

NATIONAL UNIVERSITY



Second Year Syllabus Department of Botany

Four Year B.Sc. Honours Course
Effective from the Session: 2013–2014

National University
Subject: Botany
Syllabus for Four Year B.Sc. Honours Course
Effective from the Session: 2013-2014

Year wise Papers and marks distribution

SECOND YEAR

Paper Code	Paper Title	Credits
223001	Higher Cryptogams	4
223003	Taxonomy of Angiosperms	4
223005	Plant Anatomy and Embryology	4
223006	Practical- II	4
222807	General Chemistry-II	4
222809	Environmental Chemistry	2
223107	Zoology- II	4
223108	Zoology Practical- II	2
	Total =	28
221109	English (Compulsory)	Non-Credit

Detailed Syllabus

Paper Code	223001	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Higher Cryptogams			

A. Bryophyta (Marks 50)

1. Introduction: General characters and classification of Bryophyta; range of structures in relation to habit, habitat and distribution; alternation of generations in Bryophyta.
2. Habit, habitat, distribution, external and internal features, growth, reproduction, spore dispersal mechanism, ecology, importance and phylogeny of the following groups:
 - i. Hepaticae, (ii) Anthocerotae and (iii) Musci
3. Life history of the following:
 - (a) Sphaerocarpaceae- *Sphaerocarpus*
 - (b) Marchantiales- *Riccia* and *Marchantia*
 - (c) Jungermanniales- *Pelia* and *Porella*
 - (d) Anthocerotales-*Anthoceros*
 - (e) Sphagnobrya- *Sphagnum*
4. Fossil bryophytes.
5. Origin and evolution of Bryophyta.

B. Pteridophyta (Marks 50)

1. Introduction: General characters and classification of Pteridophyta.
2. Origin and evolution of Pteridophyta.
3. Types of stele and their evolution.
4. Habit, habitat, distribution, external and internal features, reproduction, ecological and economic importance and phylogeny of the following groups:
 - (i) Psilophyta: Psilotales
 - (ii) Lepidophyta: Lycopodiales and Selaginellales (with reference to heterospory and seed habit)
 - (iii) Calamophyta: Equisetales
 - (iv) Pterophyta: (a) Definition of Eu- and Leptosporangiate and development of Eu- and Leptosporangiate sporangia; (b) Eusporangiate: Ophioglossales; (c) Leptosporangiate: (i) Filicales- Osmundaceae, Polypodiaceae and Parkeriaceae, (ii) Marsileales and (iii) Salviniales.
5. Life history of the following:
 - (i) Psilopsida- *Psilotum*

- (ii) *Eligulopsida- Lycopodium and Selaginella*
 - (iii) *Calamopsida- Equisetum*
 - (iv) *Eusporangiopsida- Ophioglossum*
 - (v) *Protileptosporangiopsida-Osmunda*
 - (vi) *Leptosporangiopsida- Pteris, Marsilea and Azolla*
6. Spore dispersal mechanisms in Pteridophyta.

Books Recommended

1. Bapna, K.R. and P. Kachroo. 2000. Hepaticology in India-I & II. Himangshu Publications, Udaipur, Delhi.
2. Emes, A.J. 1964. Morphology of vascular plants. Tata McGraw-Hill Publishing Co., Ltd., Bombay
3. Parihar, N.S. 1956. An Introduction to Embryophyta Vol. I, & II Central Book Depot, Allahabad.
4. Rashid, A. 1976. An Introduction to Pteridophyta, Vikas Publishing House Pvt. Ltd. 576 Masjid Road, Jangpura, New Delhi.
5. Smith, G.M. 1955. Cryptogamic Botany, Vol. I & II. McGraw-Hill Book Company Inc. New York, London.
6. Vashista, P.C. 1993. Botany for Degree Students: Pteridophyta, S. Chand and Company Ltd., Ramnagar, New Delhi.
7. Watson, E.V. 1974. The Structure and Life of Bryophytes. B.I. Publications. Bombay-Calcutta-Delhi-Madras.

Paper Code	223003	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Taxonomy of Angiosperms			

1. **Introduction:** Definition, scope, basic components, principles and units of classification, taxonomic hierarchy, aims and objectives of plant taxonomy.
2. **Development of plant classification:** Pre-Darwinian and Post Darwinian classification, comparison among the contemporary systems of classifications.
3. **Origin and evolution of Angiosperms:** Origin and phylogeny of Magnoliopsida and Liliopsida.
4. **Nomenclature and ICBN's:** Binomial system of nomenclature; historical background of ICBN; principles of ICBN; rules, regulations and recommendations of ICBN; major provisions of ICBN and their codes; exception of rules of ICBN.
5. **Herbarium:** Herbarium and its importance, field and herbarium techniques, National herbarium of Bangladesh and important herbaria of the world.
6. **Concept of taxonomic characters:** Good and bad characters, exomorphic and endomorphic characters, taxonomic and diagnostic characters.
7. **Chemotaxonomy:** Primary and secondary metabolites, semantides in taxonomy.
8. **Cytotaxonomy:** Chromosomal characters used in taxonomy and their significance.
9. **Numerical Taxonomy:** Principles, analysis and construction of dendrogram.
10. **Ecotype concept and biosystematics categories.**
11. **Identifying characters and phylogeny of the following families and scientific names of five important plants of each family:**
 - (a) **Magnoliopsida** (Dicots): Magnoliaceae, Nymphaeaceae, Tiliaceae, Rubiaceae,

Lamiaceae, Polygonaceae, Euphorbiaceae, Acanthaceae, Moraceae
Cucurbitaceae, Asclepiadaceae, Apocynaceae and Asteraceae.

(b) **Liliopsida** (Monocots): Typhaceae, Arecaceae, Liliaceae, Poaceae, Cyperaceae and Orchidaceae.

Books Recommended

1. Cronquist, A. 1968: The Evolution and Classification of Flowering Plants. Houghton, Mifflin Co. Mass, USA.
2. Davis, P. H. and V. H. Heywood. 1963: Principles of Angiosperm Taxonomy. Oliver Boyd, Edinburgh & London.
3. Lawrence, G.H.M. 1951: Taxonomy of Vascular Plants. The Macmillan Co. New York.
4. Radford, A. E. 1974: Vascular Plant Systematics. Harper & Row Publisher, New York.
5. Stace, C. A. 1989: Plant Taxonomy and Biosystematics (2nd ed.). Edward Arnold, London.
6. G. Singh 2004. Plant Systematics: Theory and Practice (2nd ed.) Oxford & IBH Pub.Co. New Delhi
7. nvmvb, Gg. G. Ges Gg. †K. Avjg. 1997 : Dw™ç` †kªYxweb`vm ZËj (3q ms`çiY), nvmvb eyK nvDm, XvKv|

Paper Code	223005	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Plant Anatomy and Embryology			

A. Plant Anatomy (Marks 50)

1. **Cell and Cell wall:** Different types of cell; chemical and physical nature, origin, structure and function of cell wall.
2. **Meristematic tissues:** Origin, classification and differentiation; theories related to differentiation of apical meristem; apical cell theory and Tunica-carpus theory, modification of Tunica-carpus concept.
3. **Permanent tissue:** Structure and function of parenchyma, collenchyma and sclerenchyma; secretory and excretory tissues- glandular and laticiferous.
4. **Vascular tissue system and their functions.**
5. **Primary structure of stem, root and leaf.**
6. **Normal secondary growth in dicot stem and root:** Formation of annual rings, heart wood, sap wood and formation of periderm.
7. **Anomalous secondary growth:** Introduction, anomalous secondary growth in the stem of *Boerhaavia*, *Amaranthus* and *Dracaena*.
8. **Root-stem transition in plants.**
9. **Stomata:** Origin, development, types, structure and functions.
10. **Wood anatomy:** Physical and chemical nature of wood, internal structure of wood.

Books Recommended

1. Cutter, E.G. 1969: Plant Anatomy. Part I & II. Edward Arnold Pub., UK.
2. Eames, A. J. and L. H. MacDaniels. 1947: An Introduction to Plant Anatomy. McGraw Hill Pub. Co., New York.

3. Esau, K. 1953: Plant Anatomy. John Wiley & Sons, Inc., New York.
4. Fahn, A. 1969: Plant Anatomy. Pergamon Press.
5. Pandey, B.P 1989. Plant Anatomy. S. Chand and Company Ltd., New Delhi.
6. Foster, A.S. 1949. Practical Anatomy. (2nd ed.). Van Nostrand Company, New York.

B. Embryology (Marks 50)

1. **Introduction:** Definition, historical background of Embryology.
2. Microsporangium, microsporogenesis and formation of male gametophyte.
3. Megasporangium, megasporogenesis and formation of female gametophyte.
4. **Embryo sac:** Types and development.
5. Pollination and fertilization process and formation of seed.
6. **Endosperm:** Definition and types; formation of endosperm- free nuclear, cellular and helobial endosperm.
7. **Embryogenesis:** Definition, development of dicot and monocot embryos, polyembryony and its importance.
8. **Apomixis:** Causes, types and significance of apomixis.
9. **Embryology in relation to taxonomy.**
10. **Experimental embryology:** Control of fertilization, embryo culture, induced parthenogenesis, production of adventive embryos and induced parthenocarpy.

Books Recommended

1. Maheswari, P. 1950: An Introduction to the Embryology of Angiosperms. Tata McGraw Hill Pub. Co. Ltd. Bombay, New Delhi.
2. cvkv, Gg. †K., 2006: Dw™Ç` åfYweÁvb, Kwei cvewj‡KkÝ, XvKv|

Paper Code	223006	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Practical-II (Higher Cryptogams, Taxonomy of Angiosperms and Plant Anatomy & Embryology)			

N.B. Practical examination will be carried out in two days with 6 hours duration each under the same Paper code.

Part I: (Marks 50, Credit 2)

(Bryophyta, Pteridophyta, Plant Anatomy)

A. Bryophyta: 15 Marks

- The following members to be studied and identified up to genus:
(i) *Riccia*, (ii) *Dumortiera*, (iii) *Plagiochasma*, (iv) *Marchantia*, (v) *Lejunea* and (vi) *Anthoceros*.
- The following members will be demonstrated in the practical class.
The students are required to be acquainted with these members:
(i) *Riccia fluitans*, (ii) *Ricciocarpus natans*, (iii) *Sphagnum*, (iv) *Physcomitrium*, (v) *Fissidens*, (vi) *Taxithelium*

B. Pteridophyta: 15 Marks

- The following members are to be studied and identified up to the genus:
(i) *Lycopodium*, (ii) *Selaginella*, (iii) *Equisetum*, (iv) *Nephrodium*, (v) *Pteris*, (vi) *Lygodium*, (vii) *Marsilea*, (viii) *Azolla* and (iv) *Ceratopteris*.
- The following members are to be demonstrated in the practical classes:
(i) *Psilotum*, (ii) *Isoetes*, (iii) *Salvinia*, (iv) *Drynaria* and (v) *Niphobolus*.

C. Anatomy: 12 Marks

- Preparation of stains: Safranin and fast green, dehydrating agents- alcohol, clearing agents- xylol and clove oil.
- Maceration technique and study of different cell types.
- Transverse and longitudinal sections of *Helianthus*, *Cucurbita* and *Canna* stem.
- Study of primary structure of stem, root and leaf.
- Secondary growth: Jute, *Amaranthas*, *Mirabilis*, *Boerhaavia* and *Dracaena*.
- Wood anatomy: Transverse, radial and tangential sections of *Tectona*, *Shorea*, *Artocarpus*, *Magnolia*, *Michelia*, *Mangifera*.
- Preparation of permanent slides (double staining) with free hand sections.

Collections (Bryophyta, Pteridophyta) and permanent slides of Anatomy: 3 Marks
Practical Note Book 5 Marks

Part II: (Marks 50, Credit 2) **(Taxonomy of Angiosperms, Embryology)**

Taxonomy of Angiosperms: 30 Marks

- 1 Study of morphological features and use of taxonomic terms of plant parts, inflorescence and flowers.
- 2 Study and identification of angiosperms up to families with the help of a suitable key of the locally available specimens included in the syllabus.
- 3 Collection and preparation of herbarium specimens of at least 50 species from different areas of Bangladesh.
- 4 Local excursion: Preparation of field note book and excursion report.

Embryology: 7 Marks

1. Morphological and anatomical study of various types of ovule and anther.
2. Germination of pollen grain and development of pollen tube.
3. Study of embryo-sac using available materials.

Collections: 4 Marks

Field Note Book and Excursion Report: 4 Marks

Practical Note Book: 5 Marks

Instruction to the Examiners
Part I (Higher Cryptogams and Anatomy)
Time: 6 hours Marks: 50

1. Specimen A & B will be members of Bryophyta (these should be from different class)

	Distribution of marks	Marks
i)	Preparation of slide	2.0
ii)	Neat labelled diagrams	2.0
iii)	Identifying characters	1.5
iv)	Identifications	0.5
	Total	6.0×2=12.0

2. Specimen C & D will be members of Pteridophyta (non-fern and fern)

	Distribution of marks	Marks
i)	Preparation of slide	2.0
ii)	Neat labelled diagrams	2.0
iii)	Identifying characters	1.5
iv)	Identifications	0.5
	Total	6.0×2=12.0

3. Specimen / slide will have to be given for identification from Bryophyta and Pteridophyta:

E and F (Bryophyta), G and H (Pteridophyta)

Identifying characters: 1.0
Identification: 0.5
Total 1.5×4= 6.0

4. Specimen I will be a stem / root of angiospermic plant with secondary growth (normal/ anomalous).

	Distribution of marks	Marks
i)	Preparation of slide	1.5
ii)	Neat labelled diagrams	2.5
iii)	Identifying characters	1.5
iv)	Identifications	0.5
	Total	6.0

5. Specimens /slides / models will be given for identification from the primary structure of stem, root, leaf and wood.

Specimen J, K, L and M

Identifying characters: 1.0
Identification: 0.5
Total 1.5×4= 6.0

6. Collection (Bryophyta, Pteridophyta and permanent slides of Plant Anatomy): 3.0
 7. Practical Note Book: 5.0

Part II (Taxonomy of Angiosperms and Embryology)

Time: 6 hours

Marks: 50

1. Specimen A will be angiospermic plants with flowers for identification up to family.

	Distribution of marks	Marks
i)	Labelled diagrams of the flowers and floral parts	3.0
ii)	Description of the specimen with floral formula	3.0
iii)	Floral diagram	1.0
iv)	Identification up to family	2.0
	Total	9.0

2. Specimen B will be angiospermic plants with flowers for identification up to genus.

	Distribution of marks	Marks
i)	Labelled diagrams of the flowers and floral parts	3.0
ii)	Description of the specimen with floral formula	3.0
iii)	LS f flower	1.0
iv)	Floral diagram	1.0
v)	Identification up to genus	3.0
	Total	11.0

3. Specimen C, D, E, F, G & H should be selected from common available flowering plants of the locality for spotting. Students will write only their scientific names.

Scientific name: $1.0 \times 6 = 6.0$

4. Specimen I & J should be special morphological features of plant parts/inflorescence/flowers.

Identifying characters: 1.5
 Identification: 0.5
 Total $2.0 \times 2 = 4.0$

5. Specimen K will be embryologic material (anther, ovary)

	Distribution of marks	Marks
i)	Preparation of slide	1.5

ii)	Identifying characters	1.5
iii)	Comments	1.0
	Total	4.0

6. Specimen L and M will be spotting material of Embryology.

Identifying characters: 1.0
 Identification: 0.5
 Total 1.5×2=3.0

7. Collections: 4.0
 8. Field Note Book and Excursion Report: 4.0
 9. Practical Note Book: 5.0

Paper Code	222807	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	General Chemistry - II			

- Nonmetals:** General properties of nonmetals, ortho and para hydrogen molecules, allotropy of carbon, catenation, halogens and their basic properties, chemistry of noble gases.
- Metals:** Metallic bond, electron sea theory of metallic bond, characteristics of metals, band theory of conductivity, conductors, semiconductors and insulators, transition metals and inner transition metals colour and magnetism in transition metal chemistry.
- Energy changes in chemical Reactions:** System and surroundings, open system and closed system, thermodynamics, state functions, the first law of thermodynamics, the concept of internal energy and enthalpy, measurement of enthalpy changes, enthalpy of formation, Hess's law, lattice enthalpy, Born-Haber cycle, second law of thermodynamics, entropy and free energy.
- Rates of chemical Reactions:** Reaction rate, rate constant, rate law, order of reactions, first order reaction, half life, order and molecularity, effect of temperature on the rate of reaction, collision theory and reaction rates, activation energy, Arrhenius equation.
- Electrochemistry:** Redox reactions, electrolytic and galvanic cells, cell notation, standard reduction potentials, emf of cells, the effect of concentration of cell emf, batteries, corrosion.
- Catalysis:** Catalyst, homogeneous catalysis, enzyme catalysis, auto catalysis.
- Solids:** Properties of solids, crystalline and amorphous solids, distinction between crystalline and amorphous solids, isomorphism, polymorphism and allotropy, crystal lattice unit cell crystal systems Bragg's law.
- Coordination Chemistry:** Coordination compounds, ligands, coordination number, nomenclature, structures of complex compounds, Werner's primary and secondary valency concept, sidwick's electronic concept, valence bond theory, stability of coordination compounds.
- Aromatic Compounds:** Aromaticity aromaticity of benzene, Electrophillic aromatic substitution reactions with reference to nitration halogenation, sulphonation and alkylation. Heterocyclic compounds: Pyrrole, furan, thiophene, pyridine.

10. **Organic reactions:** Brief study on Electrophilic addition, Nucleophilic addition, Elimination reaction, condensation reaction, oxidation, and reduction reactions and organic compounds. Mechanism and application of the following reactions, Friedel Craft reaction, Clemmenson reduction, Wolf Krishner reduction, Perkin reaction, Claisen reaction, Cannizzaro reaction and Aldol condensation.
11. **Carbohydrates:** Definition, classification, structure and reactions of monosaccharides. Polysaccharide-cellulose and starch.
12. **Amino Acids:** Structures classification, synthesis physical and chemical properties of amino acids.
13. **Polymer Chemistry:** Polymers homopolymer, heteropolymer, low density and high density polymer, copolymers, studies of some polymers- polyvinylchloride, nylon 66, silk and wool.

Books Recommended:

General Chemistry , D.D. Ebbing Houghton Mifflin Co.

Chemistry – The Molecular Nature of Matter and Change, M. Silberberg, WCB/ Mc Graw-Hill.

Introduction to Modern Inorganic Chemistry, S.Z. Haider, Friends International.

Selected Topics on Advanced Inorganic Chemistry, S. Z. Haider, Students' publication

Modern Inorganic Chemistry, R.D. Madan, S. Chand & company Ltd.

Selected Topics in Inorganic Chemistry, W.U. Malik, G. D. Tuli and R.D. Madan, S. Chand & Company Ltd.

Organic Chemistry by T Morrison and R.N. Boyd

Fundamentals of organic Chemistry by Solomon

Organic Chemistry Vol I & II I.L. Finar

Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson, and P. L. Gaus, John Wiley & Sons. Principles of physical chemistry, M. M. Huque and M. A. Nawab, students' publications.

Paper Code	222809	Marks: 50	Credits: 2	Class Hours: 30
Paper Title:	Environmental Chemistry			Exam Duration: 2.5 Hours

1. **Environment:** Introduction components of environment, factors affecting environment, environmental management, environment and health, environmental chemistry, segments of environment – atmosphere hydrosphere, lithosphere and biosphere, structure of atmosphere.
2. **Pollution and Pollutants:** Pollution, environmental pollution, pollutant, classification of pollutants, types of pollution PCBs and their sources and hazards, Detection & estimation of PCBs. Biomagnification.
3. **Air Pollution:** Introduction air quality, major sources of air pollution, gaseous pollutants, acid rain- how acid rain is formed, adverse effects of acid rain, greenhouse effect- how the greenhouse effect is produced, consequences of greenhouse effect and global warming El Niño phenomenon and its effect, ozone depletion, mechanism of ozone depletion, effects of ozone depletion.
4. **Water Pollution:** Introduction, classification of water pollutants, physical, chemical and biological characteristics of wastewater, industrial wastewater treatment, municipal water treatment, water quality parameters and standards, measurements of important parameters such as pH, DO, BOD, COD and temperature for water quality assessments.
5. **Soil Pollution:** Composition of soil, importance of soil to the biosphere, sources of soil pollution, effects of soil pollution- synthetic fertilizer and pesticides, effects of industrial

- effluents, effects of urban wastes, control of soil pollution.
6. **Heavy metals in the Environment:** trace metals, light metals and heavy metals, deadly heavy metals, sources of heavy metals, biochemical effects, toxicity, toxicology, control and treatment of mercury, chromium, arsenic and lead.

Books Recommended:

1. Environmental Chemistry, B.K. Sharma, Goel Publishing House.
2. Environmental Chemistry, A.K. De New Age International Publishers.
3. Environmental Chemistry, S.E. Manahan, CRC Press.
4. A Textbook of Environmental Chemistry and Pollution Control, S.S. Bara S. Chand & Company Ltd.

Paper Code	223107	Marks: 100	Credits: 4	Class Hours: 60
Paper Title:	Zoology -II			Exam Duration: 4 Hours

Group – A: Chordates: (50 Marks)

- Broad classification of the following up to order with general and diagnostic characteristics of each taxonomic category with examples (preferably local) and affinities-
Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves and Mammalia.
- Type study of the following with their systematic position, habitats, distribution, external morphology, anatomy including skeletal, digestive, circulatory, respiratory, excretory, nervous, reproductive and endocrine systems; food & feeding habits and mode of life -
 - Urachordata : *Ascidia*
 - Cephalochordata : *Branchiostoma*
 - Cephalaspimorpha: *Petromyzon*
 - Chondrichthyes : *Scoliodon*
 - Osteichthyes : *Labeo rohita*
 - Amphibia : *Bufo/Rana*
 - Reptilia : *Hemidactylus*
 - Aves : *Columba livia*
 - Mammalia : *Cavia porcellus*.

Group – B

Palaeontology, Zoogeography, Ecology, (50 Marks)

Genetics & Animal Breeding and Applied Zoology:

Palaeontology:

Geological time table; palaeontological history of Horse & Man.

Zoogeography:

Zoogeographical regions and sub-regions of the world: Nearctic Region, Ethiopian Region, Neotropical

Region-their boundaries, physical characteristics, climatic conditions, vegetation and fauna.

Ecology:

Marine ecology; Zonations and Animal Adaptation to Different Zonations; Concept of Biodiversity; Conservation of Natural Resources; Concept and Classification of Resources; Renewable and Non-Renewable Resources.

Animal Genetics & Animal Breeding:

Modification of Mendelian ratio with animal examples; multiple alleles and pseudoalleles; mutation; chromosomal inheritance of sex determination.

Applied Zoology :

1. **Introduction to the major fields of Applied Zoology:** Entomology, Fisheries, Wildlife Biology, Parasitology and others.
2. **Agricultural Pests:** Major Pests of Rice, Jute, Sugarcane & stored grain.
3. **Integrated Fish Farming:** Types; Poultry, Livestock and Paddy-cum -Fish Culture.
4. **Poultry farming:** System of poultry farming, diseases of poultry and their control, economic importance of poultry and their impacts on socio-economic condition of Bangladesh.

Books Recommended

1. D. Webster and M. Webster. 1974. *Comparative Vertebrate Morphology*, Academic Press New York.
2. I. Young. 1981. *Life of Vertebrates*. OUP, USA
3. K.V. Kardong. 1997. *Vertebrates: Comparative Anatomy, Function, Evolution* Wm. C. Brown
4. S. Stearus and R. Hoekstra. 2000. *Evolution An Introduction* OUP USA
5. A.J.Cain 1996. *Animal Species and Their Evolution* Princeton UP. USA
6. A.M. Davis. *An introduction to palacontology*
7. S. Bengtson. 1995 *Early Life on Earth* Columbia UP, USA
8. R.S. Lull. 1976. *Organic Evolution* Seema Publishing Delhi 11007
9. P.J. Darlington. 1998. *Zoogeography. The Geographical Distribution of Animals*. Krieger. USA
10. M. Begon J.L. Harper and C.R. Townsend. 1996. *Ecology. Individuals Populations*.
11. E.P. Odan *Fundamentals of Ecology*. Saunders. Philadelphia
12. E.W. Sinnott. L.C. Dunn and Dobzhansky *Principles of Genetics*. McGraw Hill Book Co. New York
13. R.E. Weaver and P.W. Hedrick 1995. *Basic Genetics* Wm. C. Brown Publisher. Dubuque. Iowa.
14. E. Mayr and P.D. Ashlock. 1997. *Principles of Syatematic Zoology* McGraw Hill
15. Kapoor. *Taxonomy*
16. Dennis S. Hill 1997. *The economic importance of insects* (1st edition) Chapman and Half. London
17. D. Dent. *Pest Management* Chapman & Hall London
18. P.Southgate and J.Lucas (Editors), 1998. *Aquaculture: Fish and Shellfish Farming* Fishing News.
19. A Midlen and T.A. Reading 1998. *Pollution Control and Environmental Management for Aquaculture*. Chapman & hall
20. M.R. Ross. 1996. *Fisheries Conservation and Management* Prentice Hall

21. R.Wall and D. Shearer, 1997 *Veternary Entomology* Chapman & Hall
22. V.G. Jhingran and R.S.V. Pullin 1985. *A Hatchery Manual for the Common Chinese and Indian Major Carps*. ADB/ICLARM
23. T.V.R Pillay. 1993. *Aquaculture Principles and Practices* Fishing News Books.
24. J.E. Bardach J.H. Ryther and W.O. McLarncy. 1972. *Aquaculture The Farming and Husbandry of Freshwater and Marine Organisms*. John Wiley & Sons.
25. B. Groombridge (Editor). *Global Biodiversity-status of the Earth's Living Resources*. Chapman and Hall London.
26. K.J. Gaston and J.I. Spicer. 1998 *Biodiversity An Introduction* Blackwell Science.
27. M. Jeffries. 1997. *Biodiversity and Conservation*. Routledge
28. O.S. Owen, Natural Resource Conservation. *An Ecological Approach* Macmillan Publishing Co. Inc.
29. P. Wathern (Editor). 1990. *Environmental Impact Assessment: Theory and Practice*, Routledge.
30. P.S. Maitland and N.C. Morgan. 1997. *Conservation Management of Freshwater Habitats: Lakes, Rivers and Wetlands*. Chapman & Hall
31. S.M. Manton and M.E. Brown 1969. *A Manual of Practical Vertebrate Morphology*. Oxford Univ. Press, London
32. W.F Walker. 1980. *Vertebrate Dissection*. W.B. Saunders Co. London.

Paper Code	223108	Marks: 50	Credits: 2	
Paper Title:	Zoology Practical -II			

1. **Study of Museum Specimens:** Representatives of Hemichordata, Urochordata, Cephalochordata and all major classes of Vertebrata {5 (at least 1 specimen from each Protochordate Phylum) and (6 x 5) =30 from vertebrata} = 35 specimens to be studied)
2. **Study of Permanent Slides:** Whole mount of scales or body parts, histological slides of tissues and organs (at least 20 slides to be studied).
3. **Study of Bones:** Comparative study of the skeleton of an amphibian, reptile, a bird and a mammal.
4. **Dissection: Dissection of the following Chordate Specimens-**
 Bufo/ any Carp - Brain and Cranial Nerves.
 Lata fish-Afferent and Efferent Blood Vessels
 Lizard - Circulatory System.
5. **Fresh Water Studies:** Identification of plankton and benthic micro-fauna in fresh water samples.

Distribution of Marks for the Final Examination

1. **Major dissection:** One item (**Chordate**)(Dissection–6, display–2, drawing & labeling–3)
(1x11)= 11 Marks
2. **Spotting of Museum Specimens :** 9 items **(9x2)= 18 Marks**
 - i. Vertebrate Museum Specimen (5 items, only one from each Phylum/ Class) (Identification with classification 1mark + characters 1 mark) (5x2) =10 marks
 - ii. Histological Slides (2 slides) (Identification 1mark + characters 1 mark) (2x2) = 04 marks
 - iii. Bones (2 bones) (Identification 1mark + characters 1 mark) (2x2) = 04 marks

3. **Fresh Water Studies:** (3 specimens) (2 micro species of plankton and 1 benthos fauna to be shown – Identification 1 and characters 1 mark) **3x 2 = 06 Marks**
4. **Class Records:** **= 05 Marks**
5. **An extensive oral test will be taken during practical examination session:** **=10 Marks**
- Total = 50 Marks**

Paper Code	221109	Marks: 100	Non-Credit	Class Hours: 60
Paper Title:	English (Compulsory)			Exam Duration: 4 Hours

Aims and objectives of this Paper:

To develop students' English language skills, to enable them to benefit personally and professionally. The four skills ~ listening, speaking, reading and writing will be integrated to encourage better language use.

1. Reading and understanding 5×4=20

Students will be expected to read passages they might come across in their everyday life, such as newspapers, magazines, general books etc. Simple stories will also be included to give students a familiarity with different uses of the language.

[N.B. : 5 Questions are to be answered. Each question will carry 4 marks. There may be division in each question]

- a) Understanding different purposes and types of readings
- b) Guessing word-meaning in context.
- c) Understanding long sentences
- d) Recognizing main ideas and supporting ideas.
- e) Answering comprehension questions.
- f) Writing summaries.

2. Writing 40

- a) Writing correct sentences, completing sentences and combining sentences. 5
- b) Situational writing : Posters, notices, slogans, memos, advertisements etc. 4
- c) Paragraph writing : Structure of a paragraph; topic sentences; developing ideas; writing a conclusion; types of paragraphs (narrative, descriptive, expository, persuasive); techniques of paragraph development (such as listing, cause and effect, comparison and contrast).

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Or,

- d) Newspaper writing : Reports, press releases dialogues etc.
- e) Writing resumes. **Or,**

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- f) Writing letters : Formal and informal letters, letters to the editor, request letters, job applications, complaint letters etc.
- g) Essay : Generating ideas; outlining; writing a thesis sentence; writing the essay: writing introductions, developing ideas, writing conclusions; revising and editing.

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3. Grammar

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- a) Word order of sentences.
 - b) Framing questions.
 - c) Tenses, articles, subject-verb agreement, noun-pronoun agreement, verbs, phrasal verbs, conditionals, prepositions and prepositional phrases, infinitives, participles, gerunds. (Knowledge of grammar will be tested through contextualised passages).
 - d) Punctuation.
4. **Developing vocabulary** : Using the dictionary, suffixes, prefixes, synonyms, antonyms, changing word forms (from verb to noun etc.) and using them in sentences. 10
5. **Translation from Bengali to English** : 1x 5=5
6. **Speaking skills** : Speaking skills should be integrated with writing and reading in classroom activities.

The English sound system; pronunciation skills; the IPA system; problem sounds, vowels, consonants and diphthongs; lexical and syntactic stress.

(Writing dialogue and practising it orally students can develop their speaking skill. Dialogue writing can be an item in writing test.)