UNIVERSITY OF CALCUTTA

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To
The Principals/T.I.C.
of all the Undergraduate Colleges
offering B.Sc. (Honours and General) in Zoology
affiliated to the University of Calcutta

Sir/Madam,

The undersigned is to inform you that the proposed **revised semesterised draft Syllabus for Zoology (Honours and General)** Courses of Studies under **CBCS has been uploaded in the Calcutta University website (www.caluniv.ac.in).**

The said syllabus has been prepared by the **U.G. Board of Studies in Zoology, C.U.**, suppose to be implemented from the academic session 2018-2019

You are requested kindly to go through it and send your feedback within 31st December, 2017.

In this regard you may send your observation/ suggestion to the **Department of U.G. Councils, C.U.** or through email (u.g.councilsc.u@gmail.com), and you also may contact **Prof. Goutam Kr. Saha,** Department of Zoology through e-mail **(gkszoo@gmail.com).**

Your cooperation in this regard will be highly appreciated. Kindly treat the matter as urgent.

Thanking you,

Yours faithfully,

05.12.17.

(Milan Kr. Pal)
O.S.D., C.U.

Dr. Milan Kumar Pal
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DRAFT

UNIVERSITY OF CALCUTTA

ZOOLOGY SYLLABUS FOR B. Sc. (HONOURS & GENERAL)

Under

CBCS SYSTEM

(Approved by Board of Studies, University of Calcutta)

CBCS ZOOLOGY SYLLABUS FOR B. Sc. (Honours), CU

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 (CREDIT DISTRIBUTION ACROSS COURSES)

Course Type	Number of Courses	Credits		
		Theory	Practical	Theory + Practical
Core Courses	14	14×4 = 56	14×2 = 28	84
Discipline Specific Electives	4	4×4 = 16	4×2 = 8	24
Generic Electives	4	4×4 = 16	4×2 = 8	24
Ability Enhancement Language Courses	2	2×2 = 4		4
Skill Enhancement Courses	2	2×2 = 4		4
Totals	26	96	44	140

3. SCHEME FOR CBCS CURRICULUM (Courses at a glance under semester)

3 A. COMPULSORY CORE COURSES

Compulsory Core Courses			
Non-chordates I	Ecology	Non-chordates II	Cell Biology
Chordates	Physiology: Controlling and Coordinating Systems	Fundamentals of Biochemistry	Comparative Anatomy of Vertebrates
Physiology: Life Sustaining Systems	Immunology	Molecular Biology	Genetics
Developmental Biology	Evolutionary Biology		

3 B. CHOICES FOR DISCIPLINE SPECIFIC ELECTIVES

Discipline Specific Elective – 4	
1. Fish and Fisheries	2. Animal Behaviour & Chronobiology
3. Endocrinology	4. Parasitology

3 C. CHOICES FOR SKILL ENHANCEMENT COURSES

Skill Enhancement Course – 2	
1. Apiculture	2. Sericulture

3 D. CHOICES FOR GENERIC ELECTIVE COURSES

Generic Elective Courses –4	
1. Animal Diversity	2. Human Physiology
3. Food, Nutrition and Health	4. Insect Vectors and Diseases

SEMESTERWISE DISTRIBUTION OF COURSES

Semester	Course Name	Course Detail	Credit	Page No.
PART-I :: SEMESTER-I	Ability Enhancement	English communication	2	
	Compulsory Course – I	Environmental Science	2	
	Core course – I Theory	Non-chordates I (CT1)	4	7
	Core course–I Practical	Non-chordates I Lab (CP1)	2	8
	Core course – II Theory	Ecology (CT2)	4	8
	Core course–II Practical	Ecology Lab (CP2)	2	9
	Generic Elective – 1 Theory	Animal Diversity (GET1)	4	10
	Generic Elective – 1 Practical	Animal Diversity (GEP1)	2	11
PART-I :: SEMESTER-II	Ability Enhancement	English communication	2	
	Compulsory Course – II	Environmental Science	2	
	Core course – III Theory	Non-chordates II (CT3)	4	12
	Core course – III Practical	Non-chordates II Lab (CP3)	2	13
	Core course – IV Theory	Cell Biology (CT4)	4	13
	Core course – IV Practical	Cell Biology Lab (CP4)	2	15
	Generic Elective – 2 Theory	Human Physiology (GET2)	4	15
	Generic Elective – 2 Practical	Human Physiology (GEP2)	2	16
PART-II :: SEMESTER-III	Core course – V Theory	Chordates (CT5)	4	16
	Core course – V Practical	Chordates Lab (CP5)	2	17
	Core course – VI Theory	Animal Physiology: Controlling and Coordinating Systems (CT6)	4	18
	Core course – VI Practical	Animal Physiology: Controlling and Coordinating Systems Lab (CP6)	2	19
	Core course – VII Theory	Fundamentals of Biochemistry (CT7)	4	19
	Core course – VII Practical	Fundamentals of Biochemistry Lab (CP7)	2	20
	Skill Enhancement Course – 1 Theory	Apiculture (SET1)	4	20
	Generic Elective – 3 Theory	Food, Nutrition & Health (GET3)	4	21
	Generic Elective – 3 Practical	Food, Nutrition & Health (GEP3)	2	22

PART I: SEMESTER I

ABILITY ENHANCEMENT COMPULSORY COURSE I: ENGLISH COMMUNICATION

CORE THEORY 1 (CT1) **NON-CHORDATES I**

4 CREDITS; CLASS 50; MARKS 50
(Number of classes for each Unit is given at the side)

Unit 1: Basics of Animal Classification 4

Definitions: Classification, Systematics and Taxonomy; Taxonomic Hierarchy, Taxonomic types; Codes of Zoological Nomenclature; Principle of priority; Synonymy and Homonymy; Five kingdom concept of classification (Whittaker scheme)

Unit 2: Protista and Metazoa 15

(a) **Protozoa**

General characteristics and Classification up to phylum (according to Levine *et. al.,* 1981); Locomotion in *Euglena*, *Paramoecium* and *Amoeba*; Conjugation in *Paramoecium*; Life cycle and pathogenicity of *Plasmodium vivax* and *Entamoeba histolytica*

(b) **Metazoa**

Evolution of symmetry and segmentation of Metazoa

Unit 3: Porifera 6

General characteristics and Classification up to classes (Rupert and Barnes, 1994, 6th Ed.); Canal system and spicules in sponges

Unit 4: Cnidaria 10

General characteristics and Classification up to classes (Rupert and Barnes, 1994, 6th Ed.); Metagenesis in *Obelia* & *Aurelia;* Polymorphism in Cnidaria; Corals and coral reef diversity, function & conservation

Unit 5: Ctenophora 2

General characteristics

Unit 6: Platyhelminthes 6

General characteristics and Classification up to classes (Rupert and Barnes, 1994, 6th Ed.); Life cycle, pathogenicity and control measures of *Fasciola hepatica* and *Taenia solium*

Unit 7: Nematoda 7

General characteristics and Classification up to classes (Rupert and Barnes, 1994, 6th Ed.); Life cycle, and pathogenicity and control measures of *Ascaris lumbricoides* and *Wuchereria bancrofti;* Parasitic adaptations in helminthes

Examination Pattern

Time: 2 Hour **Full Marks: 50**

(40 theory + 10 internal assessments)

Questions are to be set covering the entire syllabus; 4 questions (out of six) of 2 marks each [4×2=8], four questions (out of six) of 4 marks each [4×4=16], and two questions (out of four) of 8 marks each [2×8=16], are to be answered

Reference Books

- Anderson D T. (Ed.) - Invertebrate Zoology. 2nd Ed. (Oxford University Press)
- Barnes R. S. K. - The Diversity of Living Organisms; Blackwell Science
- Barrington E. J. W. - Invertebrate structure and function; ELBS Nelson
- Blackwelder R E. - Taxonomy- A text and reference book. (John Wiley & Sons)
- Brusca R. C. & G. J. Brusca Invertebrate; Sinauer Asoc. Inc.
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology (Vol. 1), NCBA, Kolkata
- Hyman L H. - The Invertebrates (Vol-I). (Mc. Graw Hill)
- IMM's General Text Book of Entomology – (Chapman & Hall)
- Kapoor V C. - Theory and practice of animal taxonomy. 6th Ed. (Oxford & IBH Pub)
- Kotpal R. L. – Modern Text Book of Invertebrates; Rastogi
- Mayr E & Ashlock P D. - Principles of Systematic Zoology. 2nd Ed. (McGraw-Hill)
- Mayr E. Principle of Systematic Zoology (TATA McGraw Hill)

- Meglisch P. A. and F. R. Schram - Invertebrate Zoology; Oxford Univ Pr.
- Moore J. - An introduction to the Invertebrates; Cambridge Univ. Pr.
- Nigam H.C. - Biology of non-chordates; Vishal Pub.
- Parker & Haswell (Eds. Marshall & Williams) - Text Book of Zoology, Vol I. (ELBS Macmillan)
- Pechenik J A. - Biology of the Invertebrates, 4th Ed. (McGraw Hill)
- Rupert E E, Barnes R D. 2006. Invertebrate Zoology, VIII Ed. (Harcourt Asia)
- Ruppert E E, Fox R, Barnes R D. 2003. Invertebrate Zoology: a Functional Evolutionary Approach. (Brooks Cole)
- Ruppert E. E. and R. D. Barnes Invertebrate Zoology; Harcourt Asia
- Simpson G. G. - Principles of Animal Taxonomy (Oxford IBH)
- Sinha A K, Adhikari S, Ganguly B B. - Biology of Animals. Vol. I. (New Central Book Agency)
- Villee, C. A., W. F. Walker and R. D. Barnes - General Zoology; Saunders College Pub.
- Wilmer P. - Invertebrate inter relationship; Cambridge Univ. Pr.
- Wood R. - Reef evolution; Oxford Univ. Pr.

CORE PRACTICAL 1 (CP1) NON-CHORDATES I 2 CREDITS

List of Practical

1. Study of whole mount of *Euglena*, *Amoeba* and *Paramoecium*
2. Identification with reason and systematic position of *Amoeba*, *Euglena*, *Paramecium*, *Plasmodium vivax* (from the prepared slides)
3. Identification with reason and systematic position of *Sycon*, Neptune's Cup, *Obelia*, *Physalia*, *Aurelia*, *Gorgonia*, *Metridium*, *Pennatula*, *Madrepora*
4. Identification with reason and systematic position and parasitic significance of adult *Fasciola hepatica*, *Taenia solium* and *Ascaris lumbricoides*
5. Staining, mounting and identification of any biota from the gut of cockroach

(Systematic position will be strictly followed as mentioned in theory syllabus)

Question Pattern

Time: 2½ Hour **Full Marks: 25**

Staining and Mounting/Whole Mount (Item No.1) = 10
Spot identification (2 from Item 2, 2 from item 3) (4 X1½) = 06
Spot identification with significance (1 from item 4) = 02
Laboratory Note Book = 02
Internal Assessment = 05

Suggested Reading

- Chatterjee A K, Chakraborty C. – Practical Zoology. (Nirmala Library)
- Ghosh K C, Manna B. – Practical Zoology (New Central Book Agency)
- Sinha J K, Chatterjee A K. and Chattopadhyay P. – Advanced Practical Zoology (New Central Book Agency)

PART I: SEMESTER I

CORE THEORY 2 (CT2) **ECOLOGY**

4 CREDITS; CLASS 50; MARKS 50
(Number of classes for each Unit is given at the side)

Unit 1: Introduction to Ecology 4

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of Physical factors, The Biosphere.

Unit 2: Population 20

Unitary and Modular populations; Unique and group attributes of population: Demographic factors, life tables, fecundity tables, survivorship curves, dispersal and dispersion; Geometric, exponential and logistic growth, equation and patterns, r and K strategies; Population regulation -

density-dependent and independent factors; Population Interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition.

Unit 3: Community 11

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

Unit 4: Ecosystem 10

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; Nutrient and biogeochemical cycle with an example of Nitrogen cycle; Human modified ecosystem

Unit 5: Applied Ecology 5

Wildlife Conservation (*in-situ* and *ex-situ* conservation)

Examination Pattern

Time: 2 Hour **Full Marks: 50**

(40 theory + 10 internal assessments)

Questions are to be set covering the entire syllabus; 4 questions (out of six) of 2 marks each [4×2=8], four questions (out of six) of 4 marks each [4×4=16], and two questions (out of four) of 8 marks each [2×8=16], are to be answered

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Reference Books

- Atlas R. M. and R. Bartha – Microbial Ecology : Fundamentals and Applications
- Begon M, Harper J L, Townsend CR. 2006. Ecology: Individuals, Populations & communities. 4th Ed. Blackwell sc.
- Cain M L, Bowman W D and Hacker S D. 2013. Ecology. 3rd edition. Sinauer associates.
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology (Vol. 2), NCBA, Kolkata
- Chapman J. L. & M. J. Reiss Ecology: Principles and Applications; Cambridge Univ. Pr.
- Chapman RL, Reiss MJ. 2000. Ecology - Principles & Application. Cambridge University Press.
- Colinvaux P. 1993. Ecology 2. John Wiley & Sons, Inc. New York.
- Faurie C, Ferra C, Medori P, Devaux J. 2001. Ecology-Science and Practice. Oxford & IBH Pub. Company.
- Faurie, C.; C. Ferra, P. Medori & J. Devaux Ecology: Science and Practice –Oxford IBH
- Freedman B. 1989. Environmental Ecology. Academic press, Inc.
- Ghosh, A., S. P. Agarwala & B. Sau Loss of biodiversity and its ethical implications – Sadesh
- Hunter, M. L., J. James & P. Gibbs – Fundamentals of Conservation Biology – John Willey & Sons
- Kormondy EJ. 2002. Concepts of Ecology. 4th Indian Reprint, Pearson Education.
- Krebs CJ. 2001. Ecology. VI Edition. Benjamin Cummings.
- Krebs CJ. 2016. Ecology: The Experimental Analysis of Distribution and Abundance. Pearson India Education Limited.
- Krebs J. R. & N. B. Davies – An introduction to Behavioural Ecology – Blackwell Scientific
- Mackenzie, A, A. S. Ball & S. R. Virdee – Ecology – (Viva)
- Majupuria T. C. – Wildlife of India – Techpress, Bangkok
- Miller G. T. – Environmental Science – Brookes Kole
- Miller T, Spoolma SE. 2013. Environmental Science. Delhi: Cengage learning India Private limited.
- Molles Jr. MC. 2005. Ecology: Concepts and Applications. 3rd Ed. McGraw- Hill.
- Mukherjee A. K. – Endangered animals of India – Z.S.I
- New T. R. – Invertebrate Surveys for Conservation – Oxford Univ. Pr.
- Odum EP, Barret GW. 2017. Fundamentals of Ecology. 15th Indian reprint. Cengage learning India Private limited.
- Odum EP. 2008. Fundamentals of Ecology. Indian Edition. Brooks/Cole
- Park – Environmental Biology
- Rastogi V. B. & M. S. Jayaraj Animal Ecology and distribution of animals – KNRN, N Delhi
- Ricklefs RE, Miller, GL. 2000. Ecology. 4th Ed. W. H. Freeman & Company.
- Russel PJ, Wolfe LS, Hertz PE, Starr C, McMillan B. 2008. Ecology.

- Saha G. K. – Wetland: Crisis and options; (Astral)
- Saha G. K. & S. Majumdar – Threatened Mammals of India – Daya Publication House
- Saha G. K. & S. Majumder – An introduction to Wildlife Biology: Indian perspective – PHI
- Saharia VB. 1998. Wildlife in India. Natraj Publishers.
- Smith TM, Smith R L. 2006. Elements of Ecology. 6th Ed. Pearson Education.
- Stiling P. 2009. Ecology- Theories and Applications. 4th Ed. Prentice Hall of India.
- Townsand, C.; J. L. Harper, M. Bagon – Essentials of Ecology
- Van Dyke F. 2008. Conservation Biology: Foundations, Concepts, Application. 2nd Ed. Springer Science
- Walker, C. H., S. P. Hopkin, R. M. Sibley & D. B. Peakall Principles of Ecotoxicology; Taylor & Francis
- Wild life (Protection) Act 1972 – Wild life Society of India (Nataraj Publication)
- Wilson, E. O. – Biodiversity – National Academic Press

CORE PRACTICAL 2 (CP2) ECOLOGY LAB 2 CREDITS

List of Practical

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 quadrate method
3. Manual calculation (with the help of scientific calculator only) of various indices with the knowledge of derivation (Simpson index, Morisita index, Shannon-Weiner diversity index for the same community)
4. Study of an aquatic ecosystem: Study of phytoplankton and zooplankton, Measurement of salinity, determination of pH, and Dissolved Oxygen content (Winkler's method), Chemical Oxygen Demand and free CO_2.
5. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary/any place of ecological interest/ecological uniqueness/Zoological Garden etc.

Question Pattern

Time: 2½ Hour **Full Marks: 25**

1 question From Item 1/2/3 (5 × 1) = 05
1 question from item 4 (5 × 1) = 05
Excursion/Field Report = 08
Laboratory Note Book = 02
Internal Assessment = 05

PART I: SEMESTER I

GENERIC ELECTIVE THEORY 1 (GET1) **ANIMAL DIVERSITY**

4 CREDITS; CLASS 50; MARKS 50

(Number of classes for each Unit is given at the side)

Unit 1: Protista 3
Protozoa: General characters of Protozoa; Life cycle of *Plasmodium*

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 Helminthes

Unit 5: Pseudocoelomates 3
General characters of Nematoda Parasitic adaptations

Unit 6: Annelida 3
General characters of Annelida Metamerism

Unit 7: Arthropoda 4
General characters Social life in insects

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 Osmoregulation, Migration of Fish
Unit 12: Amphibia 4
General characters, Adaptations for terrestrial life, Parental care
Unit 13: Reptilia 4
General Characters; Amniotes; Origin of reptiles. Terrestrial adaptations in reptiles
Unit 14: Aves 4
General Characters; The origin of birds; Flight adaptations
Unit 15: Mammalia 4
General Characters; Early evolution of mammals; Primates; Dentition in mammals

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

(40 theory + 10 internal assessments)

Questions are to be set covering the entire syllabus; 4 questions (out of six) of 2 marks each [4×2=8], four questions (out of six) of 4 marks each [4×4=16], and two questions (out of four) of 8 marks each [2×8=16], are to be answered

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Reference Books

- Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub.
- Bhattacharyya, B. N. – An introduction to Ornithology & biology of the blue rock pigeon; NCBA
- Campbell & Reece (2005). Biology, Pearson Education Pvt. Ltd.
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology (Vol. 1&2), NCBA, Kolkata
- Duellman, W.E. & L. Trueb – Biology of Amphibians; McGraw Hill
- Hildebrand M. & G. Goslow Analysis of Vertebrate Structure, Wiley
- Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill
- Kent G.C. & L. Miller – Comparative Anatomy of Vertebrates, WCB Pub
- Kotpal, R. L. – Modern Text Book of Vertebrates; Rastogi
- Mondal, F. B. – Vertebrate Zoology; Oxford IBH
- Parker & Haswell (Ed. Marshall) - Text book of Zoology, Volume II, Vertebrates, ELBS Macmillan
- Pough F. H. & W. N. McFarland – Vertebrate life, Prentice Hall
- Raven, P. H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill
- Romer A. S. & T. S. Parsons – The Vertebrate body, Saunders
- Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole
- Walter H. E. & L. P. – Sayles Biology of Vertebrates; Macmillan
- Weichert C. K. & W. Presch Elements of Chordate Anatomy; TATA McGraw Hill
- Yong J. Z. – The Life of Vertebrates, ELBS Oxford

GENERIC ELECTIVE PRACTICAL 1 (GEP1) **ANIMAL DIVERSITY LAB** **2 CREDITS**

List of Practical

1. Identification of following specimens:
    - **a.** Non Chordates: *Noctiluca*, *Nereis*, *Aphrodite*, Leech, *Limulus*, Hermitcrab, *Daphnia*, Millipede, Centipede, Beetle, *Chiton*, *Octopus*, *Asterias*
    - **b.** Chordates: *Balanoglossus*, *Amphioxus*, *Petromyzon*, *Pristis*, *Hippocampus*, *Icthyophis*, Salamander, *Rhacophorus, Draco*, *Uromastix*, *Naja*, *Viper*, Crow, sparrow, Owl

2. Study of following Permanent Slides: T. S. of Earthworm passing through pharynx, gizzard, and typhlosolar intestine
3. Temporary mounts of:
    a. Mouth parts of cockroach
    b. Unstained mounts of placoid, cycloid and ctenoid scales
4. Dissections
    a. Digestive and nervous system of Cockroach
    b. Digestive and urinogenital system of Tilapia

Question Pattern

Time: 2½ Hour **Full Marks: 25**

One question from Item No. 4 {display 2, drawing and labelling 2+2} = 06
One question from Item No. 3 (display) = 02
Spot identification 2 specimens each from Item 1a and 1b; 1 slide from Item 2 (5 X 2) = 10
Laboratory Note Book = 02
Internal Assessment = 05

(Systematic position will be strictly followed as mentioned in Core theory syllabus)

PART I SEMESTER II

ABILITY ENHANCEMENT COMPULSORY COURSE II: ENVIRONMENTAL SCIENCE

PART I SEMESTER II

CORE THEORY 3 (CT3) **NON-CHORDATE**

4 CREDITS; CLASS 50; MARKS 50

(Number of classes for each Unit is given at the side)

Unit 1: Introduction 2
Evolution of coelom and metamerism

Unit 2: Annelida 10
General characteristics and Classification up to classes (Rupert and Barnes, 1994, 6th edition); Excretion in Annelida through nephridia; Metamerism in Annelida

Unit 3: Arthropoda 16
General characteristics and Classification up to classes (Rupert and Barnes, 1994, 6th edition); Vision in Cockroach and wasp; Respiration in prawn and cockroach; Metamorphosis in Lepidopteran Insects; Social life in termite

Unit 4: Onychophora 2
General characteristics and Evolutionary significance

Unit 5: Mollusca 10
General characteristics and Classification up to classes (Rupert and Barnes, 1994, 6th edition); Nervous system and torsion in Gastropoda; Feeding and respiration in *Pila*

Unit 6: Echinodermata 8
General characteristics and Classification up to classes (Rupert and Barnes, 1994, 6th edition); Water-vascular system in starfish; Larval forms in Echinodermata; Affinities with Chordate

Unit 7: Hemichordata 2
General characteristics of phylum Hemichordata (Rupert and Barnes, 1994, 6th edition); Relationship with non-chordates and chordates

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

(40 theory + 10 internal assessments)

Questions are to be set covering the entire syllabus; 4 questions (out of six) of 2 marks each [4×2=8], four questions (out of six) of 4 marks each [4×4=16], and two questions (out of four) of 8 marks each [2×8=16], are to be answered

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Reference Books

- Anderson DT (Ed.) 2001. Invertebrate Zoology. 2nd Ed. Oxford University Press.
- Barrington EJW. 1981. Invertebrate Structure and function. 2nd Ed. ELBS & Nelson.
- Blackwelder RE. 1967. Taxonomy- A text and reference book. John Wiley & Sons.
- Brusca RC , Brusca GJ. 2002. Invertebrates. 4th Ed. Sinauer Associates...
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology (Vol. 1), NCBA, Kolkata
- Hyman LH. 1951. The Invertebrates (Vol-I). Mc.Graw Hill Book Company.
- Jordan EL,Verma PS. 2006. Invertebrate Zoology. S. Chand & Com. New Delhi.
- Kapoor VC. 2008. Theory and practice of animal taxonomy. 6th Ed. Oxford & IBH Pub
- Kotpal RL. 1988 – 1992. Protozoa, Porifera, Coelentereta, Annelida, Arthropoda, Mollusca, Echinodermata, –
- Mayr E ,Ashlock PD. 1991. Principles of Systematic Zoology. 2nd Ed., McGraw-Hill.
- Meglitsch PA, Schram FR. 1991. Invertebrate Zoology. Oxford University Press.
- Parker TJ, Haswell W. 1972. Text Book of Zoology, Volume I. Macmillan Press, London.
- Pechenik JA. 1998. Biology of the Invertebrates, 4th Ed. McGraw Hill..
- Ruppert , Barnes RD. 2006. Invertebrate Zoology, VIII Ed. Saunders Int. Ed.
- Ruppert EE, Fox R, Barnes RD. (2003). Invertebrate Zoology: a Functional Evolutionary Approach. Brooks Cole.
- Sinha AK, Adhikari S , Ganguly BB. Biology of Animals. Vol. I. New Central Book Agency.

CORE PRACTICAL 3 (CP3) **NON-CHORDATES – II** **2 CREDITS**

List of Practical

1. Study of following specimens: (The scheme of Systematic position will be strictly followed as mentioned in theory syllabus)
    a. **Annelids** - *Aphrodite, Heteronereis, Sabella, Chaetopterus, Hirudinaria*
    b. **Arthropods** - *Palamnaeus, Palaemon, Balanus, Cancer, Eupagurus, Scolopendra, Julus, Bombyx,* Termites and honey bees
    c. **Molluscs** - *Dentalium, Patella, Chiton, Pila, Achatina, Laevicaulis alte* (slug)*, Unio, Pinctada, Sepia, Octopus, Nautilus*
    d. **Echinodermata** - *Ophiura* (Serpent star)*, Clypeaster* (sand dollar)*, Echinus* (sea urchin)*, Cucumaria* (sea cucumber) and *Antedon* (Feather star)
2. Study of anatomy of digestive and nervous system of *Pila*

Question Pattern

Time: 2½ Hour **Full Marks: 25**

Dissection, drawing and labelling (From item No. 2) any one (10 ×1) = 10
Identification and systematic position (one each from item No. 1a, 1b, 1c, and 1d) (2×4) = 08
Laboratory Note Book = 02
Internal Assessment = 05

PART I SEMESTER II

CORE THEORY 4 (CT4) **CELL BIOLOGY**

4 CREDITS; CLASS 50; MARKS 50
(Number of classes for each Unit is given at the side)

Unit 1: Overview of Cells 2

Basic structure of Prokaryotic and Eukaryotic cells

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

Type, structure and functions of cytoskeleton, Accessory proteins of microfilament & microtubule; a brief idea about molecular motors

Unit 6: Nucleus 8

Structure of Nucleus – Nuclear envelope, nuclear pore complex, 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 with special reference to p53, Retinoblastoma and Ras and APC; Mitosis and Meiosis: Basic process and their significance

Unit 8: Cell Signaling 8

Cell signaling transduction pathways; Types of signaling molecules and receptors GPCR and Role of second messenger (cAMP); Extracellular matrix; Cell interactions, Apoptosis and Necrosis

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

(40 theory + 10 internal assessments)

Questions are to be set covering the entire syllabus; 4 questions (out of six) of 2 marks each [4×2=8], four questions (out of six) of 4 marks each [4×4=16], and two questions (out of four) of 8 marks each [2×8=16], are to be answered

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Reference Books

- Alberts B et al. 2008. Molecular Biology of the Cell. V Edition, Garland publishing Inc., NY & London
- Banerjee P. K. – Problems on Genetics, Molecular Genetics and evolutionary genetics; NCBS
- Becker W. M., L. J. Kleinsmith, J. Hardin – The World of Cell
- Cassimeris L, Plopper G, Lingappa VR. 2010. Lewin's Cells – 3rd Edition –Johns & Bartlett Publishers
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology (Vol. 1), NCBA, Kolkata
- Cohen N. – Cell Structure, Function and Metabolism; Hodder & Stoughton
- Cooper G M – Cell Biology; Sinauer
- Cooper GM, Hausman RE. 2009. The Cell: A Molecular Approach. V Ed. ASM Press and Sunderland
- Elrod S. and W. Stansfield – Genetics; Schaum
- Hardin J, Bertoni G, Kleinsmith JL. 2012. Becker's World of the Cell, Pearson Benjamin Cummings.
- Harvey L. 2004. Molecular Cell Biology. 5th Edn. W.H. Freeman
- Hutchison C. & D.M. Glover – Cell cycle control; IRL Oxford Univ.
- Karp G. 2008. Cell and Molecular biology: Concepts and Application. 5th Edn, John Wiley.
- Klug W S and M. K. Cummings – Concepts of Genetics; Pearson
- Lewin B. – Genes IX; Oxford
- Lodish H et al. 2016. Molecular Cell Biology. 8th Edn. W.H. Freeman.
- Masters J R W – Animal Cell Culture – a practical approach; Oxford Univ. Pr.
- Meyers R.A. – Molecular Biology and Biotechnology; VCH Pub.
- Morgan S. J. & D. C. Darling – Animal cell culture; Oxford
- Pal A. 2011. Textbook of Cell and Molecular Biology 3rd Edn, Bokks and Allied, Kolkata.
- Plopper GD, Sharp, Siroski, E (2015) Lewin's Cell 3rdEdition––Johns & Bartlett Publishers
- Pollard MD TD, Earnshaw WC, Lippincott-Schwartz . 2007.Cell Biology. 2nd. Edn Saunders. Press
- Rastogi V. B. – Genetics; Kedarnath Ramnath
- Reed JC, Green DR. 2011. Apoptosis: Physiology and Pathology. Cambridge University.
- Robert A. – Biology of Cancer Weinberg. 2nd edition.
- Roychoudhuri S – A Text Book of Genetics & Molecular Biology; NCBA

- Russel P. J – I-Genetics; Pearson, Benjamin Cummings
- Stansfield W. D., J. S. Colome and R. J. Cano – Molecular and cell biology; Schams
- Strachan T. & A. Read – Human Molecular Genetics; BIOS Scientific
- Strickberger M. W – Genetics; Macmillam
- Tamarin R. H. – Principles of Genetics; McGraw Hill
- Thieman W.J. and M.A. Palladino – Introduction to Biotechnology; Pearson
- Twyman – Advanced Molecular Biology; Springer
- Verma P.S & V. K. Agarwal – Genetic Engineering; S. Chand
- Watson J. D. – Molecular Biology of the gene; Pearson
- Weinberg RA. 2014. Biology of Cancer. 2ndedition. Garland Science, Taylor & Francis.
- Winter P. C., G. I. Hickey & H. L. Fletcher – Genetics; Viva

CORE PRACTICAL 4; CP4: CELL BIOLOGY LAB **2 CREDITS**

List of Practical

1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
2. Study of various stages of meiosis **from grass hopper testis**
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells
4. Preparation of permanent slide to demonstrate:
    a. DNA by Feulgen reaction
    b. Cell viability study by Trypan Blue staining

Question Pattern

Time: 2½ Hour **Full Marks: 25**

Preparation, identification of a stage, drawing, labelling; from item No. 2; 3+2+2+1 = 08
Preparation, identification, drawing, labelling; one from item Nos. 1/3/4; 3+2+2+1 = 08
Laboratory Note Book = 02
Internal Assessment = 05

PART I SEMESTER II

GENERIC ELECTIVE THEORY 2; GET 2 **HUMAN PHYSIOLOGY**

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

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

- Guyton, A.C. and Hall, J.E. ;2011. Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Kesar, S. and Vashisht, N. ;2007. Experimental Physiology, Heritage Publishers.
- Marieb, E. ;1998. Human Anatomy and Physiology, IV Edition, Addison-Wesley.
- Prakash, G. ;2012. Lab Manual on Blood Analysis and Medical Diagnostics, S. Chand and Co Ltd.
- 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.

GE P2 –HUMAN PHYSIOLOGY LAB **2 Credits**

List of Practical

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

Laboratory Note book should be submitted

Examination Pattern

Time: 2½ Hour **Full Marks: 25**

One mounting [Item No. 1] = 06
One preparation [Item No. 2] = 06
Identification of three tissues [Item No. 4] ;2 × 3 = 06
Laboratory Note Book = 02
Internal Assessment = 05

PART II - SEMESTER III

CORE THERY 5; CT5 **CHORDATES**

4 CREDITS; CLASS 50; MARKS 50
Number of classes for each Unit is given at the side

Unit 1: Introduction to Chordates 2
General characteristics and outline classification of Phylum Chordata

Unit 2: Protochordata 6
General characteristics and classification of sub-phylum Urochordata and Cephalochordata up to Classes; Metamorphosis in *Ascidia*; Chordate Features and Feeding in *Branchiostoma*

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

Unit 5: Pisces 6
Classification up to living Sub-Classes; J.Z. Young 1980, Life of vertebrates; Accessory respiratory organ, migration and parental care in fishes; Swim bladder in fishes;

Unit 6: Amphibia 6
General characteristics and classification up to living Sub-Classes ;J.Z. Young 1980, Life of vertebrates; Metamorphosis and parental care in Amphibia

Unit 7: Reptilia 8
General characteristics and classification up to living Sub-Classes ;J.Z. Young 1980, Life of vertebrates; Poison apparatus and Biting mechanism in Snake

Unit 8: Aves 8

General characteristics and classification up to living Sub-Classes ;J.Z. Young 1980, Life of vertebrates; Exoskeleton and migration in Birds; Principles and aerodynamics of flight

Unit 9: Mammals 8

General characters and classification up to living Sub-Classes ;J.Z. Young 1980, Life of vertebrates; Affinities of Prototheria; Exoskeleton derivatives of mammals; Adaptive radiation in mammals with reference to locomotory appendages; Echolocation in Micro chiropterans and Cetaceans

Unit 10: Zoogeography 2

Zoogeographical realms, Plate tectonic and Continental drift theory, distribution of birds and mammals in different realms

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions; out of six of 2 marks each [4×2=8], four questions; out of six of 4 marks each [4×4=16], and two questions; out of four of 8 marks each [2×8=16], are to be answered

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Reference Books

- Arora MP. *Chordata I. Himalaya Pub Hous*
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 2, NCBA, Kolkata
- Darlington PJ. The Geographical Distribution of Animals, R.E. Krieger Pub Co
- Hall BK, Hallgrimsson B. 2008. Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc
- Jordan EL, Verma PS. 2003.Chordate Zoology. S.Chand & Company Ltd. New Delhi.
- Kardong KV. 2002.Vertebrates: Comparative anatomy, function evolution. Tata McGraw Hill.
- Kent GC, Carr RK. 2001.Comparative anatomy of the Vertebrates. 9th Ed. Mc Graw Hill.
- Nelson JS. 2006. Fishes of the World, 4th Edn. Wiley.
- Parker TJ, Haswell W. 1972. Text Book of Zoology, Volume II: Marshall and Willam ;Eds. 7th Ed. Macmillan Press.
- Pough H, Christine MJ, Haiser B. 2002. Vertebrate life, VIII Edition, Pearson Internatl.
- Rastogi VB. Ecology and Animal Distribution. Rastogi Publication.
- Romer AS, Parsons TS. 1986. The vertebrate body. 6th Ed. Saunders College Publishing
- Sinha KS, Adhikari S, Ganguly BB. 2001. Biology of Animals. Vol. II. New Central Book Agency ;p Ltd.
- Young JZ. 2004. The Life of Vertebrates. III Edition. Oxford university press

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CORE PRACTICAL 5; CP5 CHORDATES LAB 2 CREDITS

List of Practical

Identification of the animals with reason and systematic position

1. Protochordata: *Balanoglossus*, *Branchiostoma*
2. Agnatha: *Petromyzon*
3. Fishes: *Scoliodon*, *Pristis*, *Torpedo*, *Heteropneustes*, *Labeo rohita*, *Exocoetus*, *Hippocampus*, *Anabas*, Flat fish
4. Amphibia: *Necturus, Bufo ;Duttaphrynus melanostictus, Rana ;Hoplobatrachus tigerinus, Hyla, Axolotl* larva *, Tylototriton*
5. Reptilia: *Chelone*, *Trionyx*, *Hemidactylus, Varanus, Chamaeleon, Draco, Vipera, Naja, Hydrophis,*
6. Mammalia: Bat ;Insectivorous and Frugivorous, *Funambulus palmarum* ;Indian palm squirrel
7. Pecten from Fowl eye
8. Dissection of brain and pituitary ;*ex situ* of *Tilapia*
9. Power point presentation on study of habit, habitat or behaviour of any one animal by students ;for internal assessment only

Scheme of systematic position will be strictly followed as recommended in the theory

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Question Pattern

Time: 2½ Hour **Full Marks: 25**

Any two dissections; From Item nos. 7 and 8 [4 × 2] = 08
Identification with reason of four specimens; 2½ × 4 = 10
Laboratory Note Book = 02
Internal Assessment = 05

PART II - SEMESTER III

CORE THEORY 6; CT6 ANIMAL PHYSIOLOGY: CONTROLLING & COORDINATING SYSTEMS

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

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 types of bones and cartilages, Ossification

Unit 3: Nervous System 10

Structure 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 muscle contraction; Characteristics of muscle fiber

Unit 5: Reproductive System 6

Histology of testis and ovary; Physiology of Reproduction

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 and Non steroidal hormones; Hypothalamus ;neuroendocrine gland - principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system; Placental hormones

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions; out of six of 2 marks each [4×2=8], four questions; out of six of 4 marks each [4×4=16], and two questions; out of four of 8 marks each [2×8=16], are to be answered

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Reference Books

- Berg J. & G. Tomaselli – A Clinical Companion to Accompany Biochemistry –; Freeman & Co
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 2, NCBA, Kolkata
- Conn E. E. & P. K. Stumpf – Outlines of Biochemistry –(Wiley Eastern
- Cormack DH. 2003. PDQ Histology. B.C. Decker Ins., London.
- Das D. – Biochemistry; Academic Publishers
- Deb A. C. – Fundamentals of Biochemistry; NCBA
- Ganong's Review of Medical Physiology –; McGraw Hill
- Gunasegaran JP. 2010. A Text book of Histology and a Practical Guide. Elsevier
- Guyton A C – Text Book of Medical Physiology; Holt Saunders
- Hames B. D., N. M. Hooper & J. D. Houghton – Biochemistry; Viva
- Harper's Illustrated Biochemistry; McGraw Hill
- Hoar W. S. – General and Comparative Physiology –; PHI
- Junqueria LC, Carneiro J. 2005. Basic histology text and atlas
- Lehninger Principle of Biochemistry – D. L. Nelson & M. M. Cox; Maxmillan
- McCue, D.–Comparative Physiology of Fasting, Starvation, and Food Limitation; Springer
- Navas A., C. Carvalho, J. Eduardo – Aestivation: Molecular and Physiological Aspects –(Springer

- Prosser C. L. and F. A. Brown – Comparative Animal Physiology –; Saunders
- Randall D , Burggren W. 2001. Eckert Animal Physiology by. 4th edition. W. H. Freeman.
- Ross M H, Pawlina W. 2010. Histology: A Text and Atlas. Sixth Edition. Lippincott W i l l i a m s
- Saltsman K., J. Berg & G. Tomaselli – A clinical companion to accompany biochemistry; Freeman
- Schmidt-Neilson K – Animal Physiology – Adaptation & Environment, Cambridge University Pr
- Sembulingam K, Sembulingam P. 2012. Essentials of Medical Physiology. 6th Edn. Jaypee

CORE PRACTICAL 6; CP6 ANIMAL PHYSIOLOGY: CONTROLLING & COORDINATING SYSTEMS LAB
2 CREDITS

List of Practical

1. Recording of cardiac and simple muscle twitch with electrical stimulation
2. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
3. Study of permanent slides of section of skin, Spinal cord, Pancreas, Testis, Ovary, Adrenal, Thyroid, lung, pyloric stomach, cardiac stomach, small intestine, large intestine of mammalian; white rat tissues

Question Pattern

Time: 2½ Hour **Full Marks: 25**

One question; From Item 1 = 06
Preparation of one stained temporary mount; Item No. 2 = 04
Identification with reason of four slides; 2×4 = 08
Laboratory Note Book = 02
Internal Assessment = 05

PART II - SEMESTER III

CORE THEORY 7; CT7 FUNDAMENTALS OF BIOCHEMISTRY
4 CREDITS; CLASS 50; MARKS 50
Number of classes for each Unit is given at the side

Unit 1: Carbohydrates 8

Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides; Derivatives of Monosachharides; 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 terpinoids; Lipid metabolism: β-oxidation of fatty acids; Fatty acid biosynthesis

Unit 3: Proteins 10

Amino acids: Structure, Classification, General and Electro chemical properties of α-amino acids; Physiological importance of essential and non-essential amino acids; Proteins: Bonds stabilizing protein structure; Levels of organization; Protein metabolism: Transamination, Deamination, Urea cycle, Fate of C-skeleton of Glucogenic and Ketogenic amino acids

Unit 4: Nucleic Acids 10

Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids; Types of DNA and RNA, Complementarity of DNA, Hpyo-, Hyper-chromaticity of DNA Basic concept of nucleotide metabolism

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; 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, Inhibitors and un-couplers of Electron Transport System

Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions; out of six of 2 marks each [4×2=8], four questions; out of six of 4 marks each [4×4=16], and two questions; out of four of 8 marks each [2×8=16], are to be answered

Reference Books

- Berg J. & G. Tomaselli - A Clinical Companion to Accompany Biochemistry – Freeman & Co
- Berg JM, Tymoczko JL, Stryer L.2007.Biochemistry, VI Edition, W.H.Freeman and Co., New York.
- Campbell MK, Farrell SO. 2012. Biochemistry. 7th Edn. Brooks and Cole.
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 2, NCBA, Kolkata
- Chatterjee MN, Shinde R. 2012. A Textbook of Medical Biochemistry. 8th Edn. Jaypee
- Conn E. E. & P. K. Stumpf – Outlines of Biochemistry – Wiley Eastern
- Cox MM, Nelson DL. 2008. Lehninger's Principles of Biochemistry, W.H. Freeman & Co., NY
- Das D. 2000. Biochemistry. NCBA, Kolkata
- Fundamentals of Biochemistry – A. C. Deb NCBA
- Hames B. D., N. M. Hooper & J. D. Houghton – Biochemistry – Viva
- Hames BD, Hooper NM. 2000. Instant Notes in Biochemistry, II Edition, BIOS Scientific
- Jain JL, Jain N, Jain S. 1979. Fundamentals of Biochemistry. S. Chand Pub. N. Delhi
- Maheswari N. 2008. Clinical Biochemistry. Jaypee Pub., New Delhi
- Metzler DE. 2001. The chemical reactions of living cells – Academic Press.
- Murray RK et al. 2009. Harper's Illustrated Biochemistry, 28th Edition, McGraw- Hill Co.
- Nelson D. L. & M. M. Cox Lehninger Principle of Biochemistry – Maxmillan
- Saltsman K., J. Berg & G. Tomaselli – A clinical companion to accompany biochemistry – Freeman
- Sathyanarayana U, Chakrapani. 2002. Biochemistry –Books & Allied ;P Ltd, Kolkata
- Voet D, Voet JG. 2004. Biochemistry –3rd edition, 2004, John Wiley & Sons, Inc.
- Watson D et al. 2008. Molecular Biology of the Gene, VI Edition, Cold Spring Harbor Lab. Press
- Zubay GL. 1998. Biochemistry,4th edition, Mc Graw-Hill.

CORE PRACTICAL 7; CP7 FUNDAMENTALS OF BIOCHEMISTRY LAB 2 CREDITS

List of Practical

1. Qualitative tests of functional groups in carbohydrates, proteins and lipids. Qualitative tests for Carbohydrate; Starch, Sucrose, Maltose Fructose, Glucose, Protein; Albumin, Gelatin, Peptone, fat; Tests to be performed – Biuret test, Millon's test, Iodine test, Benedict's test, Barfoed test, Seliwanof's test
2. Paper chromatography of essential amino acids
3. Quantitative estimation water soluble protein following Lowry's Method

Question Pattern

Time: 2½ Hour **Full Marks: 25**

Identification of one unknown sample; Qualitative test; Item No. 1 = 08
Identification of one amino acid ;From Item 2 = 04
Quantitative estimation of concentration of unknown protein sample = 06
Laboratory Note Book = 02
Internal Assessment = 05

PART II - SEMESTER III

CHOSE EITHER SEC 1

SKILL ENHANCEMENT COURSE 1; SEC T1 APICULTURE 2 CREDITS CLASS 25

Unit 1: Biology of Bees 2

Life History, Classification and Biology of Honey Bees; Social Organization of Bee Colony

Unit 2: Rearing of Bees 10

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

Unit 3: Diseases and Enemies 5

Bee Diseases and Enemies; Control and Preventive measures

Unit 4: Bee Economy 2

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

Unit 5: Entrepreneurship in Apiculture 6

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

Reference Books

- Bisht D.S., Apiculture, ICAR Publication.
- Sarkar S; Kundu G & Chaki K C - Introduction to Economic Zoology, NCBA, Kolkata
- Chaudhuri S. 2017. Economic Zoology. Kolkata: New Central Book Agency ;PLtd.
- Cramp D. 2012. The Complete Step by Step Book of Beekeeping. Anness Publishing.
- Prost PJ. 1962. Apiculture. Oxford and IBH, New Delhi.
- Singh S. Beekeeping in India, Indian council of Agricultural Research, New Delhi.
- Sarkar, S. G., Kundu, & K. K. Chaki – Introduction to Economic Zoology – NCBS

Examination Pattern

Time: 1 hour **Full Marks: 25**

20 theory + 05 internal assessments

Questions are to be set covering the entire syllabus; 2 questions; out of four of 2 marks each [2×2=4], two questions; out of four of 4 marks each [2×4=8], and one question; out of three of 8 marks [1×8=8], are to be answered

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PART II - SEMESTER III

GENERIC ELECTIVE THEORY 3; GET 3 FOOD, NUTRITION & PUBLIC HEALTH

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

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 and government programmes, if any; Life style related diseases- hypertension, diabetes mellitus, and obesity- their causes and prevention through dietary and lifestyle modifications; Social health problems- smoking, alcoholism, drug dependence and Acquired Immuno Deficiency Syndrome ;AIDS - their causes, treatment and prevention; Common ailments- cold, cough, and fevers, their causes and treatment Concepts of Nutrigenomics and health informatics

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

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Reference Books

- Bamji MS, Rao NP, and Reddy V. Text Book of Human Nutrition; 2009; Oxford & IBH Publishing
- Gibney et al. Public Health Nutrition; 2004; Blackwell Publishing
- 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.
- Mudambi, SR and Rajagopal, MV. Fundamentals of Foods, Nutrition and Diet Therapy; 5th Ed; New Age International Publishers
- Srilakshmi B. Food Science; Fourth Ed; 2007; New Age International ;P Ltd.
- Srilakshmi B. Nutrition Science; 2002; New Age International ;P Ltd.
- Swaminathan M. Handbook of Foods and Nutrition; Fifth Ed; 1986; BAPPCO.
- Wardlaw GM, Hampl JS. Perspectives in Nutrition; Seventh Ed; 2007; McGraw Hill.

Examination Pattern

Time: 2 Hour **Full Marks: 50**

;40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], four questions ;out of six of 4 marks each [4×4=16], and two questions ;out of four of 8 marks each [2×8=16], are to be answered

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GE P5 – FOOD NUTRITION AND HEALTH LAB **2 Credits**

List of Practical

1. To detect adulteration in a Ghee b Sugars c Tea leaves and d Turmeric
2. Lactose and calcium estimation in food by titrimetry
3. Methylene Blue Reductase Test ;MBRT of milk. Gram staining of bacteria.
4. Study of the stored grain pests and mosquito vectors ;*Anopheles, Culex* and *Aedes* from slides/ photograph; *Sitophilus oryzae*, *Trogoderma granarium*, identification, habitat and food sources, damage caused and control. 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.

OR

6. Identify nutrient rich sources of foods; fruits and vegetables, their seasonal availability and price

OR

7. Study of nutrition labeling on selected foods

Laboratory Note book should be submitted

Examination Pattern

Time: 2½ Hour **Full Marks: 25**

1. One experiment from Item No. 1 = 06
2. One experiment from Item No. 2/3 = 06
3. Identification of two samples from item no. 4 [2+2] =04
4. Project Report on item number 6 = 02
5. Laboratory Note Book = 02
6. Internal Assessment = 05

PART II: SEMESTER IV

CORE THEORY 8; CT8 COMPARATIVE ANATOMY OF VERTEBRATES

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

Unit 1: Integumentary System 6
Structure, function and derivatives of integument in amphibian, birds and mammals

Unit 2: Skeletal System 6
Overview of axial and appendicular skeleton ;limbs and girdles of pigeon; Jaw suspension

Unit 3: Digestive System 8
Comparative anatomy of stomach; types of teeth in vertebrates; dentition in mammals

Unit 4: Respiratory System 6
Respiratory organs in fish, amphibian, birds and mammals

Unit 5: Circulatory System 8
General plan of circulation, Comparative account of heart and aortic arches

Unit 6: Urinogenital System 6
Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri

Unit 7: Nervous System 6
Comparative account of brain; Cranial nerves in mammals

Unit 8: Sense Organs 4
Classification of receptors, Brief account of olfactory and auditory receptors in vertebrate

Reference Books

- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 2, NCBA, Kolkata
- Hilderbrand M, Gaslow GE. Analysis of Vertebrate Structure, John Wiley and Sons
- Kardong K V. 2005. Comparative Anatomy of Vertebrates, Function and Evolution; McGraw-Hill
- Kent GC, Carr RK. 2000. Comparative Anatomy of the Vertebrates. IX Edition

Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions; out of six of 2 marks each [4×2=8], four questions; out of six of 4 marks each [4×4=16], and two questions; out of four of 8 marks each [2×8=16], are to be answered

CORE PRACTICAL 8; CP8 COMPARATIVE ANATOMY OF VERTEBRATES 2 CREDITS

List of Practical

1. Study of placoid, cycloid and ctenoid scales
2. Study of disarticulated skeleton of Toad, Pigeon and Guinea pig
3. Identification of skulls: Pigeon, Guinea pig ;herbivore and Dog ;carnivore mammal
4. Comparative studies of heart and brain, with the help of model/picture
5. Comparative studies of different types of feather of pigeon and their distribution

Examination Pattern

Time: 2½ Hour **Full Marks: 25**

1. Preparation, temporary mount and display of a scale ;From Item No. 1 = 04
2. Identification with reason of six specimen ;from item 2 and 3 ;2×6 = 12
3. One question on comparative studies ;Item No. 4 and 5 = 02
4. Laboratory Note Book = 02
5. Internal Assessment = 05

PART II: SEMESTER IV

CORE THEORY 9; CT9 ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

Unit 1: Physiology of Digestion 12

Structural organisation and functions of Gastrointestinal tract and Associated glands; Mechanical and chemical digestion of food, absorption of Carbohydrates, Lipids, Proteins and Nucleic Acids; 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, 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, 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; Extra-renal osmo-regulatory organs in vertebrates

Unit 6: Renal Physiology 8

Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid-base balance

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Reference Books

- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 2, NCBA, Kolkata
- Eroschenko VP. 2008. Atlas of Histology with Functional correlations. Lippincott & Wilkins.
- Fox SI. 2011. Human Physiology. 12th Edn. Mc Graw Hill
- Gunstream SE. 2010. Anatomy and Physiology with integrated study guide. Mc Graw Hill.
- Guyton AC, Hall JE. 2006. Textbook of Medical Physiology. Hercourt Asia P Ltd.
- Hill RW, Wyse GA, Anderson M. 2012. Animal Physiology. 3rd Edn. Sineuer Associaes.
- Randall, Burggren and French Eckert Animal Physiology: Mechanisms and adaptations
- Rastogi SC. 2007. Essentials of Animal Physiology4th Edn. New Age Pub., N. Delhi
- Sembulingam K, Sembulingam P. 2012. Essentials of Medical Physiology. Jaypee Pub, New Delhi
- Sherwood L. 2013. Human Physiology from cells to systems. 8th Edn., Brooks & Cole
- Tortora GJ, Grabowski S. 2006. Principles of Anatomy & Physiology. XI Edition John Wiley & son
- Vander A, Sherman J, Luciano D. 2014. Vander's Human Physiology: The Mechanism of Body Function. XIII Edn. McGraw Hills

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions; out of six of 2 marks each [4×2=8], four questions; out of six of 4 marks each [4×4=16], and two questions; out of four of 8 marks each [2×8=16], are to be answered

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CORE PRACTICAL 9; CP9 ANIMAL PHYSIOLOGY: LIFE SUSTAINING SYSTEMS LAB 2 CREDITS

List of Practical

1. Determination of ABO Blood group

2. Total count of RBC and WBC using haemocytometer
3. Estimation of haemoglobin using Sahli's haemoglobinometer/colorimetric/spectrophotometric techniques
4. Preparation of haemin crystals and haemochromogen crystals
5. Recording of blood pressure using a sphygmomanometer/digital meter

Examination Pattern

Time: 2½ Hour **Full Marks: 25**

Determination of blood group [Item No. 1] = 05
TC/DC [Item No. 2] = 07
One Experiment from Item No. 3 or 4 = 06
Laboratory Note Book = 02
Internal Assessment = 05

PART II: SEMESTER IV

CORE THEORY 10; CT10 **IMMUNOLOGY**

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

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 8
Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive immunity; Cell mediated and humoral.

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 6
Structure and functions of MHC molecules; Structure of T cell Receptor and its signalling, T cell development & selection

Unit 6: Cytokines 2
Types, properties and functions of cytokines

Unit 7: Complement System 6
Components and pathways of complement activation.

Unit 8: Hypersensitivity 4
Gell and Coombs' classification and brief description of various types of hypersensitivities

Unit 9: Immunology of diseases 6
Malaria, Filariasis, Dengue and Tuberculosis

Unit 10: Vaccines 4
Various types of vaccine; Active & passive immunization; Artificial and natural

Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions; out of six of 2 marks each [4×2=8], four questions; out of six of 4 marks each [4×4=16], and two questions; out of four of 8 marks each [2×8=16], are to be answered

Reference Books

- Abbas K A, Lechtman H Andrew. 2003. Cellular and Molecular Immunology. Saunders Publication.

- Abbas KA, Andrew, LH. 2011. Basic Immunology: Functions and Disorders of Immune System. Saunders Elsevier Publication.
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 2, NCBA, Kolkata
- Delves PJ, Martin SJ, Burton DR, Roitt I M. 2006. Roitt's Essential Immunology. Blackwell Pub.
- Kindt TJ, Goldsby RA, Osborne BA, Kuby J 2006. Immunology, W.H. Freeman and Company.
- Mohanty SK , Leela KS. 2014. Text book of Immunology. 2nd Edn. Jaypee Pub. N. Delhi
- Parija SC. 2012. Text book of Microbiology and Immunology. Elsevier.
- Playfair, JHL, Chain BM 2001. Immunology at a glance. 7 th Edn. Blackwell Pub.
- Shetty N. 2005. Immunology: Introductory Textbook, New Age International Pub.
- Virella G. 2007. Medical Immunology, Informa Healthcare.

CORE PRACTICAL; CP10 IMMUNOLOGY LAB **2 CREDITS**

List of Practical

1. Demonstration of lymphoid organs in diagram
2. Histological study of Bursa fabricius, spleen, thymus and lymph nodes through slides/ photographs
3. Preparation of stained blood film to study various types of blood cells
4. Demonstration of ELISA

Examination Pattern

Time: 2½ Hour **Full Marks: 25**

Identification, characterisation and function of one lymphoid organ [Item No. 1] = 06
Identification of slides/ photographs ;Three [Item No. 2] ;2 X3 = 06
Preparation of stained blood film [Item No. 3] = 06
Laboratory Note Book = 02
Internal Assessment = 05

PART II: SEMESTER IV

SKILL ENHANCEMENT COURSE; SEC T2 **SERICULTURE**

2CREDITS: CLASS 25: MARKS 25

Unit 1: Introduction 2

Sericulture: Definition, history and present status; Silk route Types of silkworms, Distribution and Races; Exotic and indigenous races; Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm 4

Life cycle of *Bombyx mori;* 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 Visit to various sericulture centres.

Reference Books

- Agarwal MP. Solar energy. S Chand and Co. Ltd.
- Boyle G. 2004. Renewable Energy, Power for a sustainable future. Oxford University Press
- Sarkar S; Kundu G & Chaki K C - Introduction to Economic Zoology ;Vol. 2, NCBA, Kolkata
- Chaudhuri S. 2017. Economic Zoology. Kolkata: New Central Book Agency ;P Ltd.
- Chun and Chen Da-Chung ;1988 Silkworm Rearing; Pub. By FAO, Rome.

- Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, Fuzi Pub. Co. Ltd.,
- Improved Method of Rearing Young age silkworm; ;1986 S. Krishnaswamy, Bangalore
- Jayakumar P. 2009. Solar Energy: Resource Assessment Handbook.
- Jolly, M. S: Appropriate Sericultural Techniques
- Narasimhanna MN. 1988. Manual of Silkworm Egg Production;, CSB, Bangalore.
- Rai GD. 2004. Non-conventional energy sources. Khanna Publishers, New Delhi
- Rangaswami G. 1976. Manual on Sericulture; Food and Agriculture Organisation, Rome
- Sengupta, K, ;1989 A Guide for Bivoltine Sericulture
- Ullal SR, Narasimhanna MN. Handbook of Practical Sericulture: CSB, Bangalore

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Examination Pattern

Time: 1 hour **Full Marks: 25**

20 theory + 05 internal assessments

Questions are to be set covering the entire syllabus; 2 questions; out of four of 2 marks each [2×2=4], two questions; out of four of 4 marks each [2×4=8], and one question; out of three of 8 marks [1×8=8], are to be answered

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PART II: SEMESTER IV

GENERIC ELECTIVE THEORY; GET4 **INSECT VECTORS AND DISEASES**

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

Unit 1: Introduction to Insects 2

General Features of Insects, Morphological features, Head – Eyes, Types of antennae, Mouth parts

Unit 2: Concept of Vectors 4

Brief introduction to 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, Siphonoptera, 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,; 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: Hempitera as Disease Vectors 6

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

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], four questions ;out of six of 4 marks each [4×4=16], and two questions ;out of four of 8 marks each [2×8=16], are to be answered

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Reference Books

- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 2, NCBA, Kolkata
- Chandra G. 2000. Mosquito. Sribhumi Publication Co. Kolkata
- Chapman RF. 1998. The Insects: Structure and Function. IV Edition, Cambridge University Press
- Chaudhuri S. 2017. Economic Zoology. New Central Book Agency
- Hati AK. 1979. Medical Entomology. Allied Book Agency
- Imms AD. 1977. A General Text Book of Entomology. Chapman & Hall, UK
- Mathews G. 2011. Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell
- Pedigo LP. 2002. Entomology and Pest Management. Prentice Hall Publication

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GENERIC ELECTIVE PRACTICAL; GEP 4 INSECT VECTORS AND DISEASES LAB 2 CREDITS

List of Practical

1. Study of different kinds of mouth parts of insect vectors
2. Study of following insect vectors through permanent slides/photographs: *Aedes*, *Culex*, *Anopheles*, *Xenopsylla cheopis*, *Cimex lectularius*, *Phlebotomus argentipes*, *Musca domestica*
3. Study of different diseases transmitted by above insectvectors
4. Submission of a project report on any one of the insect vectors and disease transmitted

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Examination Pattern

Time: 2½ Hour **Full Marks: 25**

One question from Item No. 1 = 08
Identification of four specimens Item No. 2 ;2 × 4 = 08
Project Report = 02
Laboratory Note Book = 02
Internal Assessment = 05

PART III: SEMESTER V

CORE THEORY 11; CT11 MOLECULAR BIOLOGY

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

Unit 1: Nucleic Acids 3

Salient features of DNA and RNA; Watson and Crick Model of DNA

Unit 2: DNA Replication 9

Mechanism of DNA Replication in Prokaryotes, Prove that replication is Semi-conservative, bidirectional and discontinuous Replication, RNA priming, Replication of telomeres

Unit 3: Transcription 9

Mechanism of Transcription in prokaryotes and eukaryotes, Transcription factors, Difference between prokaryotic and eukaryotic transcription

Unit 4: Translation 9

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; Difference between prokaryotic and eukaryotic translation

Unit 5: Post Transcriptional Modifications and Processing of Eukaryotic RNA 8

Capping and Poly A tail formation in mRNA; Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing, Processing of tRNA

Unit 6: Gene Regulation 7

Regulation of Transcription in prokaryotes: *lac* operon and *trp* operon; regulation of Transcription in eukaryotes: Activators, enhancers, silencer, repressors, miRNA mediated gene silencing, Genetic imprinting

Unit 7: DNA Repair Mechanisms 2

Types of DNA repair mechanisms, RecBCD model in prokaryotes, nucleotide and base excision repair, SOS repair

Unit 8: Molecular Techniques 3

PCR, Western and Southern blot, Northern Blot, Sanger DNA sequencing

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions; out of six of 2 marks each [4×2=8], four questions; out of six of 4 marks each [4×4=16], and two questions; out of four of 8 marks each [2×8=16], are to be answered

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Reference Books

- Allison LA. 2007. Fundamental Molecular Biology. Blackwell Publishing. W.H. Freeman
- Bruce A, Dennis B, Julian L, Martin R, Keith R, James W. 2008.
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 2, NCBA, Kolkata
- Cooper GM, Hausman RE. 2009. The Cell: A Molecular Approach. ASM
- Harvey L. 2004. Molecular Cell Biology. W.H. Freeman
- Karp G. 2008. Cell and Molecular biology: Concepts and Application. John Wiley.
- Lackie JM. 2013. Dictionary of Molecular Biology. Academic Press.
- Lewin B. 2008. Gene IX. Joned and Barlett.
- Lodish, B, Matsudaira, K B, Plough, A and Martin ;2016. Molecular Cell Biology. W.H. Freeman
- Pal A. 2011. Textbook of Cell and Molecular Biology, Books and Allied Pub
- Russel PJ. 2010. iGenetics: A Molecular Approach, Pearson Benjamin
- Turner, McLennan, Bales & White ;2005. Instant Notes in Molecular Biology. Taylor Francis
- Twyman, Advanced Molecular Biology. Viva Publication.

CORE PRACTICAL 11; CP11 MOLECULAR BIOLOGY LAB 2 CREDITS

List of Practical

1. Demonstration of polytene and lampbrush chromosome from photograph
2. Isolation and quantification of genomic DNA using UV spectrophotometer ;Procedure/reference to be mentioned
3. Agarose gel electrophoresis for DNA
4. DNA isolation from goat liver
5. Differential Centrifugation of an artificially prepared mixture
6. Histological staining of DNA & RNA in prepared slide

Question Pattern

Time: 2½ Hour **Full Marks: 25**

One Experiment from Item No. 2 = 08
One experiment from Item No. 6 = 04
One experiment from Item No. 3, 4, 5 = 06
Laboratory Note Book = 02
Internal Assessment = 05

PART III: SEMESTER V

CORE THEORY 12; CT12 **GENETICS**

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

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 basis of crossing over, Measuring Recombination frequency and linkage intensity using three factor crosses, Interference and coincidence

Unit 3: Mutations 8

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 *Drosophila* and man; Dosage compensation in *Drosophila*

Unit 5: Extra-chromosomal Inheritance 4

Criteria for extra chromosomal inheritance, Antibiotic resistance in *Chlamyadomonas,* Kappa particle in *Paramoecium;* Shell spiralling in snail

Unit 6: Recombination in Bacteria and Viruses 6

Conjugation, Transformation, Transduction, Complementation test in Bacteriophage

Unit 7: Transposable Genetic Elements 4

Transposons in bacteria, Ac-Ds elements in maize and P elements in *Drosophila,* LINE, SINE, Alu elements in humans

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions; out of six of 2 marks each [4×2=8], four questions; out of six of 4 marks each [4×4=16], and two questions; out of four of 8 marks each [2×8=16], are to be answered

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Reference Books

- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 1, NCBA, Kolkata
- Gilbert SF. 2010. Developmental biology. 9th ed. Sinauer Associates
- Klug WS, Cummings MR, Spencer CA. 2012. Concepts of Genetics. Xth Ed. Benjamin Cummings
- Russell PJ. 2009. Genetics- A Molecular Approach.III Edition. Benjamin Cummings
- Snustad DP, Simmons MJ. 2009. Principles of Genetics. V Edition. John Wiley and Sons Inc

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CORE PRACTICAL 12; CP12 GENETICS 2 CREDITS

List of Practical

1. Chi-square analyses of provided genetic data
2. Linkage maps based on three point crossing over in *Drosophila*
3. Identification of chromosomal aberration in *Drosophila* and man from photograph
4. Pedigree analysis of some human inherited traits.

Question Pattern

Time: 2½ Hour **Full Marks: 25**

One analysis from Item No. 1 = 05
One linkage map from Item No. 2 = 05
Identification any two aberrations from Item No. 3 ;2 × 2 = 04
One pedigree analysis = 04
Laboratory Note Book = 02
Internal Assessment = 05

PART III: SEMESTER V

DISCIPLINE SPECIFIC ELECTIVE; DSET1 **FISH and FISHERIES**

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

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

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

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

Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions; out of six of 2 marks each [4×2=8], four questions; out of six of 4 marks each [4×4=16], and two questions; out of four of 8 marks each [2×8=16], are to be answered

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DSEP1 – FISH AND FISHERIES LAB **2 Credits**

List of Practical

1. Morphometric and meristic characters of fishes
2. Study of *Petromyzon*, *Pristis*, *Chimaera*, *Exocoetus*, *Hippocampus*, *Heteropneustes*, *Anabas*
3. Study of different types of scales
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* and *Clarias*

7. Project Report on a visit to any fish farm/ pisciculture unit/Zebrafish rearing Lab.

Laboratory Note book should be submitted

Examination Pattern

Time: 2½ Hour **Full Marks: 25**

One question from Item No. 1 = 04
Identification of four specimens from item no. 2 ;2 × 4 = 08
One question from Item No. 3/4/6 = 03
One question from Item No. 5 = 03
Laboratory Note Book = 02
Internal Assessment = 05

PART III: SEMESTER V

DISCIPLINE SPECIFIC ELECTIVES; DSET2 ANIMAL BEHAVIOUR AND CHRONOBIOLOGY
4 CREDITS; CLASS 50; MARKS 50
Number of classes for each Unit is given at the side

Unit 1: Introduction to Animal Behaviour 5

Origin and history of Ethology; Proximate and ultimate causes of behaviour, Methods and recording of 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 and the senses; Altruism; Insects' society with Honey bee as example; Foraging in honey bee and advantages of the waggle dance; Sexual Behaviour: Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection ;male rivalry, Inter-sexual selection ;female choice, Sexual conflict in parental care.

Unit 4: Introduction to Chronobiology 10

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

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Examination Pattern

Time: 2 hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], four questions ;out of six of 4 marks each [4×4=16], and two questions ;out of four of 8 marks each [2×8=16], are to be answered

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Reference Books

- Alcock J. 2013. Animal Behaviour, Sinauer Associate Inc., USA.
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 2, NCBA, Kolkata
- Chattopadhyay S. 2012. Life: Evolution, Adaptation, Ethology. 3rd Edn. Books and Allied, Kolkata.
- Drickamer LC , Vessey SH . 2001. Animal Behaviour. McGraw-Hill
- Dujatkin LA. 2014. Principles of Animal Behaviour. 3rd Edn. W.W.Norton and Co.
- Dunlap JC, Loros JJ, DeCoursey PJ. 2004. Chronobiology Biological Timekeeping. Sinauer Assoc.
- Kumar V. 2002. Biological Rhythms. Narosa Publishing House, New Delhi.

- Mandal F. 2010. A Text Book of Animal Behaviour. Pentice Hall India.
- Mathur R. 2005. Animal Behaviour. Rastogi Pub.
- Refinetti R. 2000. Circadian Physiology. CRC Press, Boca Raton.
- Ruhela A, Sinha M. 2010. Recent Trends in Animal Behaviour. Oxford Book Co.
- Saunders DS. 2002. Insect Clocks. Elsevier Science.
- Sherman PW, Alcock J. 2013. Exploring Animal Behaviour, Sinauer Assoc Inc., Massachusetts, USA.

DISCIPLINE SPECIFIC ELECTIVE; DSE P2 ANIMAL BEHAVIOUR AND CHRONOBIOLOGY LAB

2 CREDITS

List of Practical

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

Question Pattern

Time: 2½ Hour **Full Marks: 25**

One question from Item No. 1, 2, 3 and 4 = 05
One question from Item No. 6 = 05
One question from Item No. 7 = 05
Excursion Report = 03
Laboratory Note Book = 02
Internal Assessment = 05

PART III: SEMESTER VI

CORE THEORY 13; CT13 **DEVELOPMENTAL BIOLOGY**

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

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 and Internal: 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 birds; Implantation of embryo in human; Structure, types and functions of placenta in mammal

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

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Examination Pattern

Time: 2 hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], four questions ;out of six of 4 marks each [4×4=16], and two questions ;out of four of 8 marks each [2×8=16], are to be answered

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Reference Books

- Carlson BM. 2014. Human Embryology and Developmental Biology. 5th Edn. Elsevier..
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 1, NCBA, Kolkata
- Das N. 2012. Fundamental Concept of Developmental Biology. New Central Book Agency
- Dudek RW, Fix JD. 2013. BRS Embryology. 3rd Edn. Lippincoat Williams Wilkins
- Gardner DK. 2006. In Vitro Fertilization: a Practical Approach. CRC Press.
- Gilbert S.F. 2010. Developmental Biology, IX Edition, Sinauer Associates, Inc., Publishers,
- Schoenwolf GC, Bleyl SB, Brauer PR, Francis-West PH. 2009. Ladesn's Human Embryology. Elsevier
- Slack JMW . 2012. Essential Developmental Biology. Wiley-Blackwell.
- Verma PS, Agarwal VK. 2014. Chordate Embryology: Developmental Biology. S. Chand Pub.
- Wolpert L. 2002. Principles of Development. 2nd Edn. Oxford Univ. Press.

CORE PRACTICAL; CP13 DEVELOPMENTAL BIOLOGY LAB **2 CREDITS**

List of Practical

1. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak, 24, 48, and 96 hours of incubation
2. Study of the developmental stages and life cycle of *Drosophila*
3. Study of different sections of placenta ;photo-micrograph/ slides

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Question Pattern

Time: 2½ Hour **Full Marks: 25**

One question from Item No. 2 = 08
Identification any five from Item No.1 and 3; 2 × 5 = 10
Laboratory Note Book = 02
Internal Assessment = 05

PART III: SEMESTER VI

CORE THEORY; CT14 **EVOLUTIONARY BIOLOGY**

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

Unit 1 5

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

Unit 2 5

Historical review of Evolutionary concepts, Lamarkism, Darwinism and Neo Darwinism

Unit 3 6

Geological time scale with reference to origin and evolution of animals, evolution of horse; 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 ;application of law to bi-allelic 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 6

Origin and Evolution of Man, Unique Hominid characteristics contrasted with primate characteristic; Molecular analysis of human origin

Unit 9 3

Phylogenetic trees, Construction & interpretation of Phylogenetic tree using parsimony, Convergent & Divergent evolution.

Examination Pattern

Time: 2 hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions; out of six of 2 marks each [4×2=8], four questions; out of six of 4 marks each [4×4=16], and two questions; out of four of 8 marks each [2×8=16], are to be answered

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Reference Books

- Barton NH, Birggs DEG, Elsen JA, Goldstein DB, Patel NH. 2007. Evolution. CSHL Press
- Bergstorm CT, Dujatkin LA. 2012. Evolution. 1st Edn. W.W. Norton and Co.
- Campbell NA, Reece JB. 2011. Biology. IX Edition. Pearson, Benjamin, Cummings.
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 1, NCBA, Kolkata
- Dobzhansky T, Ayala FJ, Stebbins JL, Valentine JW. 1977. Evolution. Surajeet Pub., N.Delhi
- Freeman S, Herron JC. 2016. Evolutionary Analysis. Pearson Education Limited, Noida, India.
- Futuyma DJ. 1997. Evolutionary Biology. Sinauer Associates.
- Gillespie JH. 1998. Population Genetics: a Concise Guide. John Hopkins Univ Press.
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- Kardong K. 2004. An Introduction to Biological Evolution. McGraw Hill.
- Page RDM, Holmes EC. 1998. Molecular Evolution: A Phylogenetic Approach. Blackwell Sc
- Rauchfuss H. 2010. Chemical Evolution and the Origin of Life. Springer.
- Ridley M. 1996. Evolution. 2nd Edn. Blackwell Science.
- Russell PJ. 2009. iGeneics: A Molecular Approach. 3rd edition. Pearson Education India.
- Smith JM. 1998. Evolutionary Genetics. 2nd Edn. Oxford Univ Press.
- Volpe EP, Rossenbaum PA. 1999. Evolution. McGraw Hill.

CORE PRACTICAL; CP 14 EVOLUTIONARY BIOLOGY LAB 2 CREDITS

List of Practical

1. Study of fossils from models/pictures
2. Study of homology and analogy from suitable specimens
3. Study and verification of Hardy-Weinberg Law by chi-square analysis
4. Graphical representation and interpretation of data of height/weight of a sample of 100 humans in relation to their age and sex.

Question Pattern

Time: 2½ Hour **Full Marks: 25**

Identification any two from Item No. 1 and 2 ;2 × 2 = 04

One question from Item No. 3 = 08

One question from Item No. 4 = 06
Laboratory Note Book = 02
Internal Assessment = 05

PART III: SEMESTER VI

DISCIPLINE SPECIFIC ELECTIVES THEORY; DSET3 **ENDOCRINOLOGY**

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

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 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

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Examination Pattern

Time: 2 hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], four questions ;out of six of 4 marks each [4×4=16], and two questions ;out of four of 8 marks each [2×8=16], are to be answered

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Reference Books

- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 1, NCBA, Kolkata
- Fox T, Brooks A, Baidya B. 2015. Endocrinology. JP Medical, London.
- Gardner DG, Shoback D. 2011. Greenspan's Basic and Clinical Endocrinology. McGraw Hill Lange.
- Goodman HM. 2000. Basic Medical Endocrinology. Academic Press.
- Hall JE. 2015. Guyton and Hall Textbook of Medical Physiology. Saunders publication.
- Jameson JL. 2010. Harrison's Endocrinology. McGraw Hill
- Melmed S, Conn PM. 2005. Endocrinology: Basic and Clinical Principles. Humana Press.
- Melmed S, Polonsky K, Larsen PR, Kronenberg H. 2016. William's Text Book of Endocrinology. Elsevier.
- Molina PE. 2013. Endocrine Physiology. McGraw Hill Lange.
- Neal JM. 2000. Basic Endocrinology; an Interactive Approach. Blackwell Science.
- Norris DO, Carr JA. 2013. Vertebrate Endocrinology. Academic Press
- Norris DO. 2007. Vertebrate Endocrinology. 4th Edn. Elsevier Academic Press
- Ross MH, Pawlina W. 2010. Histology: A Text and Atlas. Lippincott Williams and Wilkins.
- Strauss JF, Barbieri RL. 2014. Yen & Jaffe's Reproductive Endocrinology. Elsevier Sounders

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DISCIPLINE SPECIFIC ELECTIVES; DSEP3 **ENDOCRINOLOGY LAB** **2 CREDITS**

List of Practical

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1. Demonstration of Endocrine glands in rat ;model/photograph.
2. Study of the permanent slides of thyroid, pancreas, ovary, testis and adrenal
3. Tissue fixation, embedding in paraffin, microtomy and slide preparation of any endocrine gland

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Question Pattern

Time: 2½ Hour **Full Marks: 25**

One question from Item No. 1 = 04
Identification of three specimens from Item No. 2 ;3 × 2 = 06
One question from Item No. 3 = 08
Laboratory Note Book = 02
Internal Assessment = 05

DISCIPLINE SPECIFIC ELECTIVE THEORY; DSET4 **PARASITOLOGY**

4 CREDITS; CLASS 50; MARKS 50

Number of classes for each Unit is given at the side

Unit 1: Introduction to Parasitology 2

Brief introduction of Parasitism, Parasite, Parasitoid 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 *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani*

Unit 3: Parasitic Platyhelminthes 12

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

Unit 4: Parasitic Nematodes 12

Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Wuchereria bancrofti* and *Trichinella spiralis*, *Brugia malayi*; Nematode plant interaction; Gall formation

Unit 5: Parasitic Arthropods 10

Biology, importance and control of ticks ;Soft tick *Ornithodoros,* Hard tick *Ixodes*, mites ;*Sarcoptes*, Lice ;*Pediculus*, Flea ;*Xenopsylla* and Bug ;*Cimex*

Unit 5: Parasite Vertebrates 2

Brief account of Cookicutter Shark, Hood Mocking bird, Vampire bat

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions; out of six of 2 marks each [4×2=8], four questions; out of six of 4 marks each [4×4=16], and two questions; out of four of 8 marks each [2×8=16], are to be answered

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Reference Books

- Ahmed N, Dawson M, Smith C, Wood Ed. 2007. Biology of Disease. Taylor and Francis Group.
- Arora D R, Arora B. 2001. Medical Parasitology. II Edition. CBS Publications and Distributors
- Bogitsch B J, Carter CE, Oeltmann TN. 2013. Human Parasitology. 4th Edn. Elsevier.
- Bose M. 2017. Parasitoses and zoonoses. New Central Book Agency. 1:3-808.
- Chakraborty P. 2016.. Textbook of Medical parasitology, 3rd edition. New Central Book Agency.
- Chatterjee K D. 2009. Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors ;P Ltd.
- Dailey MD. 1996. Meyer, Olsen & Schmidt's Essentials of Parasitology. W.C. Brown Publishers
- Gunn A, Pitt SJ. 2012. Parasitology: an Integrated Approach. Wiley Blackwell.
- John DT, Petri WA. 2006. Markell and Voge's Medical Parasitology. Elsevier.

- Marr JJ, Nilsen TW, Komuniecki RW. 2003. Molecular Medical Parasiology. 2nd Edn. Academic Press.
- Muller R, Wakelin D. 2002. Worms and Human Disease. CAB International Publication.
- Noble ER, Noble GA. 1982. Parasitology: The biology of animal parasites. Lea & Febiger
- Paniker CKJ, Ghosh S. [Ed} ;2013. Paniker's Text Book of Medical Parasitology. Jaypee
- Parija SC. 2013. Textbook of medical parasitology, protozoology & helminthology II Edition, All India Publishers and Distributers, Medical Books Publishers, Chennai, Delhi.

DISCIPLINE SPECIFIC ELECTIVE PRACTICAL; DSE P4 PARASITOLOGY LAB 2 CREDITS

List of Practical

1. Study of life stages of *Giardia intestinalis*, *Trypanosoma gambiense*, *Leishmania donovani* through micro photographs
2. Study of adult and life stages of *Ancylostoma duodenale*, through micro photographs
3. Study of *Pediculus humanus*, *Xenopsylla cheopis* and *Cimex lectularius* through photographs
4. Study of monogenea from the gills of fresh/marine fish [Gills can be procured from fish market as by product of the industry]
5. Study of nematode/cestode parasites from the intestines of poultry bird [Intestine can be procured from poultry/market as a by-product
6. Submission of a brief report on parasitic vertebrates

Question Pattern

Time: 2½ Hour **Full Marks: 25**

Identification of four specimens from item no.1, 2 and 3 ;2 × 4 = 08
One question from Item No. 4 = 04
One question from Item No. 5 = 04
Project report on item No. 6 =02
Laboratory Note Book = 02
Internal Assessment = 05

UNIVERSITY OF CALCUTTA

ZOOLOGY SYLLABUS FOR B. Sc. (GENERAL)

UNDER

CBCS SYSTEM

Approved by Board of Studies, University of Calcutta

2018 ONWARDS

SCHEME OF B. Sc. SYLLABUS UNDER CBCS WITH ZOOLOGY GENERAL

	SEMESTER	CORE COURSE ;CC ;12	Ability Enhancement Compulsory Courses ; AEC; 2	Skill Enhancement Courses; SEC ;4	Discipline Specific Elective; DSE; 2
PART - I	I	BOTANY CC I CC-ZOOLOGY I CC-CHEMISTRY I	ENGLISH COMMUNICATION		
	II	CC-BOTANY II CC-ZOOLOGY II CC-CHEMISTRY II	ENVIRONMENTAL SCIENCE		
PART - II	III	CC-BOTANY III CC-ZOOLOGY III CC-CHEMISTRY III		SEC-I	
	IV	CC-BOTANY IV CC-ZOOLOGY IV CC-CHEMISTRY IV		SEC-II	
PART - III	V			SEC-III	DSE-BOTANY I DSE-ZOOLOGY I DSE-CHEMISTRY I
	VI			SEC-IV	DSE-BOTANY II DSE-ZOOLOGY II DSE-CHEMISTRY II

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Note: As UGC and West Bengal Higher Education Council not yet mentioned any other subject combination for studying Zoology (Honours or General), here it cannot be mentioned. These will be decided in University authority.

COURSE STRUCTURE OF 3 YEAR B. Sc. GENERAL COURSE WITH ZOOLOGY UNDER CBCS SYSTEM

PART + SEMESTER		COURSES	DETAILS OF COURSES	CREDITS
PART - I	I	ZOOLOGY CC1	Animal Diversity ;CC1T	4
			Animal Diversity ;CC1P	2
		AEC 1	English communication ;AEC1	4
	II	ZOOLOGY CC2	Comparative Anatomy and Developmental Biology of Vertebrates ;CC2T	4
			Comparative Anatomy and Developmental Biology of Vertebrates ;CC2P	2
		AEC 2	Environmental science ;AEC2	4
PART - II	III	ZOOLOGY CC3	Physiology and Biochemistry ;CC3T	4
			Physiology and Biochemistry ;CC3P	2
		SEC-I	Apiculture ;SEC1T	2
	IV	ZOOLOGY CC4	Genetics and Evolutionary Biology ;CC4T	4
			Genetics and Evolutionary Biology ;CC4P	2
PART - III	V	SEC-II	Aquarium Fish Keeping ;SEC2T	2
		DSE-ZOOLOGY I	Applied Zoology ;DSE1T	4
			Applied Zoology ;DSE1P	2
	VI	SEC-III	Sericulture ;SEC3T	2
		DSE-ZOOLOGY II	Aquatic Biology ;DSE2T **OR**	4
			Insect, Vector and Diseases ;DSE3T	4
			Aquatic Biology ;DSE2P **OR**	2
			Insect, Vector and Diseases ;DSE3T	2

SCHEME FOR CBCS CURRICULUM; CREDIT DISTRIBUTION ACROSS COURSES

Course Type	**Number of Courses**	**Credits**		
		Theory	**Practical**	**Theory + Practical**
Core Courses	**4**	**4×4 = 16**	**4×2 = 8**	**24**
Discipline Specific Electives	**2**	**2×4 = 8**	**2×2 = 4**	**12**
Ability Enhancement Language Courses	**2**	**2×2 = 4**		**4**
Skill Enhancement Courses	**3**	**3×2 = 6**		**6**
Total	**11**	**34**	**12**	**46**

CORE COURSE I: ANIMAL DIVERSITY THEORY; CC1T

CLASS 60 **MARKS 50** **CREDITS 4**

Unit 1: Kingdom Protista **4**
General characters and classification up to classes; Locomotory Organelles and locomotion in Protozoa

Unit 2: Phylum Porifera **3**
General characters and classification up to classes; Canal System in *Sycon*

Unit 3: Phylum Cnidaria **3**
General characters and classification up to classes; Polymorphism in Hydrozoa

Unit 4: Phylum Platyhelminthes **3**
General characters and classification up to classes; Life history of *Taenia solium*

Unit 5: Phylum Nemathelminthes **5**
General characters and classification up to classes; Life history of *Ascaris lumbricoides* and its parasitic adaptations

Unit 6: Phylum Annelida **3**
General characters and classification up to classes; Metamerism in Annelida

Unit 7: Phylum Arthropoda **5**
General characters and classification up to classes; Vision in Arthropoda, Metamorphosis in Insects

Unit 8: Phylum Mollusca **4**
General characters and classification up to classes; Torsion in gastropods

Unit 9: Phylum Echinodermata **4**
General characters and classification up to classes; Water-vascular system in Asteroidea

Unit 10: Protochordates **2**
General features and Phylogeny of Protochordata

Unit 11: Agnatha **2**
General features of Agnatha and classification of cyclostomes up to classes

Unit 12: Pisces **4**
General features and Classification up to orders; Osmoregulation in Fishes

Unit 13: Amphibia **4**
General features and Classification up to orders; Parental care

Unit 14: Reptiles **4**
General features and Classification up to orders; Poisonous and non-poisonous snakes, Biting mechanism in snakes

Unit 15: Aves **5**
General features and Classification up to orders; Flight adaptations in birds

Unit 17: Mammals **5**
Classification up to orders; Origin of mammals

Note: Classification of Unit 1-9 to be followed from Barnes, R. D. ;1982 *Invertebrate Zoology,* V Edition

Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], four questions ;out of six of 4 marks each [4×4=16], and two questions ;out of four of 8 marks each [2×8=16], are to be answered

ANIMAL DIVERSITY PRACTICAL; CC1P

MARKS 25 **CREDITS 2**

1. Identification of the following specimens
   Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Obelia, Physalia, Aurelia, Metridium, Taenia solium, Ascaris lumbricoides ;Male and female, *Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer*,

Limulus, Palamnaeus, Julus, Apis, Chiton, Dentalium, Unio, Loligo, Sepia, Octopus, Pentaceros, Echinus, Cucumaria and *Antedon, Balanoglossus, Branchiostoma, Petromyzon, Sphyrna, Pristis, Torpedo, Labeo bata, Exocoetus, Ichthyophis, Salamandra, Hyla, Chelone, Hemidactylus, Chamaeleon, Draco, Vipera, Naja,* Any six common birds from different orders, Bat, *Funambulus*

2. Key for Identification of poisonous and non-poisonous snakes
3. Study of anatomy of digestive system, salivary gland, mouth parts of *Periplaneta*
4. Study of anatomy of digestive system, osphradium, radula of *Pila*
5. An **"animal album"** containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

Question Pattern

Time: 2½ Hour **Full Marks: 25**

1. Identification ;5 from Item 1 ;5 × 2 = 10
2. One anatomical study ;from item numbers 3/4 = 05
3. Key ;from item 2 or question from item 5 = 03
4. Laboratory Note Book = 02
5. Internal Assessment = 05

SUGGESTED READINGS

- Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J. I. ;2002. *The Invertebrates: A New Synthesis,* III Edition, Blackwell Science
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 1 & 2, NCBA, Kolkata
- Hall B.K. and Hallgrimsson B. ;2008. *Strickberger's Evolution.* IV Edition. Jones and Bartlett Publishers Inc.
- Pough H. *Vertebrate life,* VIII Edition, Pearson International.
- Ruppert and Barnes, R.D. ;2006. *Invertebrate Zoology,* VIII Edition. Holt Saunders International Edition.
- Young, J. Z. ;2004. *The Life of Vertebrates.* Ill Edition. Oxford university press.

CORE COURSE II: COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES; CC2T

CLASS 60 **MARKS 50** **CREDITS 4**

Unit 1: Integumentary System **4**
Derivatives of integument with respect to glands and digital tips

Unit 2: Skeletal System **3**
Evolution of visceral arches

Unit 3: Digestive System **4**
Brief account of alimentary canal and digestive glands

Unit 4: Respiratory System **5**
Brief account of Gills, lungs, air sacs and swim bladder

Unit 5: Circulatory System **4**
Evolution of heart and aortic arches

Unit 6: Urino-genital System **4**
Succession of kidney, Evolution of urino-genital ducts

Unit 7: Nervous System **3**
Comparative account of brain

Unit 8: Sense Organs **3**
Types of receptors

Unit 9: Early Embryonic Development **12**
Gametogenesis: Spermatogenesis and oogenesis with respect to mammals, vitellogenesis in birds; Fertilization: external ;amphibians, internal ;mammals, blocks to polyspermy; Early development

of frog; structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula; types of morphogenetic movements; Fate of germ layers

Unit 10: Late Embryonic Development **10**

Implantation of embryo in humans, Formation of human placenta and functions, other types of placenta on the basis of histology; Metamorphic events in frog life cycle and its hormonal regulation

Unit 11: Control of Development **8**

Fundamental processes in development ;brief idea - Gene activation, determination, induction, Differentiation, morphogenesis, intercellular communication, cell movements and cell death

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], four questions ;out of six of 4 marks each [4×4=16], and two questions ;out of four of 8 marks each [2×8=16], are to be answered

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COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES – PRACTICAL ;CC2P
MARKS 25 **CREDITS 2**

1. Osteology
    a. Disarticulated skeleton of pigeon
    b. Mammalian skulls: One herbivorous ;Guinea pig and one carnivorous ;Dog animal.
2. Toad - Study of developmental stages - whole mounts and sections through permanent slides - cleavage stages, blastula, gastrula, neurula, tail bud stage, tadpole external and internal gill stages.
3. Study of the different types of placenta- histological sections through photomicrographs
4. Examination of gametes - frog/rat - sperm and ova through permanent slides or photomicrographs.

Question Pattern

Time: 2½ Hour **Full Marks: 25**

1. Identification ;5 from Item 1 ;5 × 2 = 10
2. Two developmental stages from item 2 ;2× 2 = 04
3. One identification each from item 3 & 4 ;2× 2 = 04
4. Laboratory Note Book = 02
5. Internal Assessment = 05

SUGGESTED READINGS

- Balinsky, B.I. ;2008. An introduction to Embryology, Int. Thomson Computer Press.
- Carlson, Bruce M ;1996. Patten's Foundations of Embryology, McGraw Hill
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 1 & 2, NCBA, Kolkata
- Gilbert, S. F. ;2006. Developmental Biology, Sinauer Assoc Inc., Massachusetts
- Hilderbrand, M and Gaslow G.E. *Analysis of Vertebrate Structure*, John Wiley
- Kardong, KV ;2005 *Vertebrates' Comparative Anatomy, Function and Evolution*, McGraw-Hill
- Kent, G.C. and Carr R.K. ;2000. *Comparative Anatomy of the Vertebrates.* McGraw-Hill
- Walter, H.E. and Sayles, L.P; *Biology of Vertebrates,* Khosla Publishing House

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CORE COURSE III: PHYSIOLOGY AND BIOCHEMISTRY; CC3T

CLASS 60 **MARKS 50** **CREDITS 4**

Unit 1: Nerve and muscle **8**

Structure of a neuron, resting membrane potential, Graded potential, Origin of Action potential

and its propagation in myelinated and non-myelinated nerve fibres, Ultra-structure of skeletal muscle, Molecular and chemical basis of muscle contraction

Unit 2: Digestion **5**

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

Unit 3: Respiration **5**

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

Unit 4: Excretion **5**

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

Unit 5: Cardiovascular system **6**

Composition of blood, Homeostasis, Structure of Heart, Origin and conduction of the cardiac impulse, Cardiac cycle

Unit 6: Reproduction and Endocrine Glands **7**

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

Unit 7: Carbohydrate Metabolism **8**

Glycolysis, Krebs cycle, Pentose phosphate pathway, Gluconeogenesis, Glycogen metabolism, Review of electron transport chain

Unit 8: Lipid Metabolism **5**

Biosynthesis and β oxidation of palmitic acid

Unit 9: Protein metabolism **5**

Transamination, Deamination and Urea Cycle

Unit 10: Enzymes **6**

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

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], four questions ;out of six of 4 marks each [4×4=16], and two questions ;out of four of 8 marks each [2×8=16], are to be answered

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PHYSIOLOGY AND BIOCHEMISTRY PRACTICAL; CC3P

MARKS 25 **CREDITS 2**

1. Preparation of haemin and hemochromogen crystals
2. Study of permanent histological sections of mammalian pituitary, thyroid, pancreas, adrenal gland
3. Study of permanent slides of duodenum, liver, lung, kidney
4. Qualitative tests to identify functional groups of carbohydrates in given solutions ;Glucose, Fructose, Sucrose, Lactose

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Question Pattern

Time: 2½ Hour **Full Marks: 25**

1. Preparation of one crystal = 05
2. Two identification from item 2 ;2× 2 = 04
3. Two identification from item 3 ;2× 2 = 04
4. One qualitative test from item 4 = 05
5. Laboratory Note Book = 02
6. Internal Assessment = 05

SUGGESTED READINGS

- Berg, J. M., Tymoczko, J. L. and Stryer, L. ;2006. *Biochemistry.* VI Edition. W.H Freeman and Co.

- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 2, NCBA, Kolkata
- Guyton, A.C. and Hall, J.E. ;2011. *Textbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company
- Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. ;2009. *Harper's Illustrated Biochemistry.* XXVIII Edition. Lange Medical Books/Mc Graw3Hill.
- Nelson, D. L., Cox, M. M. and Lehninger, A.L. ;2009. *Principles of Biochemistry.* IV Edition. W.H. Freeman and Co.
- Tortora, G.J. and Derrickson, B.H. ;2009. *Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.
- Widmaier, E.P., Raff, H. and Strang, K.T. ;2008 *Vander's Human Physiology*, XI Edition., McGraw Hill

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CORE COURSE IV: GENETICS AND EVOLUTIONARY BIOLOGY; CC4T

CLASS 60 **MARKS 50** **CREDITS 4**

Unit 1: Introduction to Genetics **3**

Mendel's work on transmission of traits; Genetic Variation, Molecular basis of Genetic Information

Unit 2: Mendelian Genetics and its Extension **8**

Principles of Inheritance, Chromosome theory of inheritance, Incomplete dominance and co-dominance, Multiple alleles, lethal alleles, Epistasis, Pleiotropy, sex linked inheritance, extra-chromosomal inheritance

Unit 3: Linkage, Crossing Over and Chromosomal Mapping **9**

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

Unit 4: Mutations **7**

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Autoploidy, Gene mutations: Induced versus Spontaneous mutations

Unit 5: Sex Determination **4**

Chromosomal mechanisms, dosage compensation in *Drosophila*

Unit 6: History of Life **2**

Origin and Major Events in History of Life

Unit 7: Introduction to Evolutionary Theories **5**

Lamarckism, Darwinism, Neo-Darwinism

Unit 8: Direct Evidences of Evolution **5**

Types of fossils, Dating of fossils, Phylogeny of horse

Unit 9: Processes of Evolutionary Change **9**

Organic variations; Isolating Mechanisms; Natural selection ;Example: Industrial melanism

Unit 10: Species Concept **6**

Biological species concept ;Advantages and Limitations; Modes of speciation ;Allopatric, Sympatric

Unit 11: Macro-evolution **5**

Macro-evolutionary Principles ;example: Darwin's Finches

Unit 12: Extinction **6**

Mass extinction ;Causes, Names of five major extinctions, K-T extinction in detail, Role of extinction in evolution

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], four questions ;out of six of 4 marks each [4×4=16], and two questions ;out of four of 8 marks each [2×8=16], are to be answered

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GENETICS AND EVOLUTIONARY BIOLOGY PRACTICAL; CC4P

MARKS 25 **CREDITS 2**

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

Question Pattern

Time: 2½ Hour **Full Marks: 25**

1. Solve one problem from item 1 = 04
2. One gene mapping = 06
3. One karyotype = 02
4. One question from evolution ;from item 4, 5, 6 = 06
5. Laboratory Note Book = 02
6. Internal Assessment = 05

SUGGESTED READINGS

- Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H.;2007.
- Campbell, N. A. and Reece J. B. ;2011. *Biology.* IX Edition, Pearson, Benjamin, Cummings.
- Chaki K C; Kundu G & Sarkar S. - Introduction to General Zoology ;Vol. 1 & 2, NCBA, Kolkata
- Gardner, E.J., Simmons, M.J., Snustad, D.P. ;2008. *Principles of Genetics.* VIII Edition. Wiley India.
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to*
- Hall, B. K. & Hallgrimsson, B. ;2008. *Evolution.* IV Edn. Jones & Bartlett Publishers
- Klug, W.S., Cummings, M.R., Spencer, C.A. ;2012. *Concepts of Genetics.* X Edn. Benjamin Cummings.
- Ridley, M. ;2004. *Evolution.* Ill Edition. Blackwell Publishing
- Russell, P. J. ;2009. *Genetics- A Molecular Approach.* 3rd Edn. Benjamin Cummings.
- Snustad, D.P., Simmons, M.J. ;2009. *Principles of Genetics.* V Edn. John Wiley and Sons Inc.
- Futuyma, D J. ;1997. *Evolutionary Biology.* Sinauer Associates.

DISCIPLINE SPECIFIC ELECTIVE COURSES

APPLIED ZOOLOGY; DSE1T

CLASS 60 **MARKS 50** **CREDITS 4**

Unit 1: Introduction to Host-parasite Relationship **3**

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

Unit 2: Epidemiology of Diseases **7**

Transmission, Prevention and control of diseases: Tuberculosis, typhoid

Unit 3: Rickettsiae and Spirochaetes **6**

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

Unit 4: Parasitic Protozoa **8**

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

Unit 5: Parasitic Helminthes **5**

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

Unit 6: Insects of Economic Importance **8**

Biology, Control and damage caused by *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio*

demoleus, *Callosobruchus chinensis*, *Sitophilus oryzae* and *Tribolium castaneum*

Unit 7: Insects of Medical Importance **8**

Medical importance and control of Pediculus humanus corporis, Anopheles, Culex, Aedes, Xenopsylla *cheopis*

Unit 8: Animal Husbandry **5**

Preservation and artificial insemination in cattle; Induction of early puberty and synchronization of estrus in cattle

Unit 9: Poultry Farming **5**

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

Unit 10: Fish Technology **5**

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

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], four questions ;out of six of 4 marks each [4×4=16], and two questions ;out of four of 8 marks each [2×8=16], are to be answered

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APPLIED ZOOLOGY PRACTICAL; DSE1P

MARKS 25 **CREDITS 2**

1. Study of *Plasmodium vivax, Entamoeba histolytica, Trypanosoma gambiense, Ancylostoma duodenale* and *Wuchereria bancrofti* and their life stages through permanent slides/photomicrographs or specimens.
2. Study of arthropod vectors associated with human diseases: *Pediculus, Culex, Anopheles, Aedes* and *Xenopsylla.*
3. Study of insect damage to different plant parts/stored grains through damaged products/photographs.
4. Identifying feature and economic importance of *Helicoverpa ;Heliothis armigera,* Papilio demoleus, Pyrilla perpusilla, Callosobruchus chinensis, Sitophilus oryzae *and* Tribolium castaneum
5. Visit to poultry farm or animal breeding centre. Submission of visit report
6. Maintenance of freshwater aquarium

Question Pattern

Time: 2½ Hour **Full Marks: 25**

1. One question from item 1 = 04
2. One question from item 2 = 04
3. Identification and economic importance of two animals from item 4 ;2 × 2 = 04
4. One question from pest ;from item 3 = 06
5. Laboratory Note Book = 02
6. Internal Assessment = 05

SUGGESTED READINGS

- Arora, D. R and Arora, B. ;2001. *Medical Parasitology.* II Edition. CBS Publications
- Atwal, A.S. ;1986. *Agricultural Pests of India & South East Asia,* Kalyani Publishers
- Dennis, H. ;2009. *Agricultural Entomology.* Timber Press ;OR.
- Dunham R.A. ;2004. *Aquaculture and Fisheries Biotechnology Genetic Approaches.* CABI publications, U.K.

- Hafez, E. S. E. ;1962. *Reproduction in Farm Animals.* Lea & Fabiger Publisher
- Kumar and Corton. *Pathological Basis of Diseases*
- Park, K. ;2007. *Preventive and Social Medicine.* XVI Edition. B.B Publishers.
- Pedigo, L.P. ;2002. *Entomology and Pest Management,* Prentice Hall.
- Sarkar S; Kundu G & Chaki K C - Introduction to Economic Zoology, NCBA, Kolkata

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AQUATIC BIOLOGY THEORY; DSE2T

CLASS 60 **MARKS 50** **CREDITS 4**

Unit 1: Aquatic Bionics **15**

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

Unit 2: Freshwater Biology **15**

Lakes: Origin and classification, Lake as an Ecosystem, Lake morphometry, Physico-chemical Characteristics: Light, Temperature, Thermal stratification,Dissolved Solids, Carbonate, Bicarbonates, Phosphates and Nitrates, Turbidity; dissolved gases ;Oxygen, Carbon dioxide. Nutrient Cycles in Lakes-Nitrogen, Sulphur and Phosphorous.

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

Unit 3: Marine Biology **15**

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

Unit 4: Management of Aquatic Resources **15**

Causes of pollution: Agricultural, Industrial, Sewage, Thermal and Oil spills, Eutrophication, Management and conservation ;legislations, Sewage treatment Water quality assessment - BOD and COD

Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], four questions ;out of six of 4 marks each [4×4=16], and two questions ;out of four of 8 marks each [2×8=16], are to be answered

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AQUATIC BIOLOGY PRACTICAL ;DSE2P

MARKS 25 **CREDITS 2**

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

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Question Pattern

Time: 2½ Hour **Full Marks: 25**

1. One question from item 1 = 04
2. One question from item 2 = 04
3. One experiment from item 3 = 06
4. One question from item 4 = 04

5. Laboratory Note Book = 02
6. Internal Assessment = 05

SUGGESTED READINGS

- Anathakrishnan : Bioresources Ecology 3rdEdition
- Goldman : Limnology, 2nd Edition
- Odum and Barrett: Fundamentals of Ecology, 5th Edition
- Pawlowski : Physicochemical Methods for Water and Wastewater Treatment
- Sarkar S; Kundu G & Chaki K C - Introduction to Economic Zoology, NCBA, Kolkata
- Trivedi & Goyal: Chemical and biological methods for water pollution studies
- Welch : Limnology Vols. l-II

INSECT, VECTORS AND DISEASES THEORY ;DSE3T

CLASS 60 **MARKS 50** **CREDITS 4**

Unit I: Introduction to Insects **6**

General Features of Insects, Morphological features, Head - Eyes, Types of antennae, Mouth parts w.r.t. feeding habits

Unit II: Concept of Vectors **6**

Brief introduction of Carrier and Vectors ;mechanical and biological vector, Reservoirs, Host-vector relationship, Vectorial capacity, Adaptations as vectors, Host Specificity

Unit III: Insects as Vectors **8**

Classification of insects up to orders, detailed features of orders with insects as vectors - Diptera, Siphonaptera, Siphunculata, Hemiptera

Unit IV: Dipteran as Disease Vectors **24**

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 - Visceral Leishmaniasis, Cutaneous Leishmaniasis, Phlebotomus fever; Control of Sand fly;Study of house fly as important mechanical vector, Myiasis, Control of house fly

Unit V: Siphonaptera as Disease Vectors **6**

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

Unit VI: Siphunculata as Disease Vectors **4**

Human louse ;Head, Body and Pubic louse as important insect vectors; Study of louse-borne diseases -Typhus fever, Relapsing fever, Trench fever, Vagabond's disease, Phthiriasis; Control of human louse

Unit VII: Hempitera as Disease Vectors **6**

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

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Examination Pattern

Time: 2 Hour **Full Marks: 50**

40 theory + 10 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], four questions ;out of six of 4 marks each [4×4=16], and two questions ;out of four of 8 marks each [2×8=16], are to be answered

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INSECT, VECTORS AND DISEASES PRACTICAL ;DSE3P

MARKS 25 **CREDITS 2**

1. Study of different kinds of mouth parts of insects
2. Study of following insect vectors through permanent slides/ photographs: *Aedes, Culex, Anopheles, Pediculus humanus capitis, Pediculus*

humanus corporis, Phithirus pubis, Xenopsylla cheopis, Cimex lectularius, Phlebotomus argentipes, Musca domestica, through permanent slides/ photographs

3. Study of different diseases transmitted by above insect vectors

Submission of a project report on any one of the insect vectors and disease transmitted

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Question Pattern

Time: 2½ Hour **Full Marks: 25**

1. One question from item 1 = 04
2. Identification and importance of two vectors from item 2 ;2 × 5 = 10
3. One question from disease transmission ;from item 3 = 04
4. Laboratory Note Book = 02
5. Internal Assessment = 05

SUGGESTED READINGS

- Chapman, R.F. ;1998. *The Insects: Structure and Function.* IV Edition, Cambridge University Press, UK
- Imms, A.D. ;1977. *A General Text Book of Entomology.* Chapman & Hall, UK
- Mathews, G. ;2011. *Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases.* Wiley-Blackwell
- Pedigo L.P. ;2002. *Entomology and Pest Management.* Prentice Hall Publication
- Sarkar S; Kundu G & Chaki K C. - Introduction to Economic Zoology, NCBA, Kolkata

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SKILL ENHANCEMENT COURSES
APICULTURE ;SEC1T

MARKS 25 **CREDITS 2**

Unit 1: Biology of Bees **4**

History, Classification and Biology of Honey Bees Social Organization of Bee Colony

Unit 2: Rearing of Bees **10**

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

Unit 3: Diseases and Enemies **5**

Bee Diseases and Enemies Control and Preventive measures

Unit 4: Bee Economy **2**

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

Unit 5: Entrepreneurship in Apiculture **4**

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

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Examination Pattern

Time: 1 Hour **Full Marks: 25**

20 theory + 5 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], two questions ;out of four of 4 marks each [2×4=8], and one question ;out of three of 4 marks ;1×4= 4, are to be answered

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SUGGESTED READINGS

- Bisht D.S., Apiculture, ICAR Publication.
- Prost, P. J. ;1962. Apiculture. Oxford and IBH, New Delhi.

- Sarkar S; Kundu G & Chaki K C. - Introduction to Economic Zoology, NCBA, Kolkata
- Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.

AQUARIUM FISH KEEPING ;SEC2T

MARKS 25 **CREDITS 2**

Unit l: Introduction to Aquarium Fish Keeping **4**

The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes

Unit 2: Biology of Aquarium Fishes **8**

Common characters and sexual dimorphism of Fresh water and Marine Aquariumfishes 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 **5**

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

Unit 4: Fish Transportation **4**

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

Unit 5: Maintenance of Aquarium **4**

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

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Examination Pattern

Time: 1 Hour **Full Marks: 25**

20 theory + 5 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], two questions ;out of four of 4 marks each [2×4=8], and one question ;out of three of 4 marks ;1×4= 4, are to be answered

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SERICULTURE ;SEC3T

MARKS 25 **CREDITS 2**

Unit 1: Introduction **3**

Sericulture: Definition, history and present status; Silk route; Types of silkworms, Distribution and Races Exotic and indigenous races Mulberry and non-mulberry Sericulture

Unit 2: Biology of Silkworm **3**

Life cycle of *Bombyx mori;* Structure of silk gland and secretion of silk

Unit 3: Rearing of Silkworms **13**

Selection of mulberry variety and establishment of mulberry garden Rearing house and rearing appliances Disinfectants: Formalin, bleaching powder, RKO Silkworm rearing technology: Early age and Late age rearing Types of mountages; Spinning, harvesting and storage of cocoons

Unit 4: Pests and Diseases **4**

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

Unit 5: Entrepreneurship in Sericulture **2**

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

Examination Pattern

Time: 1 Hour **Full Marks: 25**

;20 theory + 5 internal assessments

Questions are to be set covering the entire syllabus; 4 questions ;out of six of 2 marks each [4×2=8], two questions ;out of four of 4 marks each [2×4=8], and one question ;out of three of 4 marks ;1×4= 4, are to be answered

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SUGGESTED READINGS

- Jolly, M. S.: Appropriate Sericultural Techniques; CSR & TI, Mysore.
- Krishnaswamy, S. 1986: Improved Method of Rearing Young age silkworm, CSB, Bangalore
- Narasimhanna, M. N. 1988, Manual of Silkworm Egg Production; CSB, Bangalore.
- Sarkar S; Kundu G & Chaki K C. - Introduction to Economic Zoology, NCBA, Kolkata
- Sengupta, K. 1989: A Guide for Bivoltine Sericulture; CSR & TI, Mysore.
- Ullal, S. R. and M. N. Narasimhanna: Handbook of Practical Sericulture: CSB, Bangalore
- Wupang Chun and Chen Da-Chung; 1988: Silkworm Rearing; FAO, Rome.