenance of Aquarium		3
General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage Industry		

Reference Books:

- ▶ Anshuman D. Dholakia. 2016. Ornamental Fish Culture and Aquarium Management. Astral International.
- ▶ Harishanker J. Alappat;A. 2011. Biju Kumar. Aquarium Fishes: A Colourful Profile. BR Publishing Corporation
- ▶ Sarij K. Swain, N. Sarangi and S. Ayyappan. 2010. Ornamental Fish Farming. Indian Council of Agricultural Research.

(OUT OF TWO GROUPS OF SEC PAPER 1 STUDENTS HAVE TO SELECT ANY ONE GROUP)

31. GE 2 PAPER 1 (Group-A) -Animal Diversity (THEORY)

Animal Diversity		
	4 Credits	Class
Unit 1: Protista		3
Protozoa General characters of Protozoa; Life cycle of <i>Plasmodium</i>		
Unit 2: Porifera		3
General characters and canal system in Porifera		
Unit 3: Radiata		3
General characters of Cnidarians and polymorphism		
Unit 4: Aceolomates		2
General characters of Platyhelminthes		
Unit 5: Pseudocoelomates		3
General characters of Nematoda		
Unit 6: Annelida		3
General characters of Annelida Metamerism		
Unit 7: Arthropoda		4
General characters Social life in Honey bees.		
Unit 8: Mollusca		4

General characters of mollusc Pearl Formation	
Unit 9: Echinodermata	4
General characters of Echinodermata Water Vascular system in Starfish	
Unit 10: Protochordata	2
Salient features	
Unit 11: Pisces	3
General Characters Migration of Fish	
Unit 12: Amphibia	4
General characters, Parental care	
Unit 13: Reptilia	4
General Characters, Differences between poisonous and non-poisonous snakes, poison apparatus, venom and anti-venom	
Unit 14: Aves	4
General Characters Flight adaptations	
Unit 15: Mammalia	4
General Characters, Integumentary glands	
Reference Books	
<ul style="list-style-type: none"> ▶ Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA. ▶ Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole ▶ Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd. 	

- ▶ Kardong, K. V. (2002). *Vertebrates Comparative Anatomy. Function and Evolution*. Tata McGraw Hill Publishing Company. New Delhi.
- ▶ Raven, P. H. and Johnson, G. B. (2004). *Biology*, 6th edition, Tata McGraw Hill Publications. New Delhi.

32. GE 2 PAPER 1 (Group-A) –Animal Diversity (Lab)

Animal Diversity

2 Credits

List of Practical

1. Spot identification (specimen/ photographs/ permanent slides):
 - a. Non Chordates: *Euglena, Paramecium, Sycon, Physalia, Metridium, Taenia, Ascaris, Nereis, Leech, Peripatus, Limulus, Hermitcrab, Daphnia, Millipede, Centipede, Beetle, Chiton, Octopus, Asterias, Antedon and Balanoglossus,*
 - b. Chordates: *Amphioxus, Petromyzon, Scoliodon, Hippocampus, Labeo, Ichthyophis/Uraeotyphlus, Salamander, Draco, Naja, Viper, Archaeopteryx,* any three common birds-(Crow, duck, Owl), Squirrel and Bat.
2. Identification of following specimen through Slides/ photographs:
Cross section of *Sycon*, and *Ascaris* (male and female). T. S. of Earthworm passing through typhlosolar intestine. Bipinnaria and Pluteus larva.
3. Temporary mounts of:
 - a. Cyclophs/ Daphnia.
 - b. Unstained mounts of Placoid, cycloid and ctenoid scales.
4. Dissections of:
 - a. Digestive system of Cockroach
5. Study of gut parasite of cockroach.

33. GE 2 PAPER 1 (Group-B) -Insect Vectors and Diseases (THEORY)

Insect Vectors and Diseases		
	4 Credits	Class
Unit 1: Introduction to Insects		
General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts (with reference to feeding)		2
Unit 2: Concept of Vectors		
Brief introduction to Carriers and Vectors (mechanical and biological vectors),Reservoirs, Host-vector relationship, Adaptations as vectors, Host specificity		4
Unit 3: Insects as Vectors		
Detailed features of orders with insects as vectors – Diptera, Siphonaptera, Siphunculata, Hemiptera		6
Unit 4: Dipteran as Disease Vectors		
Dipterans as important insect vectors – Mosquitoes, Sand fly, Houseflies Study of mosquito-borne diseases – Malaria, Dengue, Chikungunya, Viral encephalitis, Filariasis Control of mosquitoes Study of sand fly-borne diseases –Leishmaniasis,(visceral and cutaneous), phlebotomus fever; Control of Sand fly Study of house fly as important mechanical vector, Myiasis, Control of house fly		20
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		6
Unit 7: Hemiptera as Disease Vectors		
		6

Bugs as insect vectors; Blood-sucking bugs; Chagas disease, Bed bugs as mechanical vectors, Control and prevention measures	
Reference Books	
<ul style="list-style-type: none"> ▶ Imms, A.D. (1977). A General Text Book of Entomology. Chapman & Hall, UK ▶ Chapman, R.F. (1998). The Insects: Structure and Function. IV Edition, Cambridge University Press, UK ▶ Pedigo L.P. (2002). Entomology and Pest Management. Prentice Hall Publication ▶ Mathews, G. (2011). Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell ▶ Mosquito (2000) Chandra G, Sribhumi Publication Co. Kolkata ▶ Medical Entomology, Hati A. K Allied Book Agency, Kolkata 	

34. GE 2 PAPER 1 (Group-B) –Insect Vectors and Diseases (Lab)

Insect Vectors and Diseases	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Identification of different kinds of mouth parts of insects (Slides/ photographs) 2. Identification of following insect vectors through permanent slides/ photographs: <i>Aedes</i>, <i>Culex</i>, <i>Anopheles</i>, <i>Pediculus humanus capitis</i>, <i>Pediculus humanus corporis</i>, <i>Phthirus pubis</i>, <i>Xenopsylla cheopis</i>, <i>Cimex lectularius</i>, <i>Phlebotomus argentipes</i>, <i>Musca domestica</i> 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 	

35. GE 2 PAPER 1 (Group-C)-Aquatic Biology (THEORY)

Aquatic Biology		
	4 Credits	Class
Unit 1: Aquatic Biomes		10
Brief introduction to 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		20
Lakes: Lake as an Ecosystem, 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: Physico-chemical environment, Adaptation of hill- stream fishes.		
Unit 3: Marine Biology		10
Salinity and density of Sea water, Continental shelf, Adaptations of deep sea organisms, Coral reefs		
Unit 4: Management of Aquatic Resources		10
Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation (legislations), Sewage treatment Water quality assessment- BOD and COD.		
Reference Books		
<ul style="list-style-type: none"> ▶ 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 		

36. GE 2 PAPER 1 (Group-C)–Aquatic Biology (Lab)

Aquatic Biology	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Determine the area of a pond using graphimetric and gravimetric method.2. Identification of the important zooplanktons present in a pond ecosystem.3. Determine the amount of Dissolved Oxygen, and Free Carbon dioxide, Totoal 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.	

(OUT OF THREE GROUPS OF GE 1 PAPER 1 STUDENTS HAVE TO SELECT ANY ONE GROUP)

SEMESTER-IV

37. CC 8 -Comparative Anatomy of Vertebrates (THEORY)

Comparative Anatomy of Vertebrates		
	4 Credits	Class
Unit 1: Integumentary System		
Structure, function and derivatives of integument in birds and mammals		6
Unit 2: Skeletal System		
Overview of axial and appendicular skeleton; Jaw suspension; Visceral arches.		6
Unit 3: Digestive System		
Comparative anatomy of stomach in birds and mammals; dentition in mammals		8
Unit 4: Respiratory System		
Respiratory organs in fish, amphibian, birds and mammals		6
Unit 5: Circulatory System		
General plan of circulation, Comparative account of heart and aortic arches		8
Unit 6: Urinogenital System		
Succession of kidney, Evolution of urinogenital ducts		6
Unit 7: Nervous System		
Comparative account of brain, Cranial nerves in mammals		6
Unit 8: Sense Organs		
Classification of receptors		4
Reference Books		
▶ Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education		

<ul style="list-style-type: none"> ▶ Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies ▶ Hilderbrand, M and Gaslow G.E. Analysis of Vertebrate Structure, John Wiley and Sons ▶ Saxena, R.K. & Saxena, S.C. (2008) : Comparative Anatomy of Vertebrates, Viva Books Pvt. Ltd. 	
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38. CC8–Comparative Anatomy of Vertebrates (Lab)

Comparative Anatomy of Vertebrates	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Study of placoid, cycloid and ctenoid scales through permanent slides/photographs 2. Study of disarticulated skeleton of Toad, Pigeon and Guineapig 3. Identification of skulls: <i>Trionix</i>, <i>Calotes</i>, Guineapig and Dog 4. Dissection of Tilapia/ Carp/ Rat: Circulatory system, Origin and distribution of 9th and 10th cranial nerve 	

39. CC 9 - Animal Physiology: Life Sustaining Systems (THEORY)

Animal Physiology: Life Sustaining Systems		
	4 Credits	Class
Unit 1: Physiology of Digestion		12
Structural organisation and functions of Gastrointestinal tract and Associated glands; Mechanical and chemical digestion and absorption of Carbohydrates, Lipids, and Proteins ; Digestive enzymes		
Unit 2: Physiology of Respiration		10
Mechanism of Respiration, Respiratory volumes and capacities, transport of Oxygen and Carbon dioxide in blood, Dissociation curves and the factors influencing it, types of respiratory pigments; Carbon monoxide poisoning		
Unit 3: Physiology of Circulation		12
Components of Blood and their functions; Structure and functions of haemoglobin Haemostasis; Blood clotting system, Fibrinolytic system Haemopoiesis; Basic steps and its regulation Blood groups; ABO and Rh factor		
Unit 4: Physiology of Heart		8
Structure of mammalian heart with special reference to human, Coronary Circulation, Structure and working of conducting myocardial fibres, Origin and conduction of cardiac impulses Cardiac Cycle and cardiac output Blood pressure and its regulation		
Unit 5: Thermoregulation & Osmoregulation		
Physiological classification based on thermal biology. Thermal biology of endotherms Osmoregulation in aquatic vertebrates		

Extrarenal osmoregulatory organs in vertebrates	
Unit 6: Renal Physiology	8
Structure of Kidney and its functional unit, Mechanism of urine formation, counter current mechanism for formation of concentrated urine, Regulation of acid-base balance	
Reference Books	
<ul style="list-style-type: none"> ▶ 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, ▶ Eckert Animal Physiology: Mechanisms and adaptations Randall, Burggren and French Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills ▶ 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 	

40. CC 9–Animal Physiology: Life Sustaining Systems (Lab)

Animal Physiology: Life Sustaining Systems	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Determination of ABO Blood group and Rh factor 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 	

41. CC 10 - Fundamentals of Biochemistry (THEORY)

Fundamentals of Biochemistry		
	4 Credits	Class
Unit 1: Carbohydrates		8
Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides; Carbohydrate metabolism: Glycolysis, Citric acid cycle, Pentose phosphate pathway, Gluconeogenesis		
Unit 2: Lipids		7
Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Sphingolipid, Glycolipids, Steroids, Eicosanoids and terpenoids. Lipid metabolism: definition of alpha and omega oxidation; β -oxidation of saturated and even carbon-chain fatty acids; Fatty acid biosynthesis		
Unit 3: Proteins		10
Amino acids Structure, Classification, General and Electro chemical properties of α -amino acids; Proteins Bonds stabilizing protein structure; Levels of organization: primary, secondary, tertiary, quaternary, Ramachandran plot Protein metabolism: Transamination, Deamination,, Urea cycle,		
Unit 4: Nucleic Acids		10
Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids Types of DNA and RNA, Complementarity of DNA, Hpyo- Hyperchromaticity of DNA		
Unit 5: Enzymes		13
Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Derivation of Michaelis-Menten equation, Lineweaver-Burk plot;		

Factors affecting rate of enzyme-catalyzed reactions; Enzyme inhibition (competitive, uncompetitive, noncompetitive); Allosteric enzymes and their kinetics; Strategy of enzyme action- Catalytic and Regulatory (Basic concept with one example each)	
Unit 5: Oxidative Phosphorylation	2
Redox systems; Review of mitochondrial respiratory chain, ATP synthesis, Inhibitors and un-couplers of Electron Transport System	
Reference Books	
<ul style="list-style-type: none"> ▶ 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. 	

42. CC10 –Fundamentals of Biochemistry (Lab)

Fundamentals of Biochemistry	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Qualitative tests of functional groups in carbohydrates (Molisch's Test, Iodine test, Fehling's Test/ Benedict's Test, Barfoed's Test, Seliwanoff's Test), proteins (Biuret test, Millon's test) and lipids (saponification). 2. Paper & TLC chromatography of amino acids. 3. Quantitative estimation of proteins Lowry Method 4. Demonstration of proteins separation by SDS-PAGE 5. To study the enzymatic activity of salivary amylase 	

43. SEC Paper 2 (Group A)– Sericulture (THEORY)

Sericulture		
	2 Credits	Class
Unit 1: Introduction		2
Sericulture: Definition, Types of silkworms, Distribution and Races Exotic and indigenous races Mulberry and non-mulberry Sericulture		
Unit 2: Biology of Silkworm		4
Life cycle of <i>Bombyx mori</i> Structure of silk gland and secretion of silk		
Unit 3: Rearing of Silkworms		10
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		7
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		

Reference Books

- ▶ 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
- ▶ Jaiswal, K., Trivedi, S. P., Pandey, B.N. and Pandey, P.N. 2009 Indian Sericulture: Past, Present And Future, Alfa Publication.
- ▶ Ganga, G. and Sulochana Chetty, J. 2014. Introduction To Sericulture, Oxford & Ibh Publishing Co Pvt Ltd.
- ▶ Tripathi, A.K., Pandey, B.N., Jaiswal, K., Trivedi, S. P. 2009. Mulberry Sericulture: Problems and Prospects, Aph Publishing Corporation.

44. SEC Paper 2 (Group B)– MEDICAL DIAGNOSTIC TECHNIQUES (THEORY)

Medical Diagnostic Techniques		
	2 Credits	Class
Unit 1: Introduction to Medical Diagnostics and its Importance		2
Unit 2: Diagnostics Methods Used for Analysis of Blood		7
Blood composition, Preparation of blood smear and Differential Leucocyte Count (D.L.C) using Leishman's stain, Platelet count using haemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.)		
Unit 3: Diagnostic Methods Used for Urine Analysis		4
Urine Analysis: Physical characteristics; Abnormal constituents		
Unit 4: Non-infectious Diseases		5
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 (Principle)		
Unit 5: Infectious Diseases		3
Causes, types, symptoms, diagnosis and prevention of Tuberculosis and Hepatitis, Malarial parasite (Microscope based and ELISA based)		
Unit 6: Clinical Biochemistry		1
LFT, Lipid profiling		
Unit 7: Clinical Microbiology		1
Antibiotic Sensitivity Test		
Unit 8: Tumours		2
Types (Benign/Malignant), Detection and metastasis; Medical imaging: X-Ray of Bone fracture, PET, MRI and CT Scan (using photographs).		

Reference Books

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

(OUT OF TWO GROUPS OF SEC PAPER 2 STUDENTS HAVE TO SELECT ANY ONE GROUP)

45. GE 2 PAPER 2 (Group- A) -Human Physiology (THEORY)

Human Physiology		
	4 Credits	Class
Unit 1: Digestion and Absorption of Food		8
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		6
Functional anatomy of kidney, Mechanism and regulation of urine formation,		
Unit 5: Cardiovascular Physiology		8
Structure of heart, Coordination of heartbeat, Cardiac cycle, ECG		
Unit 6: Endocrine and Reproductive Physiology		12
Structure and function of endocrine glands (pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, and testes), Brief account of spermatogenesis and oogenesis, Menstrual cycle		
Reference Books		
▶ 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		

<p>Asia Pvt. Ltd/ W.B. Saunders Company.</p> <ul style="list-style-type: none"> ▶ 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. 	
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46. GE 2 PAPER 2 (Group- A) –Human Physiology (Lab)

Human Physiology	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Preparation of temporary slides: Neurons /Blood film. 2. ABO blood group typing. 3. Estimation of haemoglobin using Sahli’s haemoglobinometer. 4. Identification of permanent histological sections of mammalian oesophagus, stomach, duodenum/ileum, lung, kidney, thyroid, pancreas, adrenal, testis, ovary. 	

47. GE 2 PAPER 2 (Group- B) -Food, Nutrition and Health (THEORY)

Food, Nutrition and Health		
	4 Credits	Class
Unit 1: Basic concept of food and nutrition		6
Food Components and food-nutrients Concept of a balanced diet, nutrient needs and dietary pattern for various groups- adults, pregnant and lactating mothers, infants, school children, adolescents and elderly		
Unit 2: Nutritional Biochemistry		16
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 biological functions		
Unit 3: Health		14
Introduction to health- Definition, concept of health and disease 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 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 Acquired Immuno Deficiency Syndrome (AIDS) - their causes, treatment and prevention Common ailments- cold, cough, and fevers, their causes and treatment		
Unit 4: Food hygiene and Community health		14
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; Helminths infection: Taeniasis, Ascariasis, Vector borne diseases: Malaria and Dengue, their transmission, causative agent,		

sources of infection, symptoms and prevention	
Brief account of food spoilage: Causes of food spoilage and their preventive measures	
Reference Books	
<ul style="list-style-type: none"> ▶ 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 	

48. GE 2 PAPER 2 (Group- B) – Food Nutrition and Health (Lab)

Food Nutrition and Health	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. To detect adulteration in Ghee/ Sugars/ Tea leaves/ Turmeric/ milk 2. Gram staining of bacteria. 3.. Study of the stored grain pests (<i>Sitophilus oryzae</i>, <i>Trogoderma granarium</i>) and mosquito vectors (<i>Anopheles</i>, <i>Culex</i> and <i>Aedes</i>) from slides/ photograph. Identification, habitat and food sources, damage caused and control. 4. Preparation of temporary mounts of the above stored grain pests. 5. Project- Undertake computer aided diet analysis and Anthropometric nutritional assessment for different age groups. <p style="margin-left: 20px;">OR</p> <p style="margin-left: 20px;">Identify nutrient rich sources of foods (fruits and vegetables), their seasonal availability and price</p> <p style="margin-left: 20px;">OR</p> <p style="margin-left: 20px;">Study of nutrition labelling on selected foods</p>	

49. GE 2 PAPER 2 (Group- C) -Environment and Public Health (THEORY)

Environment and Public Health		
	4 Credits	Class
Unit 1: Introduction		10
Sources of Environmental hazards, Hazard identification and accounting, Fate of toxic and persistent substances in the environment, Biomagnification.		
Unit 2: Climate Change		10
Greenhouse gases and global warming, Acid rain, Ozone layer destruction, Effect of climate change on public health		
Unit 3: Pollution		5
Air, water, noise pollution sources and effects, Pollution control		
Unit 4: Waste Management Technologies		15
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.		
Unit 5: Diseases		10
Causes, symptoms and control of tuberculosis, Asthma, Cholera, Minamata disease, typhoid, filariasis		
Reference Books		
<ul style="list-style-type: none"> ▶ 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. 		

50. GE 2 PAPER 2 (Group- C)–Environment and Public Health Lab

Environment and Public Health	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. To determine pH, Cl, Hardness in water samples from different locations2. Visit to Auto/vehicle (Emission) pollution testing centre.	

51. GE 2 PAPER 2 (Group- D)--Animal Cell Biotechnology (THEORY)

Animal Cell Biotechnology		
	4 Credits	Class
Unit 1: Introduction		2
Concept and Scope of Biotechnology		
Unit 2: Techniques in Gene manipulation		15
Recombinant DNA technology, Isolation of genes, Restriction endonucleases Cloning Vectors: Plasmids, Phage vectors, Cosmids, Phagemids, Construction of Genomic libraries and cDNA libraries Transformation techniques: microbial and animals: Cloning in mammalian cells, Integration of DNA into mammalian genome- Electroporation and Calcium Phosphate Precipitation method.		
Unit 3: Animal cell Culture		9
Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures. Basic idea of agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, DNA sequencing: (Sanger method), Polymerase chain reaction, DNA Fingerprinting.		
Unit 4: Fermentation		8
Different types of Fermentation: Submerged & Solid state; batch, Fed batch & Continuous; Stirred tank, Air Lift, Fixed Bed and Fluidized. Downstream Processing: Filtration, centrifugation, extraction, chromatography, spray drying and lyophilization.		
Unit 5: Transgenic Animal Technology		

Production of transgenic animals: nuclear transplantation, Retroviral method, DNA microinjection method, Dolly and Polly.	
Unit 6: Application in Health	6
Development of recombinant Vaccines, Hybridoma technology, Gene Therapy (ADA). Production of recombinant Proteins: Insulin.	
Unit 7: Bio safety Physical and Biological containment	4
Bio safety Physical and Biological containment	
Reference Books	
<ul style="list-style-type: none"> ▶ Animal Cells Culture and Media, D.C. Darling and S.J. Morgan, 1994. BIOS Scientific Publishers Limited. ▶ Methods in Cell Biology, Volume 57, Jennie P. Mathur and David Barnes, 1998. Animal Cell Culture Methods Academic Press. ▶ P.K. Gupta: Biotechnology and Genomics, Rastogi publishers (2003). ▶ B.D. Singh: Biotechnology, Kalyani publishers, 1998 (Reprint 2001). ▶ T.A. Brown: Gene cloning and DNA analysis: An Introduction, Blackwell Science (2001). ▶ Bernard R. Click & Jack J. Pasternak: Molecular Biotechnology, ASM Press, Washington (1998). ▶ Methods in Gene Biotechnology, W. Wu, M.J. Welsh, P.B. Kaufman & H.H. Zhang, 1997, CRC Press, New York ▶ Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA 	

52. GE 2 PAPER 2 (Group- D) –Animal Cell Biotechnology (Lab)

Animal Cell Biotechnology	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Packing and sterilization of glass and plastic wares etc for cell culture. 2. Preparation of bacterial culture media. 3. Preparation of genomic DNA from E. coli/animals/ human. 4. DNA quantitation using agarose gel electrophoresis (by using lambda DNA as standard). 5. Restriction digestion of lambda (λ) DNA using EcoR1/ Hind III. 6. Techniques: Western Blot, Southern Hybridization, DNA Fingerprinting, PCR, (Through photographs) 	
(OUT OF FOUR GROUPS OF GE 2 PAPER 2 STUDENTS HAVE TO SELECT ANY ONE GROUP)	

SEMESTER-V

53. CC 11 - Molecular Biology (THEORY)

Molecular Biology		
	4 Credits	Class
Unit 1: Nucleic Acids		5
Salient features of DNA and RNA Watson and Crick Model of DNA, Clover leaf model of tRNA		
Unit 2: DNA Replication		10
Mechanism of DNA Replication in Prokaryotes, Semi-conservative, bidirectional and discontinuous Replication RNA priming, Inhibitors of replication		
Unit 3: Transcription		10
Mechanism of Transcription in prokaryotes Inhibitors of transcription		
Unit 4: Translation		12
Mechanism of protein synthesis in prokaryotes, Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Genetic code, Degeneracy of the genetic code and Wobble Hypothesis; Inhibitors of protein synthesis		
Unit 5: Gene Regulation		4
Regulation of Transcription in prokaryotes: <i>lac</i> operon and <i>trp</i> operon;		

Unit 6: DNA Repair Mechanisms	4
Types of DNA repair mechanisms, RecBCD model in prokaryotes, nucleotide and base excision repair, SOS repair	
Unit 7: Molecular Techniques	5
Basic Principles of PCR, Western and Southern blot, Northern Blot, Sanger DNA sequencing	
Reference Books	
<ul style="list-style-type: none"> ▶ Molecular Cell Biology by Harvey Lodish. 7th Edition. W.H. Freeman. ▶ Molecular Biology of The Gene by Watson. 7th Edition. Pearson. ▶ iGenetics: A Molecular Approach by Peter. J. Russell. 3rd edition. Pearson Benjamin Cummings. 	

54. CC 11–Molecular Biology (Lab)

Molecular Biology	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Demonstration of polytene and lampbrush chromosome from photograph 2. Isolation (NaCL-SSC method) and quantification of genomic DNA using spectrophotometer (A260 measurement)/ colorimeter (diphenylamine method) 3. Agarose gel electrophoresis for DNA (demonstration) 	

55. CC 12 – Immunology (THEORY)

Immunology		
	4 Credits	Class
Unit 1: Overview of Immune System		2
Basic concepts of health and diseases, Historical perspective of Immunology, Cells and organs of the Immune system		
Unit 2: Innate and Adaptive Immunity		12
Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity (Cell mediated and humoral). Structure of B and T cell Receptor and its signalling, T cell development & selection		
Unit 3: Antigens		4
Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes		
Unit 4: Immunoglobulins		8
Structure and functions of different classes of immunoglobulins, Antigen- antibody interactions, Immunoassays (ELISA and RIA), Hybridoma technology, Monoclonal antibody production		
Unit 5: Major Histocompatibility Complex		2
Structure and functions of MHC molecules.		
Unit 6: Cytokines		2
Types, properties and functions of cytokines.		
Unit 7: Complement System		6
Components and pathways of complement activation (Classical & alternative).		
Unit 8: Hypersensitivity		4

Gell and Coombs' classification and brief description of various types of hypersensitivities.	
Unit 9: Immunology of disease	6
Malaria	
Unit 10: Vaccines	4
Various types of vaccines. Active & passive immunization (Artificial and natural).	
Reference Books	
▶ Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.	
▶ Abbas, K. Abul and Lichtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication.	
▶ Ashim Kumar Chakraborty (2005). Immunology and Immunotechnology. Oxford University Press	
▶ Delves, Peter J.; Martin, Seamus J.; Burton, Dennis R.; Roitt, Ivan M. (2011). Roitt's Essential Immunology. Hoboken, NJ: Wiley-Blackwell	
▶ David Male Jonathan Brostoff David Roth Ivan Roitt (2012). Immunology 8th Edition, Elsevier	

56. CC 12–Immunology (Lab)

Immunology	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Demonstration of lymphoid organs. 2. Identification of spleen, thymus and lymph nodes through slides/ photographs 3. Preparation of stained blood film to study various types of leukocytes 4. Lymphocyte separation from spleen.. 5. Demonstration of ELISA 	

57. DSE Paper 1 (Group A) -Reproductive Biology (THEORY)

Reproductive Biology		
	4 Credits	Class
Unit 1: Reproductive Endocrinology		10
<p>Gonadal Hormones, Mechanism of action of steroids and glycoprotein hormones. hypothalamo – hypophyseal – gonadal axis, regulation of gonadotrophin secretion in human (male and female)</p> <p>Reproductive system:</p> <p>Development and differentiation of gonads, genital ducts</p>		
Unit 2: Functional anatomy of male reproduction		14
<p>Histoarchitecture of testis in human; Spermatogenesis; Hormonal regulation; Androgen synthesis; Accessory glands functions</p>		
Unit 3: Functional anatomy of female reproduction		18
<p>Histoarchitecture of ovary in human; Oogenesis; Hormonal regulation; Steroidogenesis and secretion of ovarian hormones; Reproductive cycles (human) and their regulation, fertilization; Hormonal control of implantation; Hormonal regulation of gestation, pregnancy diagnosis, foeto – maternal relationship; Mechanism of parturition and its hormonal regulation; Lactation and its regulation</p>		
Unit 4: Reproductive Health		8
<p>Infertility in male and female: causes, diagnosis and management</p> <p>Assisted Reproductive Technology: sex selection, sperm banks, frozen embryos, in vitro fertilization, IUI, ICSI</p> <p>Modern contraceptive technologies</p>		
Reference Books		
<ul style="list-style-type: none"> ▶ Ross & Pawlina. Histology: A text and Atlas. 6th edition. ▶ Guyton & Hall. Medical Physiology. 11th edition. ▶ Knobil, E. et al. (eds). The Physiology of Reproduction. Raven Press Ltd. ▶ Hatcher, R.A. et al. The Essentials of Contraceptive Technology. Population Information Programme. 		

58. DSE Paper 1 (Group A) -- Reproductive Biology (Lab)

Reproductive Biology	
	2 Credits
List of Practicals	
<ol style="list-style-type: none">1. Visit to animal house: set up and maintenance of animal house, breeding techniques, care of normal and experimental animals.2. Examination of vaginal smear from liverat .3. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland4. Identification of histological sections from photomicrographs/ permanent slides of rat/human: testis, epididymis and accessory glands of male reproductive systems; Sections of ovary, fallopian tube, uterus (proliferative and secretory stages), cervix and vagina.5. Demonstration of Sperm count and sperm motility in rat	

59. DSE Paper 1 (Group B) –Endocrinology (THEORY)

Endocrinology		
	4 Credits	Class
Unit 1: Introduction to Endocrinology		4
General idea of Endocrine systems, Classification, Characteristic and Transport of Hormones, Neurosecretions and Neurohormones		
Unit 2: Epiphysis, Hypothalamo-hypophysial Axis		16
Structure of pineal gland, Secretions and their functions in biological rhythms and reproduction. Structure and functions of hypothalamus and Hypothalamic nuclei, Regulation of neuroendocrine glands, Feedback mechanisms Structure of pituitary gland, Hormones and their functions, Hypothalamo-hypophysial portal system, Disorders of pituitary gland.		
Unit 3: Peripheral Endocrine Glands		16
Structure, Hormones, Functions and Regulation of Thyroid gland, Parathyroid, Adrenal, Pancreas, Ovary and Testis Hormones in Calcium and glucose homeostasis, Disorders of endocrine glands		
Unit 4: Regulation of Hormone Action		14
Mechanism of action of steroidal, non-steroidal hormones with receptors Bioassays of hormones using RIA & ELISA Estrous cycle in rat and menstrual cycle in human Multifaceted role of Vasopressin & Oxytocin. Hormonal regulation of parturition.		
Reference Books		
▶ Guyton and Hall. Textbook of Medical Physiology. 13th Edition		
▶ Histology: A Text and Atlas. Sixth Edition. Ross & Pawlina. Lippincott Williams & Wilkins.		
▶ Vertebrate Endocrinology by David O. Norris,		

60. DSE Paper 1 (Group B) --Endocrinology Lab

Endocrinology	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Dissect and display of Endocrine glands in laboratory bred rat.2. Identification of the permanent slides of all the endocrine glands3. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland4. Estimation of plasma level of any hormone using ELISA (Demonstration)	

(OUT OF TWO GROUPS OF DSE PAPER 1 STUDENTS HAVE TO SELECT ANY ONE GROUP)

61. DSE Paper 2 (Group A) -Animal Behaviour and Chronobiology (THEORY)

Animal Behaviour and Chronobiology		
	4 Credits	Class
Unit 1: Introduction to Animal Behaviour		5
Origin and history of Ethology, Brief contributions of Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen, Proximate and ultimate causes of behaviour, Methods and recording of a behaviour		
Unit 2: Patterns of Behaviour		6
Stereotyped Behaviours (Orientation, Reflexes); Individual Behavioural patterns; Instinct vs. Learnt Behaviour; Associative learning, classical and operant conditioning, Habituation, Imprinting.		
Unit 3: Social and Sexual Behaviour		15
Social Behaviour: Concept of Society; Communication: Chemical communications in insects and the senses Altruism; Reciprocal altruism and Kin selection 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		10
Brief historical developments in chronobiology; Biological oscillation: the concept of Average, amplitude, phase and period Adaptive significance of biological clocks		
Unit 5: Biological Rhythm		14
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 of seasonal reproduction of vertebrates; Role of melatonin.		
Reference Books		

- ▶ Animal Behaviour by Drickamar.
- ▶ 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. (3rdEd) 2002 Barends and Noble Inc. New York, USA
- ▶ Biological Rhythms: Vinod Kumar (2002) Narosa Publishing House, Delhi/ Springer-Verlag, Germany.

62. DSE Paper 2 (Group A) –Animal Behaviour and Chronobiology (Lab)

Animal Behaviour and Chronobiology

2 Credits

List of Practical

1. To study the aggressive behavior of fish..
- 2..To study the learning behavior of rat,
3. To study geotaxis behaviour in soil arthropod.
4. To study the phototaxis behaviour in soil arthropod/insect larvae .
5. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/ Zoological Park to study behavioural activities of animals and prepare a short report.

63. DSE Paper 2 (Group B) – Wild Life Conservation and Management (THEORY)

Wild Life Conservation and Management		
	4 Credits	Class
Unit 1: Introduction to Wild Life		6
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		8
Habitat analysis, Physical parameters: Topography, Geology, Soil and water Biological Parameters: food, cover, forage, browse and cover estimation Standard evaluation procedures: remote sensing and GIS.		
Unit 3: Management of habitats		6
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		12
Population density, Natalty, Birth rate, Mortality, fertility schedules and sex ratio computation; Pug marks and census method.		
Unit 5: Aims and objectives of wildlife conservation		6
Wildlife conservation in India – through ages; different approaches of wildlife conservation; modes of conservation; in-situ conservation and ex-situ conservation: necessity for wildlife conservation		
Unit 6: Management planning of wild life in protected areas		5
Estimation of carrying capacity; Eco tourism / wild life tourism in forests; Concept of climax persistence; Ecology of perturbence.		
Unit 7: Man and Wildlife		3

Causes and consequences of human-wildlife conflicts; mitigation of conflict – an overview; Management of excess population	
Unit 8: Protected areas	4
National parks & sanctuaries, Community reserve; Important features of protected areas in India; Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve.	
Reference Books	
<ul style="list-style-type: none"> ▶ 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. 	

64. DSE Paper 2 (Group B) –Wild Life Conservation and Management (Lab)

Wild Life Conservation and Management	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Identification of mammalian fauna/ avian fauna, herpeto-fauna of any protected area of North Bengal. 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 fauna 5. PCQ, ten tree method, Circular, Square & rectangular plots, Parker’s 2 Step and other methods for ground cover assessment, Tree canopy cover assessment, Shrub cover assessment. 6. Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences) 	
(OUT OF TWO GROUPS OF DSE PAPER 2 STUDENTS HAVE TO SELECT ANY ONE GROUP)	

SEMESTER-VI

65. CC 13 - Developmental Biology (THEORY)

Developmental Biology		
	4 Credits	Class
Unit 1: Introduction		2
Basic concepts: Phases of Development, Cell cell interaction, Differentiation and growth, Differential gene expression		
Unit 2: Early Embryonic Development		20
Gametogenesis, Spermatogenesis, Oogenesis; Types of eggs, Egg membranes; Fertilization (External (Sea urchin) and Internal (mammal)): Changes in gametes, Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps (including Techniques); 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 chick; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta)		
Unit 4: Post Embryonic Development		12
Development of brain and Eye in chick		
Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each)		
Unit 5: Implications of Developmental Biology		8
Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Stem cell (ESC), Amniocentesis		
Reference Books		
▶ Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA		
▶ Slack JMW , Essential Developmental Biology		

66. CC 13–Developmental Biology (Lab)

Developmental Biology	
	2 Credits
List of Practical	
<ol style="list-style-type: none">1. Preparation of whole mount of different developmental stages of chick2. Identification of whole mounts of developmental stages of chick through permanent slides: 24, 48, 72, and 96 hours of incubation (Hamilton and Hamburger stages)3. Study of the developmental stages and life cycle of <i>Drosophila</i> from stock culture4. Demonstration of male gametes of rat.5. Project report on <i>Drosophila</i> culture/chick embryo development	

67. CC 14–Evolutionary Biology & Biostatistics (THEORY)

Evolutionary Biology		
	4 Credits	Class
Unit 1		5
Origin of life, RNA world		
Unit 2		5
Historical review of Evolutionary concepts, Lamarkism, Darwinism and Neo Darwinism		
Unit 3		6
Geological time scale, Evolution of horse, Phylogenetic trees and their interpretations, convergent and divergent evolution		
Neutral theory of molecular evolution, Molecular clock		
Unit 4		5
Sources of variations: Heritable variations and their role in evolution		
Unit 5		12
Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to biallelic Population); Evolutionary forces upsetting H-W equilibrium; Natural selection (concept of fitness, types of selection, selection coefficient, mode of selection heterozygous superiority).		
Genetic Drift mechanism (founder's effect, bottleneck phenomenon)		
Role of Migration and Mutation in changing allele frequencies.		
Unit 6		6
Species concept, Isolating mechanisms, modes of speciation		
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 Biostatistics	9
Central tendencies, Measures of dispersion (Variance, Standard deviation, Standard error) Correlation and regression, T test	
Reference Books	
▶ Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin, Cummings.	
▶ Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.	
▶ iGeneics: A Molecular Approach. 3 rd edition. Peter. J. Russell.	
▶ Robert R. Sokal , F. James Rohlf. 2009. Introduction to Biostatistics: Second Edition. Dover Publications Inc	
▶ Pranab kumar Banerjee. 2011. Introduction to Biostatistics (A Test Book of Biometry). S. Chand & Company Ltd.	
▶ K. S. Negi. 2002. Biostatistics. AITBS publishers, New Delhi.	

68. CC 14–Evolutionary Biology and Biostatistics (Lab)

Evolutionary Biology	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Study of vertebrate fossils from models/ pictures (upto class) 2. Study of homology and analogy from suitable specimens /Photographs/ models 3. Study and verification of Hardy-Weinberg Law by chi square analysis 4. Graphical representation and interpretation (correlation and regression) of data of height/ weight of a sample of 100 humans in relation to their age and sex, 	

69. DSE Paper 3 (Group A)- Microbiology (THEORY)

Microbiology		
	6 Credits	Class
Unit 1: Introduction to Microbiology		4
Historical perspective of Microbiology, Prokaryotic pathogens, Eukaryotic pathogens		
Unit 2: Bacterial taxonomy		4
Principles and modern approaches of bacterial taxonomy. Basic idea about Hackel and Whittaker's kingdom concept and domain concept of Carl Woese		
Unit 3: Morphology of Bacteria and Virus		14
Cell wall (Structure of peptidoglycan), Cell envelope (Cell membrane, Differences between gram-positive and gram-negative species, External capsule and glycocalyx, Plasmids and episomes. Nuclear material, Bacterial Chromosome (Fundamental differences with eukaryotic chromosome). Reserve materials (carbon and phosphate reserve, cyanophycin), Cytoplasmic inclusions (Chlorosome, magnetosome, carboxysome, gas vesicles, ribosome). Structural organization of viruses, Prions and viroids		
Unit 4: Normal flora		4
Distribution of normal flora in the body: Skin, eye, mouth, intestinal tract, urino-genital tract, Beneficial functions of normal flora. Harmful effects of normal flora		
Unit 5: Pathogenicity of Microorganisms		10
Bacterial pathogenesis: Entry to the host, Adherence to host cells, Invasiveness, Bacterial toxins : Exotoxins, Endotoxins, Antigenic switching. Viral Pathogenesis: Cellular level (Cell death, Transformation, Cell fusion, Cytopathic effect). Initial infections: Routes of entry and dissemination to secondary sites, Typical secondary sites of localization, Virus shedding and mode of transmission; Factors involved in termination of acute infection		
Unit 6: Infection of pathogens to human populations		2
Communicable, Non-communicable, Endemic, Epidemic, Pandemic and Sporadic		

Unit 7: Diagnostic Microbiology and Bacteria culture	4
Koch's postulates, Sensitivity and specificity of test results, Principles and applications: Simple staining, Gram-staining, Acid-fast staining, Collection of specimens, Growth requirements and Growth factors, Oxygen requirement. Culture Media: Simple media, Complex media, Selective media and Enriched media	
Unit 8: Genetic recombination in bacteria	4
Transformation, Conjugation- F+, F-, Hfr & F' strain, Transduction, Generalised & specialized types.	
Unit 9: Microbial Diseases	4
Name of pathogen, symptoms, pathogenesis, mode of action & preventive measures of following diseases: Bacterial (Polio, Typhoid, Staphylococcal Food Poisoning) , Viral (Dengue, AIDS)	
Reference Books	
<ul style="list-style-type: none"> ▶ Alexander, M. (1977). Introduction to Soil Microbiology. John Wiley and Sons, New York. ▶ Atlas, R. M. and Bartha, R. (1997). Microbial Ecology: Fundamentals and Applications, 4th ed. ▶ Benjamin/ Cummings. Black, J. G. (2011). Microbiology: Principles and Explorations. 8th ed. John Wiley and Sons, New York. ▶ Campbell, R. (1983). Microbial Ecology. 2nd ed. Oxford, Blackwell. ▶ Pinehuk, G. (2003). Schaum's outline Series: Theory and Problems of Immunology. McGrawHill. ▶ Presscott, L. M., Harley, J. P. and Klein, D. A. (2011). Microbiology, 8th ed. McGrawHill, New York. ▶ Schlegel, H. G. (1993). General Microbiology. 7th ed. Cambridge University Press. ▶ Slonczeweski, J.L. and Foster, J.W. (2009). Microbiology- An Evolving Science. Norton. ▶ Stanier, R. Y., Adelberg, E. A. and Ingraham, J. L. (1986). General Microbiology. 5th ed. Macmillan. ▶ Talaro, K. and Talaro, A. (1999). Foundations in Microbiology. 3rd ed. Dubuque, McGraw Hill. ▶ Tortora, G. J., Funke, B. R., and Case. C. L. (2008). Microbiology. An Introduction. 9th ed. Benjamin/Cummings Publishing. Menlo Park Calif. ▶ Voyleys, B. A. (2002). The biology of viruses, 2nd ed. McGraw-Hill. 	

70. DSE Paper 3 (Group A)- Microbiology (Lab)

Microbiology	
	Credits
List of Practical	
<ol style="list-style-type: none">1. Simple staining and Gram's staining of bacteria.2. Preparation of liquid media (broth) and solid media for routine cultivation of bacteria.3. Preparation of slant and stab.4. Pure culture techniques: Spread plate, Pour plate and Streak plate5. Biochemical test for characterization: Catalase, Nitrate-reduction, Indole production, Methyl Red and Voges-Proskauer Test.6. Microbiological examination of milk (Methylene blue reductase test).7. Sugar fermentation test.	

71. DSE Paper 3 (Group B)- Parasitology

Parasitology		
	4 Credits	Class
Unit 1: Introduction to Parasitology		
		2
Brief introduction of Parasitism, Parasite, Parasitoid carriers and Vectors (mechanical and biological vector) Host parasite relationship		
Unit 2: Parasitic Protists		
		12
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of <i>Giardia intestinalis</i> , <i>Trypanosoma gambiense</i> , <i>Leishmania donovani</i>		
Unit 3: Parasitic Platyhelminthes		
		12
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of <i>Schistosoma haematobium</i> , <i>Taenia sajinata</i>		
Unit 4: Parasitic Nematodes		
		12
Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of <i>Ascaris lumbricoides</i> , <i>Ancylostoma duodenale</i> , <i>Wuchereria bancrofti</i> and <i>Trichinella spiralis</i> , <i>Brugia malayi</i>		
Unit 5: Parasitic Arthropods		
		10
Biology, importance and control of ticks (Soft tick <i>Ornithodoros</i> , Hard tick <i>Ixodes</i>), mites (<i>Sarcoptes</i>), Lice (<i>Pediculus</i>), Flea (<i>Xenopsylla</i>) and Bug (<i>Cimex</i>)		
Unit 5: Parasite Vertebrates		
		2
Brief account of Cookicutter Shark, Hood Mocking bird, Vampire bat		
Reference Books		
<ul style="list-style-type: none"> ▶ Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors ▶ E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea & Febiger 		

- ▶ Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) *Biology of Disease*. Taylor and Francis Group
- ▶ Parija, S. C. *Textbook of medical parasitology, protozoology & helminthology (Text and colour Atlas)*, II Edition, All India Publishers & Distributors, Medical Books Publishers, Chennai, Delhi
- ▶ Rattan Lal Ichhpujani and Rajesh Bhatia. *Medical Parasitology*, III Edition, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi
- ▶ Meyer, Olsen & Schmidt's *Essentials of Parasitology*, Murray, D. Dailey, W.C. Brown Publishers
- ▶ K. D. Chatterjee (2009). *Parasitology: Protozoology and Helminthology*. XIII Edition, CBS Publishers & Distributors (P) Ltd.

72. DSE Paper 3 (Group B)- Parasitology Lab

Parasitology

2 Credits

List of Practicals

1. Identification of any stage of *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani* through permanent slides/micro photographs
2. Identification of adult and any stage of *Schistosoma haematobium*, *Taenia sajinata* through permanent slides/micro photographs
3. Identification of adult and any stage of *Ancylostoma duodenale*, *Brugia malayi* and *Trichinella spiralis* through permanent slides/micro photographs
4. Identification of *Pediculus humanus*, *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides/ photographs
6. Study of monogenea from the gills of fresh water fish [Gills can be procured from fish market as by-product of the industry/ Study of gut parasite of cockroach
7. Study of nematode/cestode parasites from the intestines of Poultry bird [Intestine can be procured from poultry/market as a by-product]

(OUT OF TWO GROUPS OF DSE PAPER 3 STUDENTS HAVE TO SELECT ANY ONE GROUP)

73. DSE Paper 4 (Group A)-Animal Biotechnology (THEORY)

Animal Biotechnology		
	4 Credits	Class
Unit 1: Introduction		5
Organization of prokaryotic and eukaryotic genome, Concept of genomics		
Unit 2: Molecular Techniques in Gene manipulation		23
Cloning vectors: Plasmids, Cosmids, Phagemids, Lambda Bacteriophage, M13, BAC, YAC, MAC and Expression vectors (characteristics). Restriction enzymes: Nomenclature, detailed study of Type II. Transformation techniques: Calcium chloride method and electroporation. Construction of genomic and cDNA libraries and screening by colony and plaque hybridization		
Southern, Northern and Western blotting		
DNA sequencing: Sanger method		
Polymerase Chain Reaction, DNA Finger Printing and DNA micro array		
Unit 3: Genetically Modified Organisms		12
Production of cloned and transgenic animals: Nuclear Transplantation, Retroviral Method, DNA microinjection.		
Applications of transgenic animals: Production of pharmaceuticals, production of donor organs, knock out mice.		
Unit 4: Culture Techniques and Applications		10
Animal cell culture, Expressing cloned genes in mammalian cells, Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia)		
Reference Books		
▶ Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis. II Edition, Academic Press, California, USA.		
▶ Glick, B.R. and Pasternak, J.J. (2009). Molecular Biotechnology - Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA.		
▶ Weaver. Molecular Biology of Gene. 5th edition.		
▶ Primrose & Twyman. Principles of Gene Manipulation and Genomics. 7th edition.		

74. DSE Paper 4 (Group A)- –Animal Biotechnology (Lab)

Animal Biotechnology

2 Credits

List of Practical

1. Genomic DNA isolation from *E. coli* (method)
2. Plasmid DNA isolation (pUC 18/19) from *E. coli* (Boiling miniprep method)
3. Restriction digestion of plasmid DNA/ lambda DNA by *EcoRI/ HindIII*, electrophoresis and observation
4. Construction of circular and linear restriction map from the data provided.
5. Calculation of transformation efficiency from the data provided.
6. To study following techniques through photographs
 - a. Southern Blotting
 - b. Northern Blotting
 - c. Western Blotting
 - d. DNA Sequencing (Sanger's Method)
 - e. PCR
 - f. DNA fingerprinting
7. Project report on animal cell culture

75. DSE Paper 4 (Group B)- - Fish and Fisheries (THEORY)

Fish and Fisheries		
	4 Credits	Class
Unit 1: Introduction and Classification		4
General description of fish Feeding habit, habitat and manner of reproduction Classification of fish (up to Subclasses)		
Unit 2: Morphology and Physiology		14
Types of fins and their modifications; Locomotion in fish; 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 fish); Electric organ, Bioluminescence		
Unit 3: Fisheries		10
Inland Fisheries; Marine Fisheries; Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal; Fishing crafts and Gears; Depletion of fisheries resources; Application of remote sensing and GIS in fisheries; Fisheries law and regulations		
Unit 4: Aquaculture		16
Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Management of finfish hatcheries; Preparation and maintenance of fish aquarium; Preparation of compound diets for fish; Role of water quality in aquaculture; Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products		
Unit 5: Fish in research		6
Transgenic fish Zebrafish as a model organism in research		
Reference Books		
▶ 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

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

76. DSE Paper 4 (Group B)--Fish and Fisheries (Lab)

Fish and Fisheries

2 Credits

List of Practical

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

77. DSE Paper 4 (Group C)- Biology of Insects (THEORY)

Biology of Insects		
	4 Credits	Class
Unit 1: Introduction		2
General Features of Insects Distribution and Success of Insects on the Earth		
Unit 2: Insect Taxonomy		4
Basis of insect classification; Classification of insects up to orders (according to Brusca and Brusca, 2016)		
Unit 3: General Morphology of Insects		6
External Features; Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits Thorax: Wings and wing articulation, Types of Legs adapted to diverse habitat Abdominal appendages and genitalia		
Unit 4: Physiology of Insects		20
Structure and physiology of Insect body systems - Integumentary, digestive, excretory, circulatory, respiratory, endocrine, reproductive, and nervous system Photoreceptors: Types, Structure and Function Metamorphosis: Types and Neuroendocrine control of metamorphosis		
Unit 5: Insect Society		6
Social insects with special reference to termites Trophallaxis in social insects such as ants, termites and bees		
Unit 6: Insect Plant Interaction		4
Theory of co-evolution, role of allelochemicals in host plant mediation Host-plant selection by phytophagous insects, Major insect pests in paddy		

Unit 7: Insects as Vectors	8
Insects as mechanical and biological vectors, Brief discussion on houseflies and mosquitoes as important vectors	
Reference Books	
<ul style="list-style-type: none"> ▶ A general text book of entomology, Imms , A. D., Chapman & Hall, UK ▶ The Insects: Structure and function, Chapman, R. F., Cambridge University Press, UK ▶ Principles of Insect Morphology, Snodgrass, R. E., Cornell Univ. Press, USA ▶ Introduction to the study of insects, Borror, D. J., Triplehorn, C. A., and Johnson, N. F., M Saunders College Publication, USA ▶ The Insect Societies, Wilson, E. O., Harward Univ. Press, UK ▶ Host Selection by Phytophagous insects, Bernays, E. A., and Chapman, R. F., Chapman and Hall, New York, USA ▶ Physiological system in Insects, Klowden, M. J., Academic Press, USA ▶ The Insects, An outline of Entomology, Gullan, P. J. , and Cranston, P. S., Wiley Blackwell, UK ▶ Insect Physiology and Biochemistry, Nation, J. L., CRC Press, USA ▶ Mosquito, Chandra G (2000), Sribhumi Pub. Co. ▶ Medical Entomology, Hati A. K., Allied Book Agency, 2010 	

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

78. DSE Paper 4 (Group C)--Biology of Insects (Lab)

Biology of Insecta	
	2 Credits
List of Practical	
<ol style="list-style-type: none"> 1. Study of life cycle of Mosquito/ Silk moth 2. Study of different kinds of antennae, legs and mouth parts of insects 3. Mounting of insect wings, spiracles and genitalia of any insects 4. Methodology of collection, preservation and identification of insects. 5. Morphological studies of various castes of <i>Apis</i>, <i>Camponotus</i> <i>Odontotermes</i> 6. Study of major insect pests of paddy/tea and their damages 	
(OUT OF THREE GROUPS OF DSE PAPER 4 STUDENTS HAVE TO SELECT ANY ONE GROUP)	