

NATIONAL UNIVERSITY



Fourth 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

FOURTH YEAR

Paper Code	Paper Title	Marks	Credits
243001	Agronomy and Horticulture	100	4
243003	Economic Botany, Ethnobotany and Pharmacognosy	100	4
243005	Limnology and Aquaculture	100	4
243007	Biodiversity and Evolution	100	4
243009	Plant Breeding	100	4
243011	Molecular Biology and Bioinformatics	100	4
243013	Biostatistics and Research Methodology	100	4
243015	Biotechnology and Genetic Engineering	100	4
243016	Practical Paper-IV	100	4
243018	Viva-Voce	100	4
	Total =	1000	40

Detailed Syllabus

Paper Code	243001	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Agronomy and Horticulture			

1. **Introduction:** Definition and scope of Agronomy and Horticulture.
2. **Tillage:** Purpose, types, merits and demerits, agricultural implements.
3. **Fertilizer:** Classification of fertilizers and its application, manures, irrigation.
4. **Cropping:** Crops and cropping, mono- and multiple relay intercropping and mixed cropping, cropping system, and crop rotation.
5. **Cultivation and management of crops:** Rice, wheat, jute, sugarcane, cotton and mustard.
6. **Weeds:** Weeds of the fields, their harmful and beneficial effects and control measures.
7. **Horticultural propagation:** Details about cutting, layering, budding, thinning, pruning, grafting, and their merits and demerits; use of root inducing substances in stem cutting propagation.
8. **Preparation of seed bed:** Sowing and seedling growth composition, doses, application time and procedures.
9. **Irrigation:** Sources of irrigation water, classification of irrigation system, methods of irrigation, quality of irrigation water and water requirements of crop plants.
10. **Branches of horticulture:** Classification of horticultural plants with examples.
11. **Horticultural aspects and cultivation of following:** Vegetables: potato, brinjal, tomato, lady's finger, and cabbage; Fruits: mango, jackfruit, papaya, guava, and lemon; Flowers: rose, chrysanthemum and orchid.
12. Pre- and Post-care seedling, transplantation of seedlings, pruning and training- objectives, method, merits and demerits.
13. Problems of cultivation of horticultural plants in plain land and hilly regions of Bangladesh.
14. Concept and components of social forestry and agroforestry.

Books Recommended

1. C.C. Webster. 1980. Agriculture in the tropics. Longman Groups, Ltd. London.
2. A. Alim. 1974. An Introduction to Bangladesh Agriculture.
3. Adams, C.R., K.M. Bamford and M.P. Early. 1984. Principles of Horticulture (2nd. Ed.). Butterworth Heinmou. CBS Publisher & Distributions.
4. Sadhu, M.K. 1989. Plant Propagation. New Age Int. Pub. Ltd.
5. Fordham, R. and A.G. Biggs. 1985. Principles of Vegetable Crop Production. Collis Professional & Technical books, 8 Grafton street, London, W1X 3LA.
6. Adriance and F.R. Brison. 1955. Propagation of Horticultural Plants (2nd. Ed.). McGraw Hill Book Co. Inc.,
1. Rao, M.S. 1987. Introduction to Social Forestry.
2. gŪj, Gg. †di†Šm. 1990. d†ji evMvb, K-ve wewis (1g †d-vi), K...wl wek|we``vjq K``vřúvm, gqgbwmsn|
3. ikx`, Gg. gvgybyi. 1976. evsjv†`†ki mewR| evsjv GKv†Wgx, XvKv|

Paper Code	243003	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Economic Botany, Ethnobotany and Pharmacognosy			

A. Economic Botany (Marks 20)

1. Introduction: Definition, scope and importance of Economic Botany.
2. Scientific and local names, part/s used and importance of 10 economically important plants of each of the following groups: Cereals, pulses, oil, fiber, timber, fruit, vegetables, spices and aromatic plants.
3. Tea, rubber and sugar: Cultivation and processing.

Books Recommended

1. Albert, F.H. 1972. Economic Botany. Tata McGraw Hill Pub. Co. Ltd., New Delhi.
2. Hill, A.F. 1951. Economic Botany, Tata McGraw Hill Pub. Co. Ltd., New Delhi.
3. Pandey, B.P. 1978. Economic Botany S. Chand and Co., New Delhi.
4. nvmvb, Gg.G. 1996. evsjv`†ki †flR Dw™Ç, Avkivwdqv eB Ni, evsjv evRvi, XvKv|

B. Ethnobotany (Marks 30)

1. Introduction: Definition, current concept and scope, main subjects of Ethnobotany, aims and objectives of ethnobotanical studies.
2. Origin and development of the branch, Present and past of ethnobotanical research in Bangladesh.
3. Methods of ethnobotanical study: Basic concepts and techniques, protocol, research design, ethnobotanical methods for documentation of data, data collection and transcription.
4. Sacred plants: Plants used in religion and mythology.
5. Ethnobotany of the tribes of Bangladesh: Chakma, Garo, Marma, Sawtal, Tripura.
6. Indigenous Knowledge (IK): Definition, plant related indigenous knowledge, types and sources of indigenous knowledge, IK in folklore, folktales, folksongs and proverbs, importance of IK.

Books Recommended

1. Alexiades MN. 1996. Selected Guidelines for Ethnobotanical Research: A Field Manual.
2. Cotton, C. M. 1997. Ethnobotany, Principals and Application. John Wiley and Sons Ltd., Chichester, UK.
3. Jain, S. K. 1989. Methods and approaches of ethnobotany. Society of Ethnobiology, Lucknow, India.
4. Jain, S. K. 1989. Methods and approaches of ethnobotany. Society of Ethnobiology, Lucknow, India.
5. Martin, G. J. 1995. Ethnobotany: A methods manual. Chapman & Hall, London.
4. nvmvb, Gg.G. 1996: evsjv`†ki †jvKR e†bŠlwa, nvmvb eyK nvDm, evsjv evRvi, XvKv|
5. cvj, wW.wm. 1999: †jvK Dw™Ç` we`v| cwðge½ ivR` cy`—Kcl©`|

C. Pharmacognosy (Marks 50)

1. **Introduction:** Definition, its relation to herbal medicine, pharmacology, pharmacopoeia; medicinal and non-medicinal plants, herbal, alternative or complementary medicine.
2. Non-medicinal plants – hallucinogen, allergenic, teratogenic and other toxic plants, plants with pesticide properties.

3. Drug, medicine and poisons – their definitions and differences.
4. **Classification of drugs with examples:** a. alphabetic, b. morphological, c. taxonomical, d. chemical and e. pharmacological.
5. Major 10 -indigenous medicinal plants of Bangladesh, their scientific names, plant parts used as drug source.
6. Primary and secondary metabolites of plants and their relations to drug principle.
7. Preparatory methods of herbal medicine- a. whole plant or plant parts, b. fine abstract.
8. Cultivation and improvement of medicinal plants through agronomical and biotechnological means.
9. Name of important drugs, principles of plant origin with plant source and use of atropine, codine, digitoxin, disogenin, hyoscyamine, scopolamine, and reserpine.
10. Conservation of the medicinal plants of Bangladesh: Importance and methods of conservation.

Books recommended

1. A. Ghani. 2002. A Text Book of Pharmacognosy. Asiatic Society, Bangladesh.
2. A. Ghani. 2003. Medicinal Plants of Bangladesh. Asiatic Society, Bangladesh.
3. M. Ali. 2002. Text book of Pharmacognosy, CBS Pub. New Delhi, India.
4. Phil. B. Fontanarosa (Ed.). 2000. Alternative medicine- an objective assessment. J. Fraukos, USA (AMA).
5. W.C. Evans. 2003. Trease and Evans Pharmacognosy, ELBS, UK,.
6. G. Mwb. 1995. †fIR weÁvb, evsjv GKv†Wwg, evsjv†`k|
7. G. Mwb. 1999. †fIR imvqb, evsjv GKv†Wwg, evsjv†`k|

Paper Code	243005	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Limnology and Aquaculture			

1. **Introduction:** Definition, history, classification, scope and importance of Limnology, limnology versus hydrobiology, hydrologic cycle.
2. **Distribution of fresh water:** Ponds, lakes, rivers, and estuaries, aquatic resources of Bangladesh.
3. **Lakes:** Definition, origin and distribution, lake basins, zonation and classification of lakes, special types of lakes, natural lakes of Bangladesh, important lakes of the world.
4. **Physical factors of inland water:** Light and water, source, quality and role of light in aquatic ecosystems, calculation in lentic and lotic waters, water color, thermal stratification and mixing, density of water, cohesion, viscosity, and surface tension, classification of lakes depending on mixing, water movement and flow.
5. **Chemical features of inland water:** Dissolved oxygen, salinity, conductivity, carbonate, bicarbonate, pH, nitrogen, phosphorus, silica and diatom growth, trace elements.
6. **Structure and productivity of aquatic habitat:** Introduction to productivity, methods of measuring primary productivity of aquatic habitats.
7. **Eutrophication:** Brief account on eutrophication, causes and effects of eutrophication
8. **Aquatic flora:** Phytoplankton, algae, macrophytes, aesthetic and economic value of aquatic flora.

9. **Aquaculture:** Introduction to aquaculture, aquatic resource management, natural productivity of ponds/lakes, maintenance and improvement of ponds/lakes, methods of phytoplanktonic culture.

Books Recommended

1. Agarwal, K.C. : Limnology
2. Goldman, C.R. and A.J. Horne. 1983. Limnology. McGraw Hill Inc. Book Co., Tokyo.
3. Khan, M.S. and M. Halim. 1987. Aquatic angiosperms of Bangladesh. Bangladesh National Herbarium, BARC, Dhaka.
4. Welch, S. Paul. 1952. Limnology. McGraw-Hill Book Co.
5. Wetzel, R.G. 1983. Limnology, W.B. Saunders Co. London.
6. Wetzel, R.G. and G.E. Likens. 1979. Limnological Analysis. W.B. Saunders Co. Philadelphia, USA.
7. Cole, G.A. 1979. Text Book of Limnology. The Mosby Co. London
8. L'Kvi gwbi“%vgvb, 1994. wjg#bvjRx, XvKv wek|we“vjq cÖKvkbv, XvKv|

Paper Code	243007	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Biodiversity and Evolution			

A. Biodiversity (60 Marks)

1. **Introduction:** Definition, aims and objectives, different types of Biodiversity.
2. **Elementary knowledge:** Introduction to longitude, latitude and altitude, continental drift, tectonic movement, land bridge, biogeography, temperate, tropical, tundra and alpine zones of the world and their vegetation.
3. **Characterization of biodiversity from ecological perspectives:** Species diversity within areas and species richness, functional diversity, basic principles, micro-biodiversity, world biodiversity hot-spots.
4. **Loss of biodiversity:** Causes of loss of biodiversity; effect of the degradation of biodiversity; causes of species extinction.
5. **Biodiversity in context of Bangladesh:** Elementary knowledge on the patterns of biodiversity in Bangladesh; indigenous, exotic, common, rare threatened and endangered species of Bangladesh; plant introduction in Bangladesh; basic knowledge on plant resources of Bangladesh.
6. **Biodiversity conservation:** Causes of loss of biodiversity and need of biodiversity conservation.
7. **Methods of plant protection and conservation types:** *In-situ* and *Ex-situ* conservation, role of national and eco-parks, reserve forests, sanctuary, wetland areas, botanic gardens, orchard, seed banks and field gene banks of Bangladesh in biodiversity conservation.
8. **Role and activities:** IUCN, WWF, WCMC, UNICEF, EAS, CITES, CBD.

Books Recommended

1. Agrawal, K. C. 1996. Biodiversity: An Introduction. Agropublication, New Delhi.
2. Gain, P.S. Moral and P. Raj. 1998. Bangladesh-Environment: Pacing the 21st century, SHED, 44/D, West Panthapath, Dhanmondi, Dhaka- 1205, Bangladesh.
3. Heywood, V.H. 1995. Global Biodiversity Assessment (UNEP).
4. Jeffries, M.J. 1997. Biodiversity and Conservation. Routledge, London and New York.
5. Olwell, F.M. 1996. Restoring Biodiversity- Principles and Practice.
6. U.Kumar and M.Asija 2004. Biodiversity: Principles and Conservation.
7. K.W.Krishnamorthy. 2004. An Advanced Text Book on Biodiversity.

8. nvmvb, Gg. G. 2000. ev†qvWvBfvwm®wU GÛ KbRvi†fkb, nvmvb eyK nvDR, XvKv

B. Evolution (40 Marks)

1. **Pre-Darwinian concept:** Buffon, Herbert Spencer, Lamarck, Lamarckism, criticism of Lamarckism and Neo-Lamarckism.
2. **Darwin-Wallace theory and natural selection:** Charles Darwin and R. A. Wallace, voyage of the HMS Beagle by Darwin, essence of Darwinism, criticism of Darwinism and Neo-Darwinism, role of natural selection in evolution.
3. **Evidences of evolution:** Paleontological, missing link, living fossil, biogeographical and ecological regions of world, adaptive radiation, comparative anatomy, vestigial organs, embryological, cytological, biochemical and molecular evidences.
4. **Synthetic theory of evolution:** Stebbins' proposal, evolution process, genetic explanation, Hardy-Weinberg law, static and dynamics of gene in population.
5. **Speciation:** Species concept, characteristics of species, steps of evolution: micro-, macro-, mega-evolution, Isolation- pre-mating, post-mating, sympatric, allopatric isolation.
6. **Chemical theory of origin of life:** (a) Experimental evidences-Operin-Haldane hypothesis, Miller-Urey experiment.

Books recommended

1. Akhtaruzzaman M 1998. Bibarinbidhya, Bangla Academy, Dhaka
2. Case CJ 1986. Cosmology. The search for order of the universe. Tata Books @ Inc.
3. Darwin C 1992. The origin of species (ed. G.K. Burrow). Penguin Books.
4. Dobzhansky Th.FJ Ayala, GL Stebbins and JW Valemteni 1990. Evolution. W.H. Freeman, San Francisco, Surjeet Publication
5. Lewin R 1984. Human evolution. Blackwell Science Publication.
6. Rastogir VB 1990. Organic evolution. Keder Nath Ram Nath., New Delhi.
7. Stebbins GL 1971. Process of organic evolution. Prentice-Hall Inc., New Jersey.
8. Strickberg MQ 1990. Evolution. Jones-Bartlet publication, Boston.
9. Gg.†K. cvkv, 1998. AvYweK RxeweÁvb, cÖ_g LÛ, evsjv GKv†Wgx, XvKv|

Paper Code	243009	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Plant Breeding			

1. **Introduction:** Definition, scope and objectives of Plant Breeding.
2. **Origin and domestication of crops:** Centres of origin of crop plants, importance of this concept in plant breeding, domestication of crops.
3. **Plant genetic resources:** Definition, collection, evaluation and conservation (*ex situ* and *in situ*) of germplasm, use of germplasm in plant breeding programmes.
4. **Reproductive biology and plant breeding:** Modes of reproduction in crop plants, pollination mechanisms in plant improvement, self-incompatibility and male sterility and their significance in plant breeding.
5. **Selection:** Selection methods in self- and cross pollinated crops and clonal selection in vegetatively propagated plants.
6. **Hybridization:** Objectives; techniques and types of hybridization and importance of artificial hybridization.
7. **Breeding techniques in self- and cross-pollinated crops:** Methods, merits and demerits of mass selection, pure line selection, pedigree selection and bulk method.
8. **Heterosis breeding:** Introduction to heterosis, hybrid vigor and inbreeding depression, genetic basis of heterosis, achievements through heterosis breeding.

9. **Mutation breeding:** Introduction to mutation breeding, artificial induction of mutation in plants, use of induced mutation technique in crop improvement, limitations of mutation breeding.
10. **Backcross breeding:** Methods, merits and limitations of backcross breeding.
11. Plant Introduction and acclimatization of economically important crops.
12. Contribution of various national research institutes for the development of improved varieties of different crop plants.

Books Recommended

1. Allard, R. W. 1999. Principles of Plant Breeding. (3rd. Ed.). John Wiley & Sons. Inc., New York.
2. Chaudhury, H.K. 1978. Elementary Principles of Plant Breeding. Oxford & IBH Pub. Co., New Delhi.
3. Dana, S. 2001. Plant Breeding. Naya Udyog, Calcutta.
4. Poehlman, J. M. and D. Borthakur. 1977. Breeding Asian Field Crops. Oxford and IBH Pub. Co., New Delhi.
5. Simonds, N.W. 1979. Principles of Plant Improvement. Longman Group Ltd. London.
6. Singh, B.D. 1995. Plant Breeding – Principles and Methods, (6th. Ed.). Kalyani Publishers, New Delhi.
7. Sinha, U. and S. Sinha. 1977. Cytogenetics, Plant Breeding and Evolution, Vikas Publ. House, Pvt. Ltd. New Delhi.
8. f~Bqv, Gg. Gm. ikx`. 1992. Dw™Ç` cÖRbb, evsjv GKv\$Wgx, XvKv|

Paper Code	243011	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Molecular Biology and Bioinformatics			

1. **Introduction:** Historical development, macromolecules and store of biological information, the basis of heredity, central dogma.
2. **Bio-information molecules:** Components, structure, biological and chemical properties of DNA, RNA and proteins.
3. **DNA replication:** Introduction to DNA replication, semi-conservative replication of DNA, mechanism of DNA replication, significance of DNA replication.
4. **Repair of damaged DNA molecules:** Introduction to DNA repair, photoreactivation, excision repair, post-replication recombination repair and SOS repair.
5. **Transcription:** Transcription mechanism, post-transcriptional modification of RNAs, RNA splicing.
6. **Translation:** Genetic code, characteristic features of genetic code, code dictionary, mechanism of translation - aminoacylation, codon recognition and mechanism of protein synthesis.
7. **Regulation of gene expression:** General features of gene regulation, operon concept (*lac*-operon, tryptophan operon).
8. **Mutation:** Characteristics and classification of mutation, point mutation, mutagenesis, site-specific mutagenesis.
9. **Physical mapping and sequencing of genome:** Restriction enzyme, DNA fingerprinting, method of DNA sequencing, automated DNA sequencing.
10. **Bioinformatics:** Definition and basic knowledge about bioinformatics; information technology and biomolecular sequence analysis, similarity searches on sequence

databases, pair-wise alignments, multiple sequence alignments, application of bioinformatics.

Books Recommended

1. D. Frefelder. 1990. Molecular Biology. Norosa Pub. House, New Delhi.
2. Adams, Burdon. Compbell, Leader, Smellie. 1980. The Biochemistry of the Nucleic acids, (9th ed.), Chapman & Hall, London.
3. B. Lewin. 1993, 1995. Gene IV and V. N.J. Willey & Sons. N. York.
4. Alberts Bra, Lewis Raff Roberts and J. Watson, 1992. Molecular Biology of the Cell. (2nd. Ed.), Garland and Pub., New York..
5. A.M. Lesk 2007. Introduction to Genomics. Oxford Univ. Press, London.
6. A.M.Campbell and L.J. Heyer 2007. Discovering Genomics, Proteomics and Bioinformatics. (2nd. Ed. Low Price Edition), Pearson Education, New Delhi.
7. †gv⁻—dv Kvgvj cvkv, 1998 Ges 2000: AvYweK Rxe weÁvb 1g,2q l 3q LÛ, evsjv GKv‡Wgx, XvKv|
8. Fundamental Concepts of Bioinformatics, Dan E. Krane and Michael L. Raymer, San Francisco: Benjamin Cummings, 2003. ISBN: 0-8053-4633-3
9. Bioinformatics: A Practical Guide to the analysis of genes and proteins edited by Andreas D. Baxevanis, B.F. Francis Ouellette, New York: Wiley-Interscience, 2001, second edition. ISBN: 0-471-38391-0

Paper Code	243013	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Biostatistics and Research Methodology			

A. Biostatistics (70 Marks)

1. **Introduction:** Definition and scope of Biostatistics; continuous and discontinuous variables, concept of population and samples, random samples.
2. **Classification and Presentation of data:** Collection and classification of data; tabular and graphic (histogram, frequency, polygon) representation of data, bar diagram and pie chart.
3. **Measures of central tendency and dispersion:** Parameters of measuring central tendency (mean, mode and median) and dispersion (range, variance, standard deviation, standard error, coefficient of variation), confidence limit.
4. **Distributions:** Symmetrical and asymmetrical distributions, characteristics and importance of normal and binomial distribution.
5. **Probability:** Concepts of probability, probability rules, some elementary probability.
6. **Test of significance:** Null hypothesis, test of significance, comparison of two means, t-test, paired and unpaired t-test, Z-test, X²-test.
7. **Measures of variable association:** Scatter diagram; simple correlation and regression analysis; test of significance for correlation and regression coefficients.
8. **Analysis of variance:** One way and two way classifications of variance, comparison of three or more samples, F-test.
9. **Experimental design:** Concept; experimental unit; treatment; principles of experimental design; analysis of variance for completely randomized design (CRD), randomized block design (RBD), and latin square design; least significance difference (LSD) test.

Books Recommended

1. Gomez, A. and A. A. Gomez. 1984. Statistical Procedures for Agricultural Research. John Wiley & Sons, New York.

2. Panse, V. G. and P. V. Sukhatme. 1978. Statistical Methods (3rd. Ed.). Indian Council of Agricultural Research, New Delhi.
3. Verma, B. L., G.D. Shukla and R.N. Srivastava. 1993. Biostatistics. CBS Publication, Delhi.
4. Zaman, S.M.H., K. Rahman and M. Howlader. 1980. Simple Lessons from Biometry. Bangladesh Rice Research Institute, Gazipur.
5. Avjx, Gg. Avkivd, 1979 : cwimsL`vb weÁvb, evsjv GKv†Wgx, XvKv|
6. fª, Gm. †K. 1992 : Rxe weÁvb cwi¶Y b·v|

C. Research Methodology (30 Marks)

1. **Introduction:** Characteristics of research, research and scientific methods, rationale and significance of research, types of research, research methods and methodology, qualitative and quantitative approaches of research, ethics in research.
2. **Research Process:** Problem and hypothesis formulation, review of literature, research objectives, sampling techniques, collection, processing and analysis of data; interpretation of the findings.
3. **Report writing and oral presentation:** Basic components of a research report, effective report writing, effective oral presentations, audiovisuals, benefits of using visual aids.
4. **Technical writing:** Thesis writing, preparation of bibliography, publishing a scientific paper, writing of research proposals for grant.

Books Recommended

1. Kattaarik, C.R. 1990. Research Methodology: Methods and Techinques (2nd Edition). Ram Pritograph, New Delhi.
2. Huntsberger, D.V. and Billingsly, B. Elements of Statistical analysis.

Paper Code	243015	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Biotechnology and Genetic Engineering			

1. **Biotechnology:** Definition, scope and importance of plant biotechnology, global importance of biotechnology.
2. **Recombinant DNA technology:** Gene cloning, restriction endonucleases, cloning vectors, identification and analysis of cloned genes, application and significance of recombinant DNA technology.
3. **Molecular markers:** Introduction to molecular markers, polymerase chain reaction (PCR) and its application, random amplified polymorphic DNA (RAPD), restriction fragment length polymorphism (RFLP); application of molecular markers.
4. **Plant tissue culture:** Laboratory organization, sterilization techniques, plant cell and tissue culture medium, plant growth regulators, plant regeneration, callus culture, organogenesis, somatic embryogenesis, cell suspension culture, protoplast isolation and culture.
5. **Application of tissue culture techniques:** Micropropagation, somaclonal variation, haploid production, production of disease free plants and commercial aspects of tissue culture.
6. **Plant genetic engineering:** Introduction, gene transfer to plants, *Agrobacterium*–mediated gene transfer, Ti plasmid, vectors of plant transformation; direct gene transfer methods, particle bombardment and electroporation.

7. **Biogas technology:** Introduction to biogas technology, production method and uses.
8. **Wastewater treatment biotechnology:** Introduction to wastewater and treatment process, types and characteristics of wastewater, wastewater treatment by activated sludge process. .
9. **Biofertilizer:** An overview of biofertilizer, major biofertilizer groups, production and uses.
10. **Single cell protein (SCP):** Definition, types and importance of single cell protein, production of SCP.
11. **Biosafety guidelines and regulations:** Safety consideration in biotechnology, intellectual property right (IPR) related to biotechnology and biosafety guidelines of Bangladesh.

Books Recommended

1. Dubey, R. C. 2001: A Text Book of Biotechnology. S. Chand & Co., New Delhi.
2. Dodds, John H. and Lorin W. Roberts. 1982: Experiments in Plant Tissue Culture. Cambridge Univ. Press, Cambridge, London.
3. Kumar, H.D. 1993: Molecular Biology and Biotechnology. Vikash Publishing House Pvt. Ltd., India
4. Higgins, I.J., D.J. Best and J. Jones: Biotechnology: Principles and Applications.
5. Razdam, M.K. 1993: An Introduction to Plant Tissue Culture. Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
6. Smith, S.E. 1996: Biotechnology (3rd ed.). Cambridge Univ. Press, Cambridge, London.
7. Biosafety guidelines of Bangladesh. Ministry of Environment and Forest, Government of the People's Republic of Bangladesh <http://dbtbiosafety.nic.in/act/Bangladesh>
8. fª, Gm. †K. 1992 : Dw™Ç` wUmy¨ mæú` : cÖhyw³ l cÖ†qvM| evsjv GKv†Wgx, XvKv|
9. †gv—dv Kvgvj cvkv, 2000| AvYweK Rxe weÁvb, 3q LÛ, evsjv GKv†Wgx, XvKv|

Paper Code	243016	Marks: 100	Credits: 4	Class Hours: 60 hrs.
Paper Title:	Practical-IV			

*Practical examination will be carried out in 6 hours examination in two days each under the same Paper code.

Part A (Agronomy and Horticulture; Economic Botany, Ethnobotany and Pharmacognosy; Biodiversity and Biostatistics)

Time: 6 hours

Marks: 50

Agronomy and Horticulture: 8 Marks

1. Identification of different types of fertilizer and seeds of important crops.
2. Seed bed preparation in field and pot preparation for using seedlings.
3. Transplantation of seedlings, pre- and post- transplanting care.
4. Viability test of seeds; seed germination and calculation of percentage of germination.
5. Techniques of vegetative propagation: Cutting, budding, grafting and layering.

Economic Botany: 5 Marks

- 1 Study and identification of economically important plants, plant parts and finished products of Bangladesh included in the syllabus.
- 2 Collection, identification of and uses of important plant materials.

Ethnobotany: 5 Marks

1. Identification, naming and uses of some of common local plant material culture.
2. Plant part used and process of preparation of the identified ethnobotanical material.

Pharmacognosy: 5 Marks

1. Preparation of herbarium medicinal plants of Bangladesh.
2. Methods of preparation of different reagents for qualitative test of (i) alkaloids, (ii) terpenoids, (iii) flavonoids.
3. Qualitative test for alkaloids – spot test by Mayers, Dragendorff, Wagner, Hagers and tannic acid.
4. Production procedures (methods of production) of items like powder, tablet, paste, suspension/group etc.

Biodiversity: 8 marks

1. Study of different life forms in a suitable place.
2. Analysis of species diversity in an area.
3. Identification of at least 50 species of different plant groups in an around the institution.
4. Collection and preservation of different groups of plants, herbarium specimen preparation technique.

Biostatistics: 10 Marks

1. Recording of quantitative data and presentation in tabular and graphical form.
2. Computation of mean, mode, median, variance, standard deviation and coefficient of variation.
3. Comparison of two samples mean by t-test.
4. Test for goodness of fit by χ^2 test.
5. Testing the nature and magnitude of relationship between two traits of a plant species by correlation and regression analysis.

Collection and Excursion Report 4.0

Practical Note Book 5.0

Part B (Limnology and aquaculture, Plant Breeding, Molecular Biology, Biotechnology and Genetic Engineering)

Time: 6 hours

Marks: 50

Limnology and Aquaculture: 12 Marks

1. Determination of water temperature, pH and Secchi depth of a pond, river, lake etc.
2. Determination of dissolved oxygen (DO), free CO₂ and alkalinity of pond water.

3. Local excursion to a pond/lake/marshy place and collection of hydrophytes, phytoplankton, macrophytobenthos and their analyses in the laboratory.
4. Study of some common macrophytes of Bangladesh: Emerging, floating, submerged and free floating (3-5 from each category).

Plant Breeding: 8 Marks

1. Demonstration of hybridization technique.
2. Selection and use of marker in hybridization programme.
3. Test of pollen fertility by acetocarmine.

Molecular Biology: 8 Marks

1. Use of chromatography technique for separation of amino acids.
2. Determination of molecular weight of protein molecules using SDS PAGE gel plates.
3. Estimation of molecular size of DNA using agarose gel plate.

Biotechnology and Genetic Engineering: 10 Marks

1. The students are required to visit to different research institutes involved in biotechnological research and have to submit study report.
2. Demonstration of aseptic culture technique: Preparation and sterilization of culture/fermentation media.
3. Preparation of plant tissue culture medium such as MS medium.
4. Technique of yoghurt/cheese production.

Report on the visit of Biotechnological Institute	7.0
Practical Note Book	5.0

Instruction to the Examiners

Part A (Agronomy and Horticulture, Economic Botany, Ethnobotany and Pharmacognosy, Biodiversity, Biostatistics).

Time: 6 Hours

Marks: 50

1. Specimens for grafting should be given.

Distribution of Marks:

	Distribution	Marks
I	Demonstration of the process to the examiner	4.0

II	Precaution	1.0
	Total	5.0

2. Viability test of seeds/pot preparation for seedling

Distribution of Marks:

	Distribution	Marks
I	Results	3.0
II	Calculation	1.0
	Total	4.0

3. Specimen A, B & C should be compost fertilizer/chemicalfertilizer/seed

Distribution of Marks:

	Distribution	Marks
I	Identification	0.5
II	Comments	0.5
	Total	1.0×3= 3.0

4. Specimen E, F should be selected from common economic products/parts of ethnobotanic uses.

Distribution of Marks:

	Distribution	Marks
I	Commercial/ethnobotanic name	0.5
II	Source	0.5
III	Importance	0.5
	Total	1.5×2= 3.0

5. Specimen G, H should be selected from common available medicinal plant. Students have to write their local name and scientific name.

	Distribution	Marks
I	Common name	0.5
II	Scientific name	0.5
II	Medicinal importance	0.5
	Total	1.5×2= 3.0

6. Specimen M & N will be samples of qualitative test for alkaloids.

	Distribution	Marks
I	Requirements	1.0
II	Demonstration of procedure	3.0
III	Precaution	1.0
	Total	5.0

Or

Preparation of herbal suspension/group

	Distribution	Marks
I	Requirements	1.0
II	Demonstration of procedure	3.0
III	Precaution	1.0
	Total	5.0

7. Study of life forms.

	Distribution	Marks
I	Arrangements	1.0
II	Characterization	4.0
	Total	5.0

Or

Determination of heterogeneity by Shannon-Winner method from the supplied data (at least 2 sets of data are to be given alternately).

	Distribution	Marks
I	Calculation	4.0
II	Comment on species diversity	1.0
	Total	5.0

8. A set of data will be given for t-test/variance analysis/correlation analysis (data are to be given alternately).

	Distribution	Marks
I	Observation	2.0
II	Analysis	4.0
III	Comments on the result	2.0
	Total	8.0

9. Collection and Excursion Report

4.0

Paper-B (Limnology & Aquaculture, Plant Breeding, Molecular biology, Biotechnology & Genetic Engineering)

Time: 6 Hours

Marks: 50

1. Specimen 'A' will be water sample for limnological experiment

Distribution of Marks:

I	Principle	1.0
II	Requirements	1.0
III	Performance	3.0
IV	Procedure and Calculation	3.0
V	Result	1.0
VI	Precaution	1.0
Total		10.0

2. Specimens B & C will be common macrophytes. Students have to write their scientific name.

Distribution of Marks $1.0 \times 2 = 2.0$

3. Specimens D & E should be plants or twigs with flower, buds of two different colours for hybridization

Distribution of Marks:

I	Demonstration	4.0
II	Requirements	1.0
III	Procedure	2.0
IV	Precautions	1.0
Total		8.0

4. Sample 'F' will be given for estimation of molecular size of DNA molecules.

Distribution of Marks:

I	Record of observation	3.0
II	Classification	2.0
III	Comment	2.0
Total		7.0

5. Production of Yoghurt/isolation of nitrogen fixing bacteria by mud-pie technique.

Distribution of Marks:

	Distribution of marks	Marks
I	Requirements	1.0
II	Procedure	4.0
III	Precaution	1.0
Total		6.0

6. Preparation of tissue culture medium

Distribution of Marks:

I	Principle	2.0
II	Requirements	1.0
III	Procedure (up to inoculation)	4.0
IV	Precaution	1.0
Total		8.0

7. Report on the visit of Biotechnological Institute 5.0

8. Practical Note Book 5.0

Paper Code	243018	Marks: 100	Credits: 4	
Paper Title:	Viva-voce			