

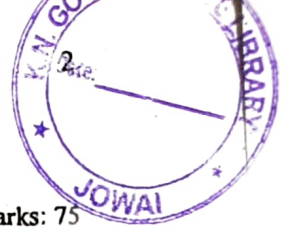


Department of Zoology
North-Eastern Hill University, Shillong

B. Sc. Zoology (Honours)
Syllabus
(Under Semester System)
2014

Manish Singh
17/9/2015

Year	Semester	Title	Paper No. & Marks	Papers	Paper-wise Marks
First Year	1 st Semester	Systematics, Animal Diversity and Evolution	Paper 1 100 Marks (4 Credits)	Paper 1A (Theory) Paper 1B (Practical)	75 25
	2 nd Semester	Cell Biology and Genetics	Paper 2 100 Marks (4 Credits)	Paper 2A (Theory) Paper 2B (Practical)	75 25
Second Year	3 rd Semester	Animal Physiology, Endocrinology and Biochemistry	Paper 3 100 Marks (4 Credits)	Paper 3A (Theory) Paper 3B (Practical)	75 25
	4 th Semester	Developmental Biology, Ecology and Economic Zoology	Paper 4 100 Marks (4 Credits)	Paper 4A (Theory) Paper 4B (Practical)	75 25
Third Year	5 th Semester	Functional Anatomy, Zoogeography and Adaptations	Paper 5 100 Marks (4 Credits)	Paper 5A (Theory) Paper 5B (Practical)	75 25
		Cell and Molecular Biology, and Genetics	Paper 6 100 Marks (4 Credits)	Paper 6A (Theory) Paper 6B (Practical)	75 25
	6 th Semester	Biochemistry, Animal Physiology and Endocrinology	Paper 7 100 Marks (4 Credits)	Paper 7A (Theory) Paper 7B (Practical)	75 25
		Developmental Biology, Environmental Biology and Biotechnology	Paper 8 100 Marks (4 Credits)	Paper 8A (Theory) Paper 8B (Practical)	75 25
Total Marks			800 Marks (32 Credits)		800 Marks (32 Credits)



Manna
17/11/2011

- Unit-I:** Systematics: Definition; Taxonomic hierarchy; Binomial nomenclature; Six-kingdom classification (Bacteria, Protozoa, Fungi, Plantae, Animalia and Chromista); Classification, salient characteristics and examples of Non-chordates (Kingdom Protozoa up to phyla, other major phyla up to classes) and Chordates (up to classes); Introduction to minor phyla.
- Unit-2:** Protozoa: *Paramecium* - Morphology and reproduction; Life cycle and pathogenicity of *Entamoeba histolytica* and *Plasmodium vivax*.
Porifera: *Sycon* - Skeletal and canal systems.
Coelenterata: *Obelia* - Morphology and reproduction.
Helminthes: *Ascaris lumbricoides* - Morphology, life cycle and pathogenicity.
- Unit - 3:** Annelida: Leech - Morphology; digestive and urinogenital systems.
Arthropoda: Cockroach - Morphology; Digestive, respiratory, excretory and reproductive systems.
Mollusca: *Pila* - Morphology; digestive, respiratory and nervous systems.
Echinodermata: *Asterias* - Morphology and water vascular system.
- Unit - 4:** Hemichordata: Salient features of *Balanoglossus*.
Protochordata: Salient features of *Amphioxus*.
Petromyzon - Morphology, Respiratory and reproductive systems.
Pisces: *Labeo* - Morphology, digestive and respiratory systems.
Rabbit - Type study (morphology; digestive, respiratory, circulatory, urinogenital and nervous systems).
- Unit - 5:** Origin of life; Theories of evolution: Lamarckism, Darwinism and Synthetic theory; Evidences of evolution - anatomical, embryological and paleontological; Geological time scale; Introduction to Evolution of man.

Suggested Readings:

- Ghosh, K. C. and Manna, B. (2004). Fundamentals of Zoology. New Central Book Agency. Kolkata.
- Hall, B.K. and Hallgrímsson, B. (2008), Strickberger's Evolution, 4th Edition. Jones and Bartlett Publishers.
- Jordan, E. L. and Verma, P. S. (1993). Chordate Zoology. S. Chand Company Ltd.
- Jordan, E. L. and Verma, P. S. (1992). Invertebrate Zoology. S. Chand Company Ltd.
- Kotpal, R. L. (2012). Modern Textbook of Zoology: Invertebrates. R. K. Rastogi Publications.
- Kotpal, R. L. (2012). Modern Textbook of Zoology: Vertebrates. R. K. Rastogi Publications.
- Mayer, E. (1980). Principles of Systematic Zoology. Addison-Wesley Publishing Company, Inc.
- Mayr, E. and Ashlock (1991), Principles of Systematic Zoology, 2nd Edition. McGraw Hill and Company.
- Minnelli, A. (1993). Biological Systematics. Chapman & Hall.
- Pough, F.H., Janis, C.M. and Heiser, J. B. (2012). Vertebrate Life, 9th Edition. Pearson Benjamin Cummings.
- Raven, P. H. (2005). Biology. McGraw Hill Education Ltd.
- Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V. and Jackson, R.V. (2011). Campbell Biology. Pearson Benjamin Cummings.
- Ruppert, E. E., Fox, R. S. and Barnes, R. D. (2006). Invertebrate Zoology: A Functional Evolutionary Approach, 7th Edition. Cengage Learning India.
- Sadava, D., Hillis, D. M., Heller, H. C. and Berenbaum, M.R. (2011). Life: The Science of Biology, 9th Edition. Sinauer Associates Inc. Publishers.

- 3
15. Sinha, A.K., Adhikari, S. and Ganguly, B. B. (2012). *Biology of Animals*, Vol. I & II. New Central Book Agency. Kolkata.
16. Sinha, A.K., Adhikari, S. and Ganguly, B. B. (2012). *Fundamentals of Biology*, New Central Book Agency, Kolkata.
17. Young, J. Z. (2004). *Life of Vertebrates*, 3rd Edition, Oxford University Press.

Paper 1B (Practical)

Systematics, Animal Diversity and Evolution

Marks: 25
Time: 4 Hours

A. Dissections:

1. Nervous system of cockroach.
2. Reproductive system of cockroach.
3. Digestive system of *Channa/Labeo/common carp*.
4. Afferent brancial system of *Channa/Labeo/common carp*.
5. Demonstration of dissections of arterial, digestive and urinogenital systems of albino rat/albino mouse/chicken.

B. Mounting:

1. General protocol for preparation of permanent microscopic slides: Basic concepts of fixation, staining, dehydration, clearing and mounting.
2. Permanent stained preparations of the following:
 - i) *Paramecium/Euglena* (whole mount)
 - ii) *Obelia* Colony
 - iii) Parapodium of *Nereis*
 - iv) Gemmules of sponge (whole mount)
 - v) Blood film of a vertebrate (single stain)

C. Osteology - Mammalia:

1. Vertebrae
2. Limb bones and girdles
3. Skull

D. Study of Prepared Slides:

1. T/S of Earthworm through typhlosolar region.
2. T/S of male and female *Ascaris*
3. T/S of *Amphioxus* through branchial region
4. T/S of stomach, intestine, liver, pancreas, lung, kidney and gonads of a vertebrate.

E. Study of Museum Specimens:

1. Representatives from Non-chordates and Chordates.
2. Study of fossils.
3. Evidences of evolution through chart and models.

Distribution of Marks

1. Dissection
2. Mounting
3. Spotting
 - a) Museum specimens
 - b) Osteology
 - c) Prepared slides
4. Laboratory Record

**Total****25 (Internal test - 7 + End semester test - 18)**

Paper 3A

Animal Physiology, Endocrinology and Biochemistry (Theory)

Marks: 75
Time: 3 Hours

Unit-1: Physiology of digestion and absorption of carbohydrates, proteins and lipids; Vitamins: Types, sources and their significance. Respiration: Breathing and gaseous exchange in vertebrate lung. Composition and functions of blood; Types of heart in vertebrates; Structure of mammalian heart.

Unit-2: Structure of mammalian kidney and nephron; Physiology of urine formation. Ultrastructure of skeletal muscle; Mechanism of skeletal muscle contraction. Ultrastructure of neuron; Nerve impulse conduction and synaptic transmission; Reflex action.



- Unit-3:** Structure and functions of major endocrine glands: Hypothalamus, pituitary, thyroid, parathyroid, pancreas, adrenals, testis and ovary. Introduction to neuroendocrine system in insects.
- Unit-4:** Classification and significance of carbohydrates, proteins and lipids. Amino acids: Essential and non-essential. Glycolysis and TCA cycle; β -Oxidation of fatty acids.
- Unit-5:** Enzymes: Properties, classification and nomenclature; Active site and mechanism of enzyme action; Factors affecting enzyme activity; Co-factors and co-enzymes. Nucleic acids: Nucleosides, nucleotides and polynucleotides; Double helical structure of DNA and structure of RNA.

Suggested Readings:

1. Berg, J., Tymoczko, J., and Stryer, L. (2012). Biochemistry, 7th Edition, W. H. Freeman.
2. Campbell, M. K. and Farrell, S. O. (2010). Introduction to Biochemistry. Cengage Learning India.
3. Hadley, M. E. & Levine (2007). Endocrinology, 6th Edition. Pearson, Benjamin Cummings.
4. Hall, J. E., (2011). Guyton and Hall Textbook of Medical Physiology, 12th Edition (Indian print). Saunders, Elsevier Inc.
5. Hill, R. W., Wyse, G. A. and Anderson, M. (2012). Animal Physiology, 3rd Edition, Sinauer Associates Inc.
6. Melmed, S., Polonsky, K. S., Larsen, P. R., and Kronenberg, H. M., (2011). William's Textbook of Endocrinology, 12th Edition. Saunders.
7. Murray, R. K. *et al.*, (2011). Harper's Illustrated Biochemistry, 29th Edition. McGraw Hill, Lange Publication.
8. Nelson, D. L. and Cox, M. (2012). Lehninger Principles of Biochemistry, 6th Edition, W. H. Freeman.
9. Norman, A. W. and Litwack, G. (1997). Hormones, 2nd Edition, Academic Press, Elsevier Inc.
10. Norris, D. O. (2007). Vertebrate endocrinology. 6th Edition. Academic Press, Elsevier Inc.
11. Prosser, C. L. (1991). Comparative Animal Physiology. W. B. Saunders & Company.
12. Randall, D. and Burggren, W. (2001). Eckert Animal Physiology, 5th Edition. W.H. Freeman.
13. Schmidt-Nielsen, K. (2002). Animal Physiology: Adaptation and Environment. Cambridge University Press.
14. Sherwood, L., Klandorf, H., and Yanchey, P. (2010). Textbook of Animal Physiology. Cengage Learning.

Paper 3B (Practical)

Animal Physiology, Endocrinology and Biochemistry

Marks: 25
Time: 4 Hours

1. Preparation of haemin crystals from human blood.
2. Determination of clotting time of human blood.
3. Oxygen consumption in fish with reference to body weight.
4. Study of histology of endocrine glands from permanent slides (pituitary, thyroid, thymus, pancreas, adrenal, testis and ovary).
5. Detection of carbohydrates, lipids and proteins (at least 3 tests each).
6. Estimation of ascorbic acid by titration method.



Distribution of Marks

1. Physiology
2. Biochemistry
3. Spotting
4. *Viva Voce*
5. Laboratory Record

Total **25 (Internal test – 7 + End semester test - 18)**

Paper 5A

Functional Anatomy, Zoogeography and Adaptations (Theory)



Marks: 75
Time: 3 Hours

- Unit - 1:** Protozoa: Locomotion and nutrition.
Porifera: Canal and skeletal systems.
Cnidaria: Polymorphism in *Siphonophora*; Corals and coral reefs.
Morphological and physiological adaptations of parasitic helminthes.
Annelida: Excretory system.
- Unit - 2:** Onychophora: General organization and affinities.
Arthropoda: Types of mouth parts and feeding in insects; Vision in insects.
Mollusca: Torsion and detortion in Gastropoda.
Echinodermata: Comparative study of water vascular system.
- Unit - 3:** Hemichordata: Affinities of *Balanoglossus*
Protochordata: Affinities of *Amphioxus*.
Retrogressive metamorphosis in *Ascidia*.
Agnatha: Comparative study of *Petromyzon* and *Myxine*.
Pisces: Scales and fins in fishes; Accessory respiratory organs; Migration of fishes.
Dipnoi: General characters and affinities.
- Unit - 4:** Amphibia: Parental care.
Reptilia: Poisonous and nonpoisonous snakes; Poison apparatus and mechanism of biting.
Aves: Flight adaptations and migration in birds.
Mammalia: Affinities of Monotremata and Marsupialia; Dentition in mammals.
Comparative anatomy of kidney in vertebrates.
- Unit - 5:** Zoogeography: Concepts and Zoogeographic realms. Patterns and regulation of behaviour: genetic and hormonal; Colouration and mimicry.
Adaptations in vertebrates: Aquatic, desert, arboreal, cursorial and deep sea adaptations.

Suggested Readings:

1. Agarwal, V. K. (2010). Animal Behaviour (Ethology). S. Chand & Co.
2. Brusca, R. C. and Brusca, G. J. (2003). Invertebrates, 2nd Edition. Sinauer Associates, Inc. Publishers.
3. Hall, B.K. and Hallgrímsson, B. (2008). Strickberger's Evolution, 4th Edition. Jones and Bartlett Inc.
4. Jordan, E. L. and Verma, P. S. (1992). Invertebrate Zoology. S. Chand Company Ltd.
5. Jordan, E. L. and Verma, P. S. (1993). Chordate Zoology. S. Chand & Co.
6. Kardong, K. V. (2006). Vertebrates: Comparative Anatomy, McGraw Hill Education (India) Ltd.
7. Kotpal, R. L. (2012). Modern Textbook of Zoology: Invertebrates. R. K. Rastogi Publications,
8. Kotpal, R. L. (2012). Modern Textbook of Zoology: Vertebrates. R. K. Rastogi Publications,
9. Lull, R. S. (1984). Organic Evolution. Seema Publication, New Delhi.
10. Manning, A. and Dawkins, M S. (2012). An Introduction to Animal Behaviour, 6th Edition. Cambridge University Press.
11. Pough, F. H., Janis, C. M. and Heiser, J. B. (2012). Vertebrate Life, 9th Edition, Pearson Benjamin Cummings.
12. Ruppert, E. E., Fox, R. S. and Barnes, R. D. (2006). Invertebrate Zoology: A Functional Evolutionary Approach, 7th Edition. Cengage Learning India.



13. Sinha, A. K., Adhikari, S. and Ganguly, B. B. (2010). Biology of Animals, Vols. I & II. New Central Book Agency. Kolkata.
14. Sinha, A. K., Adhikari, S. and Ganguly, B.B. (2010). Fundamentals of Biology. New Central Book Agency. Kolkata.
15. Young, J. Z. (2004). Life of Vertebrates, 3rd Edition, Oxford University Press.

Paper 5B (Practical)

Functional Anatomy, Zoogeography and Adaptations

Marks: 25
Time: 4 Hours

A. Dissections:

1. Nervous system in prawn/earthworm.
2. Accessory respiratory organs in teleost fish.
3. Digestive system in albino rat/ albino mouse/chicken.
3. Reproductive system in albino rat/ albino mouse/chicken.

B. Mounting (Permanent):

1. Cyclops.
2. Setae of earthworm.
3. Spicules of sponge.
4. Scales (cycloid, ctenoid and placoid) of fishes.
5. Feathers of birds (filoplumes, down feathers, barbs and barbules).

C. Study of Permanent Slides and Specimens:

1. Histology: T/S of stomach, intestine, liver, kidney, spleen and gonads of fish/Aves/mammals.
2. Permanent slides of representatives from Protozoa to Echinodermata (sections and whole mounts).
3. Adaptive modifications of beak and feet in birds using charts and models.

Distribution of Marks:

1. Dissection
2. Mounting
3. Spotting
4. *Viva Voce*
5. Laboratory Record

Total 25 (Internal test – 7 + End semester test - 18)



Paper 6A

Cell and Molecular Biology, and Genetics (Theory)

Marks: 75
Time: 3 Hours

- Unit-1:** Genome organization in virus, bacteria and eukaryotes. Central dogma of molecular biology; DNA replication in prokaryotes; Transcription and translation in prokaryotes; Genetic code. Regulation of gene expression in prokaryotes: *lac* operon.
- Unit -2:** Fine Structure of gene: Cistron, recon and muton; Split genes and overlapping genes; Transposons. Gene mutation: Types and mutagenic agents; DNA damage and repair. Detection of mutation in *Drosophila* (Muller's *CIB* method).
- Unit-3:** Extra-nuclear inheritance: Kappa particles in *Paramecium*. Sex-linked inheritance in *Drosophila* (eye color) and man (colour blindness); Dosage compensation and Lyon's hypothesis. Non-disjunction of sex chromosomes in *Drosophila*; Human karyotype; Sex determination in man; Genetic disorders in man – Down's, Turner's and Klinefelter's syndromes, Phenylketonuria, Hemophilia.
- Unit-4:** Humoral and cell mediated immunity; Characteristics of antigens; Antibodies: Structure, classes and functions; Antigen-antibody interaction; Major histocompatibility complex; Introduction to cytokines.
- Unit-5:** Principles and applications of biological techniques: Light and electron microscopy; Centrifugation; Chromatography (paper, gel filtration and ion-exchange).

Suggested Readings:

1. Albert, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. (2007). *Molecular Biology of the Cell*, 5th Edition. Garland Publishing, London.
2. Brown, T. A. (2006). *Genomes 3*. Garland Science.
3. Cooper, G. M. and Hausman, R. E. (2009). *The Cell: A Molecular Approach*, 5th Edition. Sinauer Associates Inc. Publishers.
4. Delves, P. J., Martin, S. J., Burton, D. R. and Roitt, I. M. (2011). *Roitt's Essential Immunology*, 12th Edition. Wiley-Blackwell.
5. Gardener, E. J., Simmons, M. J. and Snustad, D. P. (2005). *Principles of Genetics*, 8th Edition. John Wiley and Sons.
6. Hardin, J., Bertoni, G. P. and Kleinsmith, L. J. (2012). *Becker's World of the Cell*, 8th Edition. Benjamin Cummings.
7. Karp, G. (2010). *Cell Biology*, 6th Edition. John Wiley & Sons, Inc.
8. Khan, F. H. (2010). *Immunology*. Pearson Education India.
9. Klug, W. S., Cummings, M. R., Spencer, C. A. and Palladino, M. A. (2012). *Concepts of Genetics*, 10th Edition. Benjamin Cummings.
10. Krebs, J., Goldstein, E. and Kilpatrick, S. (2011). *Lewin's Genes X*. Jones & Bartlett Learning.
11. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M P. (2012). *Molecular Cell Biology*, 7th Edition. W.H. Freeman.
12. Owen, J., Punt, J. and Stranford, S. (2012). *Kuby Immunology*, 7th Edition. W. H. Freeman & Company.
13. Pathak, S. and Palan, U. (2012). *Immunology*, 11th Edition. Science Publishers.
14. Pierce, B. (2012). *Genetics: A Conceptual Approach*, 4th Edition. W.H. Freeman
15. Strickberger, M. W. (2006). *Genetics*, 3rd Edition. Macmillan Publishing Company.
16. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M. and Losick, R. (2008). *Molecular Biology of the Gene*, 6th Edition. Pearson, Benjamin Cummings.

17. Wilkins, K. and Walker, J (2012). Practical Biochemistry: Principles and Techniques. Cambridge University Press.



Paper 6B (Practical)

Cell and Molecular Biology, and Genetics

Marks: 25
Time: 4 hours

1. Separation and identification of amino acids by paper chromatography.
2. Demonstration of antigen-antibody interaction *in vitro*: Single radial immuno-diffusion in agarose gel.
3. Study of nucleic acids from models/charts.
4. Calorimetric estimation of DNA and RNA.
5. Preparation and identification of meiotic stages from grasshopper testis.
6. Karyotyping of normal human chromosomal complement from supplied photographic plates.
7. Karyotyping of chromosomal complement of Down's/Turner's/Klinefelter's syndrome from supplied photographic plates.
8. Demonstration of electrophoretic separation of DNA/protein.

Distribution of Marks

1. Cell biology & Genetics
2. Molecular Biology
3. Spotting
4. *Viva Voce*
5. Laboratory Record

Total **25 (Internal test – 7 + End semester test - 18)**