

THE UNIVERSITY OF BURDWAN



COURSE MODULE

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

SEMESTER I

(With effect from the session 2017-2018)

ANIMAL DIVERSITY

INVERTEBRATES	4 Credits	Class	TEACHER
Unit-1 Kingdom Protista		4	
General characters and classification up to classes		1	AB
Locomotory Organelles and locomotion in Protozoa		2	AB
Unit-2 Phylum Porifera		3	
General characters and classification up to classes		1	SC
Canal System in <i>Sycon</i>		2	SC
Unit-3 Phylum Cnidaria		3	
General characters and classification up to classes;		1	SM
Polymorphism in Hydrozoa		2	SM
Unit-4 Phylum Platyhelminthes		3	
General characters and classification up to classes;		1	MM
Life history of <i>Taenia solium</i>		2	MM
Unit-5 Phylum Nematoda		5	
General characters and classification up to classes		1	MM
Life history of <i>Ascaris lumbricoides</i> and its		3	MM
Parasitic adaptations of <i>Ascaris lumbricoides</i>		1	MM
Unit-6 Phylum Annelida		5	
General characters and classification up to classes		2	MM
Nephridia in Annelida		3	MM
Unit 7 Phylum Arthropoda		5	
General characters and classification up to classes		2	BM
Vision in Arthropoda		1	BM
Metamorphosis in Insects		2	BM
Unit-8 Phylum Mollusca		4	
General characters and classification up to classes		2	NR
Respiration in <i>Pila</i>		2	NR
Unit-9 Phylum Echinodermata		4	
General characters and classification up to classes		1	MM
Water-vascular system in <i>Asterias</i>		3	MM
Unit-10 Protochordates		2	
General features		1	SM
Feeding in <i>Branchiostoma</i>		1	SM
Unit-11 Agnatha		2	
General features of Agnatha		1	SM
classification of cyclostomes up to classes		1	SM
Unit-12 Pisces		4	
General features and Classification up to orders		1	AB
Osmoregulation in Fishes		3	AB

Unit-13 Amphibia	4	
General features and Classification up to orders	1	AB
Metamorphosis in Toad	3	AB
Unit-14 Reptiles	4	
General features and Classification up to orders	1	BM
Poisonous and non-poisonous snakes	1	BM
Biting mechanism in snakes	2	BM
Unit-15 Aves	5	
General features and Classification up to orders	1	NR
Flight adaptations in birds	4	NR
Unit-16 Mammals	5	
Classification up to orders	2	SC
Cranial nerves in <i>Cavia</i>	3	SC

Note: Classification of **Unit 1** to be followed from Levine *et al.* (1980) and **Unit 2-9** to be followed from “Ruppert & Barnes, R.D. (1994), *Invertebrate Zoology*, VI Edition

Suggested Readings [Consult Latest Editions]

1. Arora, M. P. *Chordata I. Himalaya Pub House*
2. Barnes, R. D. & Ruppert, E. E., (1994). *Invertebrate Zoology*. 6th Ed. Brooks Cole.
3. Brusca, R. C. & Brusca, G. J. (2002). *Invertebrates*. 4th Ed. Sinauer Associates.
4. Chatterjee, A & Chakraborty C.S. *Approach to a Text Book of Zoology* Nirmala Library, Kolkata.
5. Dhami P.S and J.K. Dhami – *Invertebrate Zoology* – S. Chand and Co.
6. Jordan, E. L. & Verma, P. S. (2006). *Invertebrate Zoology & Chordate Zoology*. S. Chand & Company Ltd. New Delhi.
7. Kardong, K. V. (2002). *Vertebrates: Comparative anatomy, function evolution*. Tata McGraw Hill.
8. Kent, G. C. & Carr, R. K. (2001). *Comparative anatomy of the Vertebrates*. 9th Ed. McGraw Hill.
9. Kotpal, R. L., 1988 – 1992. (All Series) Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, – Rastogi Publications, Meerut – 250 002.
10. Romer, A. S. & Parsons, T. S. (1986). *The vertebrate body*. 6th Ed. Saunders College Pub.
11. Ruppert E. E., Fox, R. & Barnes R. D. (2003). *Invertebrate Zoology: a Functional Evolutionary Approach*. 7th Ed. Brooks Cole.
12. Saxena, R. A. & Saxena, S. *Cooperative Anatomy of Vertebrates*. Viva Publication.
13. Sinha, K. S., Adhikari, S., & Ganguly, B. B. *Biology of Animals*. Vol. I, II. New Central Book Agency. Kolkata.
14. Young, J. Z. (2004). *The Life of Vertebrates*. III Edition. Oxford university press.

ANIMAL DIVERSITY PRACTICAL

(CREDITS 2)

1. Spot identification of the following specimens:

ARC

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

2. Study of the following permanent slides: Transverse section of male and female *Ascaris*

3. Identification of poisonous and non-poisonous snakes

4. An “animal album” containing photographs, cut outs, with appropriate write up about the above mentioned taxa. Different taxa/ topics may be given to different sets of students for this purpose.

Examination Pattern:

		Full Marks: 20
Spot identification (6 from Item 2, 3 from item 3)	(8 × 2)	= 16
Spot identification (1 each from item 2 & 3)	(2 × 2) =04	
Laboratory Note Book -----		= 03
Animal Album -----		=02
Suggested reading		
1. Chatterjee and Chatterjee: Practical Zoology		
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata		

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COURSE MODULE

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SEMESTER II

(With effect from the session JANUARY 2018- JUNE 2018)

**COMPARATIVE ANATOMY AND DEVELOPMENTAL BIOLOGY OF VERTEBRATES
(CREDITS 4)**

INVERTEBRATES	Class	TEACHER
Unit-1 Integumentary System	4	
Derivatives of integument with reference to glands	2	AB
Derivatives of integument with reference to digital tips	2	AB
Unit-2 Skeletal System	3	
Evolution of visceral arches	3	SC
Unit-3 Digestive System	4	
Brief account of alimentary canal	2	BM
Brief account of digestive glands	2	BM
Unit-4 Respiratory System	5	
Brief account of gills	1	SC
Brief account of lungs	2	SC
Brief account of air sacs	1	SC
Brief account of swim bladder	1	SC
Unit-5 Circulatory System	4	
Evolution of heart	2	BM
Evolution of aortic arches	2	BM
Unit-6 Urinogenital System	4	
Evolution of kidney	2	SC
Evolution of urinogenital ducts	2	SC
Unit 7 Nervous System	3	
Comparative account of brain	3	SC
Unit-8 Sense Organs	3	
Classification of receptors in vertebrate	1	MM
Brief account of auditory receptors in vertebrate	2	MM
Unit-9 Early Embryonic Development	12	
Gametogenesis: Spermatogenesis and oogenesis with reference to mammals	2	SM
Vitellogenesis in birds	1	SM
Fertilization: external (amphibians)	1	SM
Fertilization: internal (mammals)	1	SM

Blocks to polyspermy	1	SM
Early development of frog (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula)	2	SM
Early development of chick (structure of mature egg and its membranes, patterns of cleavage, fate map, up to formation of gastrula)	2	SM
Types of morphogenetic movements and Fate of germ layers	1	SM
Neurulation in frog embryo	1	NR
Unit-10 Late Embryonic Development	10	
Implantation of embryo in humans	2	NR
Types of placenta on the basis of histology	2	NR
Formation of human placenta and functions	2	NR
Metamorphic events in frog life cycle	2	NR
Hormonal regulation of metamorphosis in frog	2	NR
Unit-11 Control of Development	8	
Fundamental processes in development (brief idea) – Gene activation	2	MM
Fundamental processes in development (brief idea) – determination, induction, differentiation	2	MM
Fundamental processes in development (brief idea) – morphogenesis, intercellular communication	2	MM
Fundamental processes in development (brief idea) –cell movements and cell death	2	MM

Suggested Readings:

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

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

1. Osteology:

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

Examination Pattern:

Spot identification (5 from Item from item 1)	(5 × 2) = 10
Spot identification (5each from item 2, 3 &4)	(5 × 2) = 10
Laboratory Note Book	= 05

Full Marks: 20

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COURSE MODULES

**FOR THREE-YEAR DEGREE
COURSE IN ZOOLOGY (HONS) UNDER
CHOICE BASED CREDITS SYSTEM
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SEMESTER I

(With effect from the session 2017-2018)

2. Core Subjects Course Module

2.1. Core T1 – Non-Chordates I

Time: 2hrs

Full Marks: 50 (40 theory + 10 internal assessment) Lectures:

50

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

Non-Chordates I	4 Credits	Class	TEACHER
Unit 1: Basics of Animal Classification		4	
Definitions: Classification, Systematics and Taxonomy; Taxonomic Hierarchy, Taxonomic types.		1	NR
Codes of Zoological Nomenclature		1	NR
Principle of priority; Synonymy and Homonymy		1	NR
Six kingdom concept of classification (Carl Woese)		1	NR
Unit 2: Protista and Metazoa		15	
Protozoa General characteristics and Classification up to phylum (according to Levine et. al., 1981)		2	AB
Locomotion in <i>Euglena</i>		1	AB
Locomotion in <i>Paramecium</i>		1	AB
Locomotion in <i>Amoeba</i>		1	AB
Conjugation in <i>Paramecium</i>		2	BM
Life cycle and pathogenicity of <i>Plasmodium vivax</i>		2	BM
Life cycle and pathogenicity of <i>Entamoeba histolytica</i>		2	BM
Evolution of symmetry of Metazoa		2	BM
Evolution of segmentation of Metazoa		2	BM
Unit 3: Porifera		6	
General characteristics and Classification up to classes;		2	SC
Canal systems in sponges		2	SC
Spicules in sponges		2	SC
Unit 4: Cnidaria		10	
General characteristics and Classification up to classes		2	SM
Metagenesis in <i>Aurelia</i>		2	SM
Metagenesis in <i>Obelia</i>		2	SM
Polymorphism in Cnidaria		2	BM
Corals and coral reef diversity, function & conservation		2	SM
Unit 5: Ctenophora		2	
General characteristics		2	SC
Unit 6: Platyhelminthes		6	
General characteristics and Classification up to classes		2	MM
Life cycle and pathogenicity and control measures of <i>Fasciola hepatica</i>		2	MM

Lifecycle and pathogenicity and control measures of <i>Taenia solium</i>	2	MM
Unit 7: Nematoda	7	
General characteristics and Classification up to classes	1	MM
Life cycle, and pathogenicity and control measures of <i>Ascaris lumbricoides</i>	3	MM
Life cycle, and pathogenicity and control measures of <i>Wuchereria bancrofti</i>	3	MM

2.2.Core P1–Non-ChordatesI Lab

[Questions are to be set covering the entire syllabus; 7 questions each of 2 marks and 4 to be answered; 5questionseachof 6 marksand3to be answered; 4 questions of 12 marks and 2 to be answered]

Non- Chordates I		2 credits
List of Practical		Class
1. Preparation of stained whole mount of <i>Euglena</i> , <i>Amoeba</i> and <i>Paramecium</i>		6
2. Spot Identification of <i>Amoeba</i> , <i>Euglena</i> , <i>Entamoeba</i> , <i>Opalina</i> , <i>Paramecium</i> , <i>Plasmodium vivax</i> and <i>Plasmodium falciparum</i> (from the prepared slides)		4
3. Spot Identification of <i>Sycon</i> , Neptune's Cup, <i>Obelia</i> , <i>Physalia</i> , <i>Millepora</i> , <i>Aurelia</i> , <i>Tubipora</i> , <i>Corallium</i> , <i>Alcyonium</i> , <i>Gorgonia</i> , <i>Metridium</i> , <i>Pennatula</i> , <i>Fungia</i> , <i>Meandrina</i> , <i>Madrepora</i>		6
3. Spot Identification and significance of adult <i>Fasciola hepatica</i> , <i>Taenia solium</i> and <i>Ascaris lumbricoides</i> .		2
4. Staining/mounting of any protozoa/helminth from gut of cockroach		5
Time: 2Hrs 30mins		Full Marks: 25
Examination Pattern:		
Staining and Mounting-/Whole Mount (Item No.1)	-----	=10
Spot identification (1 from Item 2, 3from item 3)		(4X1.5) =06
Spot identification with significance(1 from item 4)		=02
Laboratory Note Book -----		=02
Internal Assessment-----		=05
Suggested Readings:		
1. Chatterjee and Chatterjee Practical Zoology		
2. Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata		
3. Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay Advanced Practical Zoology		

Suggested Readings:

1. Anderson, D. T. (Ed.) (2001). Invertebrate Zoology. 2nd Ed. Oxford University Press.
2. Barnes, R.D. & Ruppert, E. E., (1994). Invertebrate Zoology. 6th Ed. Brooks Cole.
3. Barrington, E. J. W. (1981). Invertebrate Structure and function. 2nd Ed. ELBS & Nelson.
4. Blackwelder, R. E., (1967). Taxonomy- A text and reference book. John Wiley & Sons.
5. Brusca, R.C. & Brusca, G. J. (2002). Invertebrates. 4th Ed. Sinauer Associates...
6. Dhami P.S and J.K. Dhami– Invertebrate Zoology– S. Chand and Co.
7. Hickman, C. P. Jr., F.M. Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times

Merrill / Mosby College Publication. St. Louis. 1065 pp.

8. Hyman, L. H. (1951). The Invertebrates (Vol-I). Mc.Graw Hill Book Company.
9. Jordan, E.L. & Verma, P.S. (2006). Invertebrate Zoology. S. Chand & Company Ltd. New Delhi.
10. Kapoor, V.C. (2008). Theory and practice of animal taxonomy. 6th Ed. Oxford & IBH Pub
11. Kotpal, R.L., 1988–1992. (All Series) Protozoa, Porifera, Coelenterata, Annelida, Arthropoda, Mollusca, Echinodermata, –Rastogi Publications, Meerut–250 002.
12. Mayr, E. (1969). Principles of Systematic Zoology. Tata McGraw-Hill.
13. Mayr, E. & Ashlock, P. D. (1991). Principles of Systematic Zoology. 2nd Ed., McGraw-Hill.
14. Meglitsch, P. A. & Schram, F. R. (1991). Invertebrate Zoology. Oxford University Press.
15. Parker, T. J. & Haswell, W. (1972). Text Book of Zoology, Volume I. Macmillan Press, London.
16. Pechenik, J. A. (1998). Biology of the Invertebrates, 4th Ed. McGraw Hill.
17. Ruppert E.E., Fox, R. & Barnes R.D. (2003). Invertebrate Zoology: a Functional Evolutionary Approach. 7th Ed. Brooks/Cole.
18. Sinha, K.S., Adhikari, S., & Ganguly, B.B. Biology of Animals. Vol. I. New Central Book Agency. Kolkata.

***Classification to be followed from Barnes and Rupert 1994, 6th Edition.**

3.3. Core T2–Ecology Course Module

Time:2hrs

Full Marks:50 (40 theory+10 internal assessment) Lectures:

50

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

Ecology	4 Credits	Class	TEACHER
Unit1: Introduction to Ecology		4	
History of ecology, Autecology and synecology		1	MM
Levels of organization		1	MM
Laws of limiting factors		1	MM
Study of Physical factors, The Biosphere		1	MM
Unit 2: Population		20	
Unitary and Modular populations Unique and group attributes of population: Demographic factors, dispersal and dispersion.		4	NR
Life tables, fecundity tables, survivorship curves		4	NR
Geometric, exponential and logistic growth, equation and patterns,		2	NR
R and k strategies Population regulation, density dependent and independent factors		4	NR
Population Interactions, Gause's Principle with laboratory and field examples		4	NR
Lotka-Volterra equation for competition.		2	NR
Unit3: Community		11	
Community characteristics: species diversity, abundance, dominance, richness,		4	SM
Vertical stratification		2	SM
Ecotone and edge effect.		1	SM
Succession with one example		4	BM
Unit 4: Ecosystem		10	
Types of ecosystem with an example in detail		1	AB
Food chain: Detritus and grazing food chains, Food web,		1	AB
Energy flow through the ecosystem: Linear and Y-shaped model		3	AB
Ecological pyramids		1	AB
Ecological efficiencies		1	AB
Nutrient and biogeochemical cycle with an example of Nitrogen cycle		2	BM
Human modified ecosystem		1	BM
Unit 5: Applied Ecology		5	
Wildlife Conservation (in-situ and ex-situ conservation).		3	SC
Management strategies for tiger conservation;		1	SC
Wildlife protection act (1972)		1	SC

3.4. Core P2– EcologyLab

Ecology	Credits 2	Class
List of Practical		
1. Study of life tables and plotting of survivorship curves of different types from The hypothetical/real data provided		8
2. Determination of population density in a natural/hypothetical community by quadrat method and calculation of Shannon-Weiner diversity index for the same community		8
3. Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, determination of pH and free CO ₂		8
4. Report on a visit to National Park/Biodiversity Park/Wildlife sanctuary/Biodiversity Centre/ Any Museum		1day
Time:2Hrs30mins	Full Marks: 25	
Examination Pattern:		
• 1 question (pH, freeCO ₂ estimation)	(8 X1)=	08
• 1 question From Item 1 and 2,	(8 X1)=	08
• Excursion Report	=	02
• Laboratory Note Book	=	02
• Internal Assessment	=	05
Suggested Readings:		
1. Robert Desharnais, Jeffrey Bell, 'Ecology Student Lab Manual, Biology Labs'		
2. Darrell S Vodopich, 'Ecology Lab Manual'		

Suggested readings:

1. Basu, R.N. (2004). A Compendium of Terms in Ecology and Environment. Naya Udyog.
2. Begon, M., Harper, J. L. & Townsend, C.R. (2006). Ecology: Individuals, Populations & communities. 4th Ed. Blackwell science.
3. Cain, Bowman & Hacker. Ecology. 3rd edition. Sinauer associates
4. Chapman, R. L. and Reiss, M. J. (2000). Ecology- Principles & Application. Cambridge University Press.
5. Colinvaux, P. (1993). Ecology 2. John Wiley & Sons, Inc. New York.
6. Dash, M.C., (2001). Fundamental of Ecology. 2nd Ed. Tata McGraw-Hill Company.
7. Faurie, C., Ferra, C., Medori, P. & Devaux, J. (2001). Ecology- Science and Practice. Oxford & IBH Pub. Company.
8. Freedman, B. (1989). Environmental Ecology. Academic press, Inc.
9. Joshi, P.C. & Joshi, N. (2009). A Text Book of Ecology and Environment. Himalaya Publishing House.
10. Kormondy, E. J. (2002). Concepts of Ecology. 4th Indian Reprint, Pearson Education.
11. Krebs, C. J. (2001). Ecology. Benjamin Cummings.
12. Krebs, C.J. (2016). Ecology: The Experimental Analysis of Distribution and Abundance. Pearson Education Limited, Noida, India.

13. Molles, Jr. M.C.(2005). Ecology: Concepts and Applications. 3rd Ed. McGraw- Hill.
14. Odum, E. P. & Barret, G.W. (2005). Fundamentals of Ecology. 5th Ed. Thompson Brooks/Cole.
15. Ricklefs, R. E. & Miller, G. L. (2000). Ecology. 4th Ed. W. H. Freeman & Company.
16. Russel, P.J., Wolfe, L. S., Hertz, P.E. Starr, C. & McMillan, B. (2008). Ecology.
17. Brooks/Cole. Saharia, V. B. (1998). Wildlife in India. Natraj Publishers.
18. Smith, R. L. & Smith, T. M.(2001). Ecology and Field Biology. Benjamin Cummings Pearson Education.
19. Smith, T. M. & Smith, R. L. (2006). Elements of Ecology. 6th Ed. Pearson Education.
20. Stiling, P. (2009). Ecology- Theories and Applications. 4th Ed. Prentice Hall of India.
21. Van Dyke, F. (2008). Conservation Biology: Foundations, Concepts, Application. 2nd Ed. Springer Science and Business Media.

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SEMESTER II

(With effect from the session 2017-2018)

3.5. Core T3- Non-Chordates II Course Module

Time: 2hrs

Full Marks: 50 (40 theory + 10 internal assessment) Lectures: 50

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

Non- Chordates II	4 Credits	Class	TEACHER
Unit 1: Introduction		2	
Evolution of coelom and metamerism		1	SC
Evolution of metamerism		1	SC
Unit 2: Annelida		10	
1. General characteristics and Classification up to classes		2	SM
2. Excretion in Annelida through nephridia.		4	NR
3. Metamerism in Annelida.		4	SC
Unit 3: Arthropoda		16	
1. General characteristic and Classification up to classes		2	SC
2. Vision in Insecta only.		2	SC
3. Respiration in Arthropoda (Gills in prawn)		3	SC
4. Respiration in Arthropoda (Trachea in cockroach)		3	SC
5. Metamorphosis in Lepidopteran Insects.		3	SM
6. Social life in termite		3	SM
Unit 4: Onychophora		2	
General characteristics		1	SC
Evolutionary significance		1	SC
Unit 5: Mollusca		10	
1. General characteristics and Classification up to classes		2	NR
2. Nervous system in Gastropoda		2	NR
3. Torsion in Gastropoda		2	NR
4. Feeding in <i>Pila</i> sp		2	NR
5. Respiration in <i>Pila</i> sp		2	NR
Unit 6: Echinodermata		8	
1. General characteristics and Classification up to classes		2	SM
2. Water-vascular system in Asteroidea		2	SM
3. Larval forms in Echinodermata		2	NR
4. Affinities with Chordates		2	NR
Unit 7: Hemichordata		2	
1. General characteristics of phylum Hemichordata		1	NR
2. Relationship with non-chordates and chordates		1	NR

Suggested Readings:

1. Anderson, D. T. (Ed.) (2001). Invertebrate Zoology. 2nd Ed. Oxford University Press.
2. Barnes, R.D. & Ruppert, E. E., (1994). Invertebrate Zoology. 6th Ed. Brooks Cole.
3. Barrington, E. J. W. (1981). Invertebrate Structure and function. 2nd Ed. ELBS & Nelson.
4. Brusca, R.C. & Brusca, G. J. (2002). Invertebrates. 4th Ed. Sinauer Associates...
5. Dhama P.S and J.K. Dhama–Invertebrate Zoology–S. Chand and Co.
6. Hickman, C.P. Jr., F.M. Hickman and L.S. Roberts, 1984. Integrated Principles of Zoology, 7th Edition, Times Mirror/Mosby College Publication. St. Louis. 1065pp.
7. Hyman, L. H. (1951). The Invertebrates (Vol-I). Mc.Graw Hill Book Company.
8. Jordan, E. L. & Verma, P.S. (2006). Invertebrate Zoology. S. Chand & Company Ltd. New Delhi.
9. Kotpal, R.L., 1988–1992. (All Series) Annelida, Arthropoda, Mollusca, Echinodermata, – Rastogi Publications, Meerut–250 002.
10. Meglitsch, P. A. & Schram, F. R. (1991). Invertebrate Zoology. Oxford University Press.
11. Parker, T. J. & Haswell, W. (1972). Text Book of Zoology, Volume I. Macmillan Press, London.
12. Pechenik, J. A. (1998). Biology of the Invertebrates, 4th Ed. McGraw Hill.
13. Ruppert E. E., Fox, R. & Barnes R.D. (2003). Invertebrate Zoology: a Functional Evolutionary Approach. 7th Ed. Brooks Cole.
14. Sinha, K. S., Adhikari, S., & Ganguly, B. B. Biology of Animals. Vol. I. New Central Book Agency (p) Ltd. Kolkata.

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

3.6. Core P3–Non-Chordates II

Non-Chordates II	2 Credits	Class
List of Practical		
1. Spot identification of following specimens (based on specimen characters): a. Annelids - <i>Aphrodite, Nereis, Heteronereis, Sabella, Chaetopterus, Pheretima, Hirudinaria</i>		4
b. Arthropods- <i>Carcinoscorpius, Palamnaeus, Palaemon, Daphnia, Balanus, Sacculina, Cancer, Eupagurus, Scolopendra, Julus, Bombyx, Periplaneta, Odontotermes and Apis</i>		4
c. Onychophora- <i>Peripatus</i>		1
d. Molluscs - <i>Chiton, Dentalium, Pila, Doris, Helix, Lamellidens, Ostrea, Pinctada, Sepia, Octopus, Nautilus</i>		4
e. Echinoderms- <i>Pentaceros / Asterias, Ophiura, Clypeaster, Echinus, Cucumaria and Antedon</i>		4
f. Hemichordates- <i>Balanoglossus</i>		1
2. Study of digestive system, septal nephridia and pharyngeal nephridia of earthworm using model and chart		2
3. T.S. through pharynx, gizzard, and intestine at typhlosolar region of earthworm		3
4. Mount of mouthparts and study of digestive system and nervous system of <i>Periplaneta*</i>		8

5. To submit a Project Report on any related topic on larval forms (arthropods, mollusc and echinoderm)			
Time:2Hrs 30mins		Full Marks:25	
Examination Pattern:			
Dissection (From item No. 2 and/or 4) any one	(10 ×1)	=10	
Spot identification(any four)	(1.5×4)	=06	
Project Report		=02	
Laboratory Note Book		=02	
Internal Assessment		=05	
Suggested Readings:			
Chatterjee and Chatterjee Practical Zoology			
Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata			
Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay Advanced Practical Zoology			

3.7. Core T4- Cell Biology Course Module

Time:2hrs

Full Marks:50 (40 theory+10 internal assessment) Lectures: 50

Questions are to beset covering the entire syllabus; 4 questions (out of six) of 2 marks each, four questions (out of six) of 4 marks each and two questions (out of four) of 8 marks each are to be answered

Cell Biology	Credits4	Class	TEACHER
Unit1: Overview of Cells		2	
Basic structure of Prokaryotic and Eukaryotic cells		1	MM
Basic structure of Viruses, Viroid, Prion and Mycoplasma		1	MM
Unit2: Plasma Membrane		6	
1. Ultra structure and composition of Plasma membrane: Fluid mosaic model		2	BM
2. Transport across membrane: Active and Passive transport, Facilitated transport		2	BM
3. Cell junctions: Tight junctions, Gap junctions, Desmosomes		2	BM
Unit3:CytoplasmicorganellesI		5	
1. Structure and Functions: Endoplasmic Reticulum		2	BM
1. Structure and Functions: Golgi Apparatus		1	BM
1. Structure and Functions: Lysosomes		1	BM
2. Protein sorting and mechanisms of vesicular transport		1	BM
Unit4:CytoplasmicorganellesII		6	
1. Mitochondria: Structure, Semi-autonomous nature		1	BM
1. Mitochondria: Endosymbiotic hypothesis.		1	BM
2. Mitochondria: Mitochondrial Respiratory Chain		1	BM
3. Mitochondria: Chemiosmotic hypothesis.		1	BM
4. Structure and Functions of Peroxisome		1	BM
5. Structure and Functions of Centrosome		1	BM
Unit5:Cytoskeleton		5	
1. Type, structure and functions of cytoskeleton		2	MM
2. Accessory proteins of microfilament µtubule		2	MM
3. A brief idea about molecular motors		1	MM
Unit6:Nucleus		8	
1. Structure of Nucleus: Nuclear envelope, nuclearpore complex, Nucleolus		2	AB
2. Structure of Nucleus: Nucleolus.		2	AB
3. Chromatin: Euchromatin and Heterochromatin		2	AB
4. Chromatin: Packaging of chromatin (nucleosome)		2	AB

Unit7:CellDivision	10	
1. Cell cycle: Definition, types, and models	1	MM
2. Cell cycle regulation	1	MM
2. Cancer (Concept of oncogenes with special reference to and Ras and APC.	2	MM
2. Cancer (Concept of tumor suppressor genes with special reference to p53, Retinoblastoma	2	MM
3. Mitosis: Basic process and their significance	2	MM
3. Meiosis: Basic process and their significance	2	MM
Unit8:Cell Signalling	8	
1. Cell signalling transduction pathways: Definitions, types	1	AB
2. Types of signalling molecules and receptors	1	AB
3. GPCR and Role of second messenger (cAMP)	2	AB
4. Extracellular matrix	2	AB
5. Cell interactions Apoptosis and Necrosis	2	AB

Suggested Readings:

1. Albert Bruce, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London.
2. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
3. Hardin, J. Bertoni, Gand Kleinsmith, J.L. (2012). Becker's World of the Cell. 8th Edn, Pearson Benjamin Cummings, San Francisco.
4. Harvey, L. (2004). Molecular Cell Biology. 5th Edn. W.H. Freeman
5. Karp, G. (2008). Cell and Molecular biology: Concepts and Application. 5th Edn, John Wiley.
6. Lodish, Berk, Matsudaira, Kaiser, Bretscher, Ploegh, Amon, and Martin (2016) Molecular Cell Biology. 8th Edn. W.H. Freeman
7. Pal, A. (2011). Textbook of Cell and Molecular Biology 3rd Edn, Bokks and Allied, Kolkata.
8. Plopper, G.D. Sharp, Siroski, E (2015) Lewin's Cell 3rd Edition—Johns & Bartlett Publishers
9. Pollard and Earnshaw (2007). Cell Biology. 2nd. Edn Saunders.
10. Reed, J.C. and Green, D.R. (2011). Apoptosis: Physiology and Pathology. Cambridge Univ. Press
11. Verma and Agarwal. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand Pub, Weinberg R.A. (2014). Biology of Cancer. 2nd edition. Garland Science, Taylor and Francis

3.8. CoreP4–Cell Biology Lab

Cell Biology	2 Credits		Class	Teacher
List of Practical				
1. Preparation of temporary stained squash of onion root tip to study various stages of mitosis		MM	2. Squash preparation of grasshopper testis and study of the various stages of meiosis.	
3. Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.		BM	4. Study of cell viability by Trypan Blue staining from onion root tip/ blood cell.	AB
<p>Time:2Hrs 30mins Full Marks: 25</p> <p>Examination Pattern:</p> <p>1 question on squash preparation from Item No. 1 or 2 -----(8X 1)= 08</p> <p>Preparation of slide(From Item 3or 4) ----- (10X 1)= 04</p> <p>Identification of stages of mitosis and meiosis (1.5X4) =</p> <p style="padding-left: 150px;">06</p> <p>Laboratory Note Book----- =</p> <p style="padding-left: 150px;">02</p>				
<p>Suggested Readings:</p> <p>Chatterjee and Chatterjee Practical Zoology</p> <p>Ghosh, K.C. and Manna, B. (2015): Practical Zoology, New Central Book Agency, Kolkata</p> <p>Sinha, J.K. , Chatterjee, A.K. and P. Chattopadhyay Advanced Practical Zoology</p>				