



Department of Botany, University of Dhaka
M. Phil. Syllabus in Botany
for the session 2013-2014 Onward

	Credits
BOT 601: Microbial Biotechnology	4
BOT 602: Environmental Microbiology and Biotechnology	4
BOT 603: Advanced Mycology	4
BOT 604: Plant Pathology	4
BOT 605: Plant Taxonomy - I	4
BOT 606: Plant Taxonomy - II	4
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BOT 609: Natural Resource Management and Restoration Ecology	4
BOT 610: Molecular Plant Ecology	4
BOT 611: Limnetic Organisms and Pollution	4
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BOT 613: Plant Nutrition-I	4
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Course No. BOT 601: Microbial Biotechnology

Marks 100, 4 Credit hours

1. **Fermentation Technology:** Basic concept of fermentation and fermentor/bioreactor, principles of bioreactor design, importance of fermentation in biotechnology, fermentation of penicillin.
2. **Enzyme Technology:** Importance of microbial enzymes with special reference to detergent enzymes, animal feed enzymes, fruit processing enzymes and enzymes involved in dairy products.
3. **Biodegradation of Lignocellulosic compounds:** Introduction to lignocellulose, microbial degradation of cellulose and lignin.
4. **Microbial Polysaccharides:** Introduction to microbial polysaccharides (xanthan, dextran, alginate etc.), general properties of polysaccharide, production of xanthan.
5. **Wastewater Treatment by Activated Sludge and Trickling Filters:** Composition of domestic wastewater, biology of activated sludge and trickling filters, sludge settleability, sludge bulking, biochemical and chemical oxygen demand, nitrogen and phosphorus removal by the activated sludge process, adverse effects of nitrogen discharge.
6. **Water and Wastewater Disinfectant:** Introduction, factors affecting disinfection, inactivation of microorganisms by chlorine and ozone.
7. **Solid Waste Treatment:** Introduction to solid waste, solid waste treatment by landfills and composting.
8. **Xenobiotic Compounds:** Introduction to xenobiotic compounds (Halocarbons, nitroaromatic compounds, polychlorinated biphenyls, dioxins), degradation xenobiotic compounds (haloalkyl propellants).
9. **Biodegradable Pesticides:** Pesticides, recalcitrant halogenated pesticides, biodegradable pesticides.
10. **Archaea:** Biotechnological application of archaea.

References

- Atlas RM and R Bartha 1997. Microbial Ecology: Fundamentals and applications. Benjamin/Cummings Science Publishing, California.
- Baley JE and DF Ollis 1986. Biochemical Engineering Fundamentals (2nd ed). McGraw-Hill Inc., New York.

- Glazer AN and H Nikaido 1995. Microbial Biotechnology. Fundamentals of Applied Microbiology. W. H. Freeman and Company, New York.
- Rehm HJ and G Reed (Ed) 1986. Biotechnology (Vol. 8). VCH Publishers, New York
- Smith JE 1988. New Studies in Biotechnology (2nd ed). Chapman and Hall, Inc., New York.
- Wood BJB (Ed) 1985. Microbiology of Fermented Foods (Vol. 1). Elsevier Applied Science Publishers, New York
- Madigan MT, JM Martinko and J Parker 1997. Brock Biology of Microorganisms (8th ed). Prentice Hall, Upper Saddle River, NJ 07458.
- Bitton G 1999. Wastewater Microbiology (2nd ed). A John Wiley & Sons, Inc., New York

Course No. BOT 602: Environmental Microbiology and Biotechnology

Marks 100, 4 Credit hours

1. **Microorganisms in the environment:** Terrestrial, aeromicrobiology, aquatic and extreme conditions.
2. **Techniques in environmental studies:** Sample collection, sample processing, detection of microbial populations. Recent approaches to enrich and isolate microbes having catabolic properties. Detection of microorganisms on fomites.
3. **Nucleic acid based methods of analysis:** Structure and complementarity of nucleic acids, extraction procedure and methods.
4. **Indicator microorganisms:** Concept, total coliforms, faecal coliforms, fecal Streptococci, *Clostridium perfringens*, HPC, bacteriophage, standards and criteria for indicators.
5. **Detoxification of hazardous chemicals:** Recalcitrance, synthetic organic chemicals, biodegradation of environmental contaminants, factors affecting biodegradation.
6. **Bioremediation:** Environmental modification for bioremediation, microbial seedling and bioengineering approaches to the bioremediation of pollutants.
7. **Regeneration of nutrients:** Uptake and regeneration of inorganic nutrients by heterotrophic bacteria.

References

- Atlas RM 1997. Principles of Microbiology. Wm. C. Brown Inc., NY.
- Atlas RM and R Bartha. 1998. Microbial Ecology: Fundamentals and Applications. Benjamin/Cummings Publishing Company, Inc., CA.
- Gibson TD (Ed.). 1984. Microbial Degradation of Organic Compounds. Marcel Dekker, Inc., NY.
- Kirchman, DL (Ed.). 1977. Microbial Ecology of the Ocean. Wiley-Liss, Inc., NY.
- Madigan MT, JM Martinko, PV Dunlap and DP Clark 1997. Brock Biology of Microorganisms. Pearson Education, Inc., CA.
- Mitchell R (Ed.) 1992. Environmental Microbiology. Wiley-Liss, Inc., NY.
- Pelczar MJ, ECS Chan and NR Krieg 1993. Microbiology, Concepts and Application. McGraw-Hill, Inc., NY.
- Rittmann BE and PL McCarty 2001. Environmental Biotechnology. McGraw-Hill Companies, Inc. NY.
- Tortora GJ, BR Funke and CL Case 2004. Microbiology, An Introduction. Benjamin Cummings, CA.

Course No. BOT 603: Advanced Mycology

Marks 100, 4 Credit hours

1. Introduction: Mycology a mega science.
2. Industrial mycology:
 - a. Commercial exploitation of fungal metabolites.
 - b. Industrial production of citric acid and antibiotics.
 - c. Fungal plant growth regulators.
3. Agricultural mycology: Fungi as a Biocontrol agent and their biofertilizer potential in Agriculture, Most commonly encountered soil fungi. Fungal insecticides and herbicides.
4. Mycorrhizas: Introduction and short history. Mutualistic Plant-Fungus symbiosis. Types of mycorrhiza: Ectomycorrhiza, Endomycorrhiza (VAM/AM), orchid mycorrhiza. Ectendomycorrhiza of conifers, Ericoid mycorrhiza, Arbutoid mycorrhiza, Pyrolaceous mycorrhiza, Monotropoid mycorrhiza and Ophioglossid mycorrhiza.

5. Fungal Ecology: Succession of coprophilous fungi, pineneedle micosera, amphibious fungi in streams, aero-aquatic fungi in ponds, aeromycoflora, other habitats and macrofungal ecology.
6. Wood decay: Fungi involved, types of decay, mechanism of wood decay, preventive and control measures.
7. Medical Mycology: Human pathogenic fungi : superficial mycoses, subcuticular mycoses and systemic mycoses.
8. Myconano technology: a new and emerging science:
 - a. Concept of nanotechnology,
 - b. Biosynthesis of silver nanoparticles by fungus *Trichoderma reesei*,
 - c. Nanotechnology offers new insights into plant pathology,
 - d. Anti-microbial interior coating based on nanotechnology.

References

- Blackman JP 1981. Microbial Ecology of the Phylloplane. Academic Press. London subsidiary of Harcourt Brace Jovanovich.
- Dikinson JP and TF Preece (eds) 1976. Microbiology of aerial plant surfaces. Academic Press. London & New York.
- Dilip KA 2004. Fungal biotechnology in agriculture, food and environment.
- Dilip K, A Arora, RP Elender and KG Mukerjii 1992. Hand book of Applied Mycology. Vo. 4 Fungal Biotechnology. Marcel Dekker Inc.
- Kendrik B 2002. The Fifth Kingdom. 3rd edn. Focus Publishing. R. Pullins Co.
- Preece T.F and Dickinson CH 1968. Ecology of leaf surface & Micro-organisms. Academic Press. London & New York.
- Raj M and PD Bridge. 2009. Applied Mycology CABI Publishing.

Course No. BOT 604: Plant Pathology

Marks 100, 4 Credit hours

1. Root region mycoflora and their influence on fungal root diseases:
 - a) Concept of rhizosphere, rhizoplane and non-rhizosphere
 - b) Factors affecting root region mycoflora
 - c) Effect of environmental factors on root region mycoflora
 - d) Mycobial interactions in rhizosphere and rhizoplane and its significance on development of root diseases.
2. Phyllosphere mycoflora and their influence on foliar fungal diseases:
 - a) Concept of phyllosphere and phylloplane
 - b) Factors affecting phylloplane mycoflora
 - c) Antagonism between fungal saprophytes and pathogens on aerial plant surfaces.
3. Methods of detection of seed-borne fungi
4. Wood decay: Introduction, types, fungi involved, mechanism of wood decay, preventive and control measures.
5. Recent approaches to plant disease management
 - a) Trichoderma: application, mode of action and potential and a biological control
 - b) Mycorrhiza and plant disease control
 - c) Soil solarization for the control of soil borne diseases
 - d) Disease control through use of transgenic plants
6. Crop pathology with reference to Bangladesh
 - a) Diseases of cereal crops (Rice and Wheat)
 - b) Diseases of vegetables (Potato and Brinjal)
 - c) Diseases of fiber yielding plants (Jute)

References

- Baker FE, Cook RJ 1974. Biological control of plant pathogens. Freeman, San Francisco.
- Blackeman JP (eds) 1981. Microbial ecology of the phylloplane. Academic Press, London.
- Dickinson JG 1956. Diseases of field crops McGraw Hill Book Co. Ltd.
- Dickinson CH, Preece TF (eds) 1976. Microbiology of aerial plant surfaces, Academic Press, London.
- Fokkema NJ and Van den Heuvel J (eds) 1976. Microbiology of the phylloplane, Cambridge University Press, London.
- Garret SD 1965. A text book on seed pathology. Cambridge University Press, London.
- Jha DK 1995. Plant diseases of India. A source book. Vikash Publication House Pvt. Ltd, India.
- Mukerji KG 1986. Plant diseases of India. A source book. Tata McGraw Hill Publ. Co., New Delhi.
- Rai B, Arora DK, Dubey NK and Sharma PD (eds) 1993. Fungal ecology and biotechnology. Rakesh Kumar Rastogi for Rastogi Publ., New Delhi.

Courses No. BOT 605: Plant Taxonomy -I

Marks 100, 4 Credit hours

- The scientific naming of plants;** Forms of scientific names, Concept of ranks of taxa, Names of taxa, Citation of authorities, Publication, Typification, Priority and limitation of priority, Double citation, Names of cultivated plants, Names of sexual hybrids, Retention, choice and rejection of names and epithets, Names and Nyms
- The practical naming of plants:** Naming by comparison, Naming by means of keys, Bracketed key, Indented key, Use of keys, Good points in keys, Faults and limitations of keys, Short cuts and checks, Naming by an expert
 - (a) Formation of specific epithets:** General information, Commemorative epithets, Descriptive epithets, Names of plant parts, Prefixes and suffixes.
(b) Meaning of specific epithets
 - Flora and Vegetation:** Objectives of flora and vegetation study, Standard inclusions in flora and vegetation study, Reconnaissance and planning aids for flora and vegetation study, Floral summary, Documentation, Floristic spectral analysis
 - Data accumulation and analysis:** Introduction, Organization, Data accumulation, Data presentation and documentation, Drawings, Chromatographic data, Polygonal graphs and histograms, Hybrid index
 - Botanic gardens and Arboreta:** Introduction, Basic objectives, History, Organization and development, Functions of the botanic garden

Reference

- Davis PH and Heywood VH 1963. Principles of Angiosperms Taxonomy. Oliver Boyd. Edinburgh & London.
- Jeffrey C 1986. An Introduction to plant taxonomy. 2nd edn. Cambridge Univ. Press.
- Lawrence G.HM 1968. Taxonomy of Vascular Plants. The Macmillan Company, New York.
- Radford AE, Dic Dickson WC, Masey JR and Bell CR 1974. Vascular Plant Systematic. Harper & Row Publishers NY.
- Stace CA 1989. Plant Taxonomy and Biosystematics, 2nd Edward Arnold London.
- Khan MS (ed.). 1973-2002. Flora of Bangladesh. Fasciole 1-51 BNH, BARC, Dhaka.
- Hooker JD 1827-1837. Flora of British India. Vols. 1-7.

Courses No. BOT 606: Plant Taxonomy -II

Marks 100, 4 Credit hours

Anatomical evidence in Taxonomy:

- Leaf anatomy; stomata, trichomes; petiole anatomy foliar venation; stem anatomy; stelar anatomy.
- Reproductive Biology:
Population growth, size, density and carrying capacity; out breeding systems, asexual reproduction, in breeding systems, reproductive biology in relation to systematics; study methods; pollination types, mechanisms, vectors.
 - The application of natural products chemistry to taxonomy and phylogeny:
Steps to be followed in the solution of a chemotaxonomic problem; some natural products used in chemotaxonomic correlations; chromatography - basics and definitions; chemotaxonomy through protein analysis.

4. Habitats; Environmental relationships; biotic, abiotic factors; spatial relations, temporal relations, adaptive features. Life forms, diaspores types, fidelity, vitality, leaf size, developmental responses, heterotrophy.
5. Biodiversity and conservation:
Introduction to biodiversity conservation; world conservation strategies, conservation strategies for Bangladesh; International convention to Biodiversity; Methods of *ex situ* conservation; Biodiversity conservation issues and action plan for Bangladesh; The IUCN Red List Categories and threatened plants of Bangladesh.

Reference

- Beck CB 2005. An Introduction to Plant Structure and Development, University of Michigan, Ann Arbor, Hardback
- Burkill IH 1965. Chapters on the history of Botany in India. Govt. of India Press, Delhi.
- Cronquist A 1989. The evolution and classification of flowering plants. Honoughton, Millin Co. Mass, USA
- Eames AJ, Mac-Daniels LH 1947. An Introduction to Plant Anatomy. Mc-Graw Hill Book Co. Inc. New York. pp. 427.
- Hunter ML 1996. Fundamentals of conservation biology, Blackwell Science Publishers.
- Khan MS, Rahman MM and Ali MR 2001. Red Data Book of vascular plants of Bangladesh, Bangladesh National Harbarium, Dhaka.
- Khan MS 1991. Angiosperms. *In:* (Islam AKMN ed.) Two Centuries of plant studies in Bangladesh and Adjacent Regions. Asiatic Soc. Bangladesh, Dhaka.
- Meffe GR and Carroll CR 1997. Principles of conservation biology (Second edn.) Sinauer Associates Inc. Publishers, Sunderland, Massachusetts.
- Prain D 1903. Bengal plants. Vols. 1-2, Calcutta.
- Radford AE, Dic Dickson WC, Masey JR, Bell CR 1974. Vascular Plant Systematic. Harper & Raw Publishers NY.
- Stace CA 1989. Plant Taxonomy & Biosystematics. Edward Arnold, UK.

Courses No. BOT 607: Vegetation Ecology

Marks 100, 4 Credit hours

1. Introduction, Clarification of concepts of European and Anglo-American terminology.
2. Community sampling and analysis: (i) The Releve method, (ii) Three requirements of a sample stand, (iii) The nested plot technique, (iv) Criteria for size of Releve
3. Sampling: random sampling, estimated standard error of the sample mean; Tests of comparison and application of quadrat measures
4. The poison series and the detection of non-randomness
5. Ecological diversity and its measurements: (i) The information measure of diversity, (ii) Measuring diversity in sampled and censused communities, (iii) Semantics of diversity
6. Measurement of association between a pair of species
7. Vegetation structure: (i) Concepts of vegetation structure, (ii) Life form spectra
8. Ecosystem structure and function in relation to energy

References

- Begon M 1996. Population ecology. Blackwell Scientific Publications
- Gauch HG 1982 Multivariate analysis in Community ecology. Cambridge University Press.
- Kershaw KA 1984. Quantitative and dynamic ecology. Edward Arnold
- Mueller-Dombois, D. and Ellenberg, H. 1998. Aims and methods of vegetation ecology. John Wiley and Sons.
- Pielou EC 1989. Mathematical ecology. John Wiley & sons
- Pielou EC 1994. Ecological diversity. John Wiley & Sons.
- Shimwell DW 1995. The description and classification of vegetation. Sidwick & Hackson.
- Spurr SH 1993. Forest ecology. John Wiley & Sons.

Courses No. BOT 608: Physiological Ecology

Marks 100, 4 Credit hours

1. Carbon turnover by plants as part of the ecosystem with reference to: (i) The equation for net photosynthetic productivity, (ii) The proportion of loss due to respiration, (iii) Loss as detritus by grazing and its effect on biomass
2. Rice soil environment with reference to: (i) Soil types, (ii) Changes taking place due to flooding, (iii) Response to major nutrients, (iv) Nutrition of rice, (v) Fertilizer practice in rice soil
3. Keystone species; Dominant species; Stress tolerance and stress avoidance; Water stress and Molecular basis of freezing injury and tolerance
4. The ecology of arid lands with reference to: (i) Different types of deserts and their area, (ii) Location and characteristics, (iii) Edaphic features of the arid lands, (iv) Impacts of man on arid lands
5. Characteristics of desertification; Direct and indirect causes of desertification
6. Agroecosystem: (i) The causes of diminishing arid lands, (ii) Biomass production and energy content of selected crop plants, (iii) Nutrient cycling in agro-ecosystem
7. Factors affecting the structure and function of agro-ecosystem
8. Metabolic aspects of flood tolerant and flood intolerant plants

References

- Bannister P 1987. Introduction to physiological plant ecology. Blackwell Scientific Publications
Etherington JR 1988. Environment and plants. John Wiley & Sons
Etherington JR 1999. Physiological plant ecology. Edward Arnold.
Grainger A 1990. Threatening desert. Earthscan Publications.
Townsend CR and P Calow 1981. Physiological ecology. Blackwell Scientific Publications.
Waise Y 1972. Biology of halophytes. Academic Press.
Williams CB 1992. Climate, soil and crop production in the humid tropics. Oxford University Press.

Course No. BOT 609: Natural Resource Management and Restoration Ecology

Marks 100, 4 Credit hours

Part A: Natural Resource Management

1. Introduction, Linking protected area management and local communities, Conceptual models in community conservation, Areas of action, local participation, Collaborative management (CM), approaches of CM, prospects, Motivational factors, challenges.
2. Community-Based Natural Resource Management (CBNRM), rise of community-based approaches, elements of CBNRM, genesis, inception, programmatic development, ecological impacts of CBNRM, CBNRM and protected areas.
3. Review of The Tropics - Heterogeneity in time and space, Heterogeneity, agent, substrate and response, Competition between tree and grass layer- Walter's two layered model.
4. Tropical biodiversity and forest, Biodiversity Conventions (CBD), Bioprospecting, Ecosystem Functioning and Non Timber Forest Products (NTFP), Tropical Forest Management
5. Management of dry land resource systems: Evolution of dry land, Dryland climatic variation, equilibrium and non- equilibrium condition, Functional and dys-functional landscape, Stocking rate, Calculation of Carrying capacity.
6. Coastal Zone Management: Different management practices, Marine protected areas (MPAs), Integrated coastal management (ICM), Lessons Learned from Community-Based Marine Reserves and its Effectiveness.
7. Ecohydrology: A new tool for sustainable management of estuaries and coastal waters, estuary robustness, Estimates of the residence time, estuarine food webs, human impacts in estuaries from upland activity, Ecohydrology as a solution

Part B: Restoration Ecology

1. Introduction to Restoration Ecology: Definition, Goal, Objective, Reference point, Linkage between restoration and ecology, System structure and function. Social aspect of ecological restoration, ecosystem valuation, ecosystem description, targets in restoration ecology
2. Principles of restoration Ecology: Some familiar concepts, Concept of disturbance and stability, Processes and context.

3. Ecological foundations and interactions. Patch theories, flows between landscape elements, Isolated areas and biogeography, Key aspects of restoration projects, Integration of Traditional ecological knowledge in Restoration.
4. Rivers and streams: Allocation of resources to wetland restoration, Design and project principles.
5. Challenges for the future: Eight hot topics, Challenges for the practice of ecological restoration.

References

- Aguilar-Støen M and Dhillon SS 2003. Implementation of convention on Biological Diversity in Mesoamerica: environmental and developmental perspectives. *Environmental Conservation*. **30**(2): 131-138.
- Andel JV and Aronson, J (eds) 2006. *Restoration Ecology – The New Frontier*. Blackwell Publishing.
- Anderson D and Grove R (eds) 1987. *Conservation in Africa: People, policies and Practice*. Cambridge University Press.
- Bestelmeyer BT 2006. Threshold Concepts and Their Use in Rangeland Management and Restoration: The Good, the Bad, and the Insidious. *Restoration Ecology* **14**(3): 325–329.
- Buck EL, Geister CC, Schelhas J and Wollenberg E 2001. *Biological Diversity: Balancing Interests Through Adaptive Collaborative Management*. CRC Press. NY.
- Dalal-Clayton B, Dent D and Dubois O 2003. *Rural Planning in Developing Countries: Supporting Natural Resource Management and Sustainable Livelihoods*. Iied. Earthscan.
- du Toit JT, Walker BH and Campbell BM 2004. Conserving tropical nature: current challenges for ecologists. *Trends in Ecology and Evolution*. **19**(1):12-17.
- Holechek JL, Pieper RD and Herbel CH 1995. *Range Management: Principles and Practices*. Prentice-Hall, Inc.
- Hulme D and Murphee M (eds) 1999. *African Wildlife & Livelihoods: The Promise and Performance of Community Conservation*.
- Krebs CJ 2001. *Ecology: the experimental analysis of distribution and abundance*. Benjamin Cummings.
- Lin JY, Tsao EH, Lee TC and Yu SL 2004. Stream physical parameters and habitat requirement: the case of the Formosan salmon. *Ecological Engineering* **22**: 305-309.
- McShane TO and Wells MP (eds) 2004. *Getting Biodiversity Projects to Work: Towards More Effective Conservation and Development*. Columbia University Press. NY
- Pearce D, Putz FE and Vanclay JK 2003. Sustainable forestry in the tropics: panacea or folly? *Forest Ecology and Management*. **172**: 229-247.
- Primack RB 1995. *A Premier of Conservation Biology*. Sinauer, USA.
- Wolanski E, LA Boorman, L Chi'charo, E Langlois-Saliou, R Lara, AJ Plater6, RJ Uncles and M Zalewski 2004. Ecohydrology as a new tool for sustainable management of estuaries and coastal waters. *Wetlands Ecology and Management* **12**: 235–276.
- Whitford WG 2002. *Ecology of desert systems*. Academic Press, NY.
- Yayneshet T, LO Eik and SR Moe 2009. The effects of exclosures in restoring degraded semi-arid
- Zerbe S and Kreyer D 2006. Introduction to Special Section on "Ecosystem Restoration and Biodiversity: How to Assess and Measure Biological Diversity?" *Restoration Ecology*. **14**(1):103-104.

Course No. BOT 610: Molecular Plant Ecology

Marks 100, 4 Credit hours

1. **Introduction to molecular ecology:** Definition, The Emergence of molecular ecology, DNA-An unlimited source of data.
2. **Basic Molecular Biology:** Sample sources for DNA, Enzymes used in molecular biology, Electrophoresis, Detecting DNA, Blotting, Fixing, Hybridization, DNA sequencing
3. **Molecular markers in ecology:** Inheritance patterns in organisms, Kinds and features of molecular markers used in ecology
4. **DNA-fragment markers in plants:** Methodology, application and data interpretation of RAPD, AFLP and microsatellites.
5. **Phylogenetics:** Definition of phylogenetics, Types of phylogenetic tree, Methods for constructing phylogenetic tree
6. **Community and ecosystem functions:** Relationships between genetic variation and ecosystem functions
7. **Legume-rhizobia symbiosis:** Molecular interactions between partners, Determinants of host specificity in rhizobia, The NodD/Flavinoid complex and Nod factors
8. **Diversity and evolution of legumes and rhizobia:** Diversity, taxonomy and phylogeny of rhizobia, Taxonomy and phylogeny of legumes, Evolution of interactions between rhizobia and their legume hosts
9. **Applied molecular ecology:** Wildlife forensics, Agriculture and Global climate change

10. **Conservation biology:** The need for conservation, Population size, Genetic diversity, and inbreeding, Captive breeding

References

- Baker AJ 2000. *Molecular Methods in Ecology*. Blackwell Science.
Beebe T and G Rowe 2008. *An Introduction to Molecular Ecology*. 2nd Edn. Oxford University Press, Oxford.
Dresler-Nurmi A, Fewer DP, Räsänen LA and Lindström K. 2009. The diversity and evolution of rhizobia. *Microbiology Monograph*. **8**: 3-41.
Freeland JR and SD Petersen 2011. *Molecular Ecology*. 2nd Edition. John Wiley & Sons, Ltd. England.
Freeland JR 2005. *Molecular Ecology*. John Wiley & Sons, Ltd. England.
Hoelzel AR & GA Dover. 1991. *Molecular Genetic Ecology*. IRL, Oxford.
Wardle DA 2002. *Communities and Ecosystems*. Princeton University Press.
Weaver RF 2005. *Molecular Biology*. McGraw-Hill.

Course No. BOT 611: Limnetic organisms and pollution

Marks 100, 4 Credit hours

1. History of Limnology with particular reference to the limnological research in Bangladesh.
2. Circulation of water in the epilimnion and hypolimnion; composition, body shape, floating capacity, growth, uptake kinetics of nutrients of phytoplankton, seasonal cycles, paradox of phytoplankton, spatial vertical and horizontal distribution, community structure, dynamics and function of phyto-benthos, aquatic virus, bacteria, fungi and lichen.
3. Zooplankton rotifera, crustacean, cladocera, copepoda, structure of zooplankton population, migration, seasonal cycles, interrelationships between phytoplankton and zooplankton, cyclomorphosis and its adaptive role.
4. Primary productivity in the water body of Bangladesh, vertical distribution of primary productivity and respiration, daily rate of primary productivity; secondary productivity; food intake by consumers, flow of energy in the consumer chain, decomposition, role of different microbes in the decomposition processes, flow of energy in the aquatic ecosystem.
5. Pollution of aquatic ecosystems by acid rain and pesticides: where and how acid rain occurs, effect of acid rain and its control; pesticide economy, use, contamination classes; some examples, detection and fate of pesticides in aquatic habitats, effects on flora and fauna, future of pesticide use.

References

- Ameen MU 1987. Fisheries resources and opportunities in freshwater fish culture in Bangladesh NRD II Project/DANIDA, Noakhali, Bangladesh. pp. 244.
Dodson S 2005. *Introduction to Limnology*. Mc-Graw Hill, Boston. pp. 400.
Khondker M 1994. *Limnology*. Mawla Brothers. Dhaka. pp. 464.
Moss B 1980. *Ecology of Freshwaters*. Blackwell Sc. Publ. Oxford. pp 331.
Nishat A, Hussain Z, Roy MK and Karim A (eds) 1993. *Freshwater wetlands in Bangladesh: Issues and approaches for Management*. IUCN, Gland, Switzerland. Xii+283 pp.
Tilzer MM and Khondker M (eds), 1993. *Hypertrophic and Polluted Freshwater Ecosystems: Ecological Bases for Water Resource Management*. Department of Botany, University of Dhaka. pp. 229.
Wetzel RG 2001. *Limnology, lake and river ecosystems*. 3rd edn. Academic Press. San Diego. pp. 1006.

Course No. BOT 612: Limnetic production and Paleolimnology

Marks 100, 4 Credit hours

1. Production biology of limnetic waters: (a) Production by planktonic organisms. (b) Benthic macroinvertebrates their role in the material recycle and food chain. (c) Macrophytes production and their ecological role (in the detrital pathway) and economic role. (d) Freshwater fish biology, distribution of fish (floodplain fisheries), fish and fisheries resource of Bangladesh, aquaculture of fish and shrimp in tropical areas, strategies, proposals and constraints.
2. Palaeolimnology, the history and development of lake ecosystems: (a) Study of core sediments. (b) Dating of sediments. (c) Sources of information on sediments, microfossil studies of diatoms in sediment cores.

3. Hydrobiological problems in the tropics- manmade lakes and water-borne diseases: (a) Man-made lakes- the early stages of fillings. (b) New tropical lakes and human populations. (c) Trematode, filarial, protozoan and viral diseases. (d) Interaction between bacteria and algae in aquatic ecosystems. Studies on microbiotic cycles in surface waters. Bacteria, CO₂ and algal bloom. Association between blue-green algae and gram negative bacteria.
4. The conservation of freshwater ecosystem: (a) The North American Great Lakes. (b) Lake Okichubee. (c) Conservation related to the freshwater wetlands of Bangladesh.

References

- Ameen MU 1987. Fisheries resources and opportunities in freshwater fish culture in Bangladesh NRD II Project/DANIDA, Noakhali, Bangladesh. pp. 244.
- Khondker M 1994. Limnology. Mawla Brothers. Dhaka. pp. 464.
- Moss B 1980. Ecology of Freshwaters. Blackwell Sc. Publ. Oxford. pp 331.
- Nishat A, Hussain Z, Roy MK and Karim A (eds) 1993. Freshwater wetlands in Bangladesh: Issues and approaches for Management. IUCN, Gland, Switzerland. Xii+283 pp.
- Tilzer MM and Khondker M (eds), 1993. Hypertrophic and Polluted Freshwater Ecosystems: Ecological Bases for Water Resource Management. Department of Botany, University of Dhaka. pp. 229.
- Wetzel RG 2001. Limnology, lake and river ecosystems. 3rd edn. Academic Press. San Diego. pp. 1006.

Course No. BOT 613: Plant Nutrition-I

Marks 100, 4 Credit hours

1. Driving forces and transport of ions across plasma membranes: (a) Electrochemical potential as driving forces of ions, (b) The Nernst potential and the detection of active transport, (c) Driving forces for ion movement in *Hydrodictyon africanum*, (d) Activity of ions in cytoplasm, (e) Consumption of ions in metabolism, (f) Origin of membrane potential and factors controlling the electrical potential across membranes, (g) The role of calcium in controlling membrane permeability, (h) Conductance and electrical resistance of membranes.
2. Passive movements of ions across plasma membranes and ion selectivity: (a) Hydrated and non-hydrated ions, (b) Permeation of synthetic lipid bilayers by ions and water, (c) Modification of bilayer permeability and ion selectivity, (d) Ion selectivity of binding sites, (e) Passive permeation of algal cells by ions.
3. Ion transport in higher plants: the chemical approach: (a) Compartmentation and other complications in higher plants, (b) Ionic composition of intracellular compartments, (c) Transmembrane potential in cell of higher plants.
4. Links between cellular metabolism and ion transport: (a) Energy flow and ATP production in photosynthesis, (b) Energy flow in respiration, (c) Dependence of ion pumping on ATP and electron flow, (d) Charge separation and ion transport.
5. Adaptation of plants to adverse chemical soil conditions.
6. The role of protein synthesis in ion transport.
7. Regulation of inorganic ion transport in plants: (a) Regulation of transport in whole plants, (b) Regulation of transport in cells.

References

- Clarkson DT 1980. Ion Transport and Cell Structure in Plants. McGraw Hill, V.S.H.
- Epstein E 1982. Mineral Nutrition of PLants. Principle and Perspective. John Wiley and Sons, New York.
- Gauch HG 1982. Inorganic Plant Nutrition. Dowder, Hutchinson and Ross. Inc. Stroudsburg, Pa.
- Hewitt EJ and TA Smith 1974. Plant Mineral Nutrition. The English University Press, London.
- Marschner H 1995. Inorganic Nutrition of Higher Plants. Academic Press, New York.
- Peel AJ 1974. Transport of Nutrients in Plants. Butterworths, London.
- Sutcliffe JF and DA Baker 1984. Plants and Mineral Salts. Edward Arnold, London.
- Annual Review of Plant Physiology.

Course No. BOT 614: Plant Nutrition-II

Marks 100, 4 Credit hours

1. Long distance transport in higher plants: (a) Radial migration of ions by apoplastic pathway, (b) Endodermis as a barrier of translocation, (c) Upward movement.
2. Distribution and redistribution of ions: (a) Extraction of ions from xylem, (b) Delivery of ions and solutes within leaves, (c) Movement of ions and solutes within leaves, (d) Export of ions from leaves, (e) Redistribution of ions in relation to physiological processes.
3. The hypothesis of the mechanism of sieve tubes transport: (a) 'Passive' mechanisms, (b) 'Active' mechanisms.
4. Metabolic energy and transport of carbohydrate: (a) 'The metabolic potential' of phloem, (b) The effect of localized application of low temperature, metabolic inhibitors and anoxia on transport.
5. The soil-root interface (rhizosphere) in relation to mineral nutrition.
6. Basic concept in isotopic studies: (a) Radioactivity, (b) Artificial radioactivity, (c) Isotopic techniques for tracer studies, (d) health physics.
7. Isotopes in biology and agriculture: use of isotopes in (a) Fundamental studies of soils, (b) Crop studies, (c) Root pattern studies, (d) Nitrogen fixation, (e) Plant protection studies, (f) Irrigated agriculture, (g) Irrigation studies, (h) Plant physiological studies, (i) Future agricultural research.
8. Ionic relation under salinity: (a) Salt transport by plants in relation to salinity, (b) Relation between effects of salinity on ion uptake and that on growth of plants.
9. Ionic relation under waterlogging conditions.

References

- Clarkson DT 1980. Ion Transport and Cell Structure in Plants. McGraw Hill, V.S.H.
Epstein E 1982. Mineral Nutrition of PLants. Principle and Perspective. John Wiley and Sons, New York.
Gauch HG 1982. Inorganic Plant Nutrition. Dowder, Hutchinson and Ross. Inc. Stroudsburg, Pa.
Hewitt EJ and TA Smith 1974. Plant Mineral Nutrition. The English University Press, London.
Marschner H 1995. Inorganic Nutrition of Higher Plants. Academic Press, New York.
Peel AJ 1974. Transport of Nutrients in Plants. Butterworths, London.
Ramulu USS 1982. Isotopes in Agriculture. New Delhi, India
Sutcliffe JF and DA Baker 1984. Plants and Mineral Salts. Edward Arnold, London.
Annual Review of Plant Physiology.

Course No. BOT 615: Plant Physiology

Marks 100, 4 Credit hours

1. The Power plant and the chemical factory of life; The age of pneumochemistry, Improvement of air by plants and the role of light.
2. Photosynthesis in isolated chloroplast, chloroplasts, grana and lamellae, characteristics absorption peaks, occurrence, molecular origin of photosynthetic energy, Ribulose diphosphate carboxylase activity.
3. (a) Structure and composition of photosynthetic antenna pigments.
(b) Role of antennae in CO₂ fixation: light harvesting function, protection against active oxygen species, regulation of light utilization, and regulation of energy distribution from PSII to PSI.
4. Role of C₃ and C₄ cycle in crop productivity.
5. Regulation of glycolysis, TCA cycle and Pentose phosphate pathway.
6. Relation of photosynthesis, total respiration in a leaf, the adaptation and electrical analogue and other factors to control productivity in stands: correlation of net photosynthesis with productivity, variation in available irradiation, relation of stage of plant development to productivity, yield of photosynthesis on earth in tons of carbon.
7. Dark respiration and photorespiration, CO₂ compensation point, Effects of temperature on the CO₂ compensation point of various species, post illumination CO₂ outburst .
8. Cyanide-resistant respiration: an alternative pathway; significance of alternative path.
9. Coupling of respiration with other metabolic pathways in the cell.
10. Theories on the mechanism of energy transduction; The chemical coupling theory, The conformational coupling theory, The chemiosmotic theory, Binding- change mechanism of

ATP synthesis.

11. Biosynthesis and bioassay of auxin, gibberellin, cytokinin and abscisic acid.
12. Distribution and role of phytochrome, phytochrome mediated responses in plants, cryptochrome mediated responses in plants.
13. Application of growth regulating chemicals for increasing crop yield.

References

- Conn EE and PK Stumpf 1972. Outlines of Biochemistry, 3rd Edition, John Wiley and Sons Inc., New York.
- Hopkins WG 1999. Introduction to Plant Physiology, 2nd Edition, John Wiley and Sons Inc. New York.
- Jain VK 2004. Fundamentals of Plant Physiology, 7th Rev. Edition. S. Chand and Company Ltd., New Delhi.
- Leopold AC and EP Kriedemann 1975. Plant growth and development, McGraw Hill Inc., New York.
- Mukherji S and AK Ghosh 2009. Plant Physiology, Revised central copy, New Central Book Agency (P) Ltd., Delhi, Kolkata, Pune, Ernakulam.
- Pieatre A 1964. Harvesting the sun, Academic Press, New York and London.
- Robinowitch E and Govindjee 1989. Photosynthesis, John Wiley and Sons Inc. New York.
- Taiz L and E Zeiger 1991. Plant Physiology, The Benjamin Cumming Publishing Company Inc., California.
- Zelitch I 1971. Photosynthesis, photorespiration and plant productivity, Academic Press, New York

Course No. BOT 616: Plant Tissue Culture - I

Marks 100, 4 Credit hours

1. Current potential application of tissue culture in agriculture and botanical research.
2. The application of anther and pollen culture in the production of rice varieties resistant salinity, pest and diseases.
3. The application of *in vitro* culture in overcoming incompatibility of inter-specific crosses for breeding of disease and pest resistance.
4. Cryopreservation and its role in exchange of disease free stocks and propagules.
5. Genetic and cytological basis of the new strains of sugarcane produced through tissue culture.
6. Production of elite trees through tissue culture and its impact in some afforestation programme.
7. Histology of callus following suspension culture.
8. Growth pattern and physiology of callus in suspension cultures.

References

- Bhojwani SS 1990. Plant Tissue Culture: Applications and Limitations. Elsevier. Amsterdam, Oxford, New York, Tokyo.
- Bhojwani SS and MK Razdan. 1996. Plant Tissue Culture: Theory and Practice, Elsevier, Amsterdam, New York, Tokyo.
- Dixon RA 1985. Plant Cell Culture - a Practical Approach. IRL Press, Oxford, Washington.
- Doods JH and LW Roberts. 1982. Experiments in Plant Tissue Culture, Cambridge University Press.
- Gamborg OL and GC Philips. 1995. Plant Cell Tissue and Organ Culture Fundamental Methods. Springer.
- George ED and PD Sherrington. 1984. Plant Propagation by Tissue Culture. Exetetics Publ. Ltd., England.
- Pierik RLM 1997. In Vitro Culture of Higher Plants. Kluwer Academic Publishers. Dordrecht/Boston/London.
- Razdan, M.K. 1993. An Introduction to Plant Tissue Culture, Oxford & IBH Publ. Co. (Pvt) Ltd., New Delhi, India.

Course No. BOT 617: Plant Tissue Culture -II

Marks 100, 4 Credit hours

1. Commercial application of tissue culture, its prospects.
2. Advantages of monoploid production through inter-specific hybridization by chromosomal elimination with special references to barley.
3. The role of tissue culture in the production of genetic variation with the aim of producing novel

- varieties of orchids with importance in flower industry.
4. Biosynthesis of economically important secondary products through cell and tissue culture. Factors limiting the biosynthesis of secondary products from cultured cells in suspension culture.
 5. Distant hybridization through fusion of protoplast and its importance in plant breeding. Production of hybrids in obtaining male sterile line.
 6. The application of meristem culture and heat therapy in the production of virus free stocks.
 7. Cytogenetics of differentiation and production of genetic variability through tissue culture.
 8. *In vitro* pollination and fertilization in difficult hybrid combinations.

References

- Bhojwani SS 1990. Plant Tissue Culture: Applications and Limitations. Elsevier. Amsterdam, Oxford, New York, Tokyo.
- Bhojwani SS and MK Razdan 1996. Plant Tissue Culture: Theory and Practice, Elsevier, Amsterdam, New York, Tokyo.
- Dixon RA 1985. Plant Cell Culture - a Practical Approach. IRL Press, Oxford, Washington.
- Doods JH and LW Roberts 1982. Experiments in Plant Tissue Culture, Cambridge University Press.
- Gamborg OL and GC Philips 1995. Plant Cell Tissue and Organ Culture Fundamental Methods. Springer.
- George ED and PD Sherrington 1984. Plant Propagation by Tissue Culture. Exetetics Publ. Ltd., England.
- Grout B 1995. Genetic Preservation of Plant Cells *In Vitro*. Springer.
- Pierik RLM 1997. *In Vitro* Culture of Higher Plants. Kluwer Academic Publishers. Dordrecht/ Boston/London.
- Razdan MK 1993. An Introduction to Plant Tissue Culture, Oxford & IBH Publ. Co. (Pvt) Ltd., New Delhi, India.
- Vasil IK (Ed.) 2003. Plant Biotechnology 2002 and Beyond. Kluwer Academic Publishers. Dordrecht/Boston/London.
- Zimmerman RH, RJ Griesbach FA Hamerschla and RH Lawson. Tissue Culture as a Plant Propagation System for Horticultural Crops, Martinus Nijhoff Publishers, Dordrecht, Boston, Lancaster.

Course No. BOT 618: Molecular Cytogenetics - I

Marks 100, 4 Credit hours

1. Structure and composition of chromosomes: (a) Constituents of chromosome- DNA, RNA, histones, inorganic ions. (b) Assembly of chromosomal constituents into chromosomes-nucleosome, solenoids, higher order packing of chromosome fibres. (c) Distribution of chromosomal constitutions along chromosomes. (d) Changes during chromosome condensation.
2. Smear technique for plant chromosomes: (a) Chromosome preparation from the root. (b) Chromosome preparation from cell suspension and callus, (i) Suspension culture of celery (*Apium graveolens*), (ii) Callus culture of *Brassica carinata*. (c) Chromosome preparation from flower. (d) Chromosome preparation from Shoot
3. Karyotyping and sorting of plant chromosomes by flow cytometry: (a) Protocol 1, (i) Accumulation of mitotic metaphase, (ii) Analysis of the degree of the metaphase synchrony. (b) Protocol 2, (i) Suspension of plant chromosome, (ii) Alignment of flow cytometer for chromosome analysis and sorting. (c) Protocol 3, (i) Univariate flow karyotyping and sorting of plant chromosomes, (ii) Bivariate flow karyotyping and chromosome sorting. (d) Protocol 4, (i) Physical mapping of DNA sequences using PCR, (ii) Two- step sorting, (iii) Reagents and solutions. (e) Protocol 5, (i) Karyotype analysis by pachytene chromosomes, (ii) Karyotype analysis by flow cytometry, (iii) Karyotype analysis by image analysis
4. Genetic control of meiosis: (a) Synaptic mutants- (i) Distribution of synaptic mutants, (ii) Origin of synaptic mutants (iii) Cytological behavior of synaptic mutants, (iv) Synaptic Mutants and recondensation. (v) Factors influencing pairing in Synaptic Mutants, (b) Genetic Control of recondensation, (c) Genes responsible for chromosome disjunction, (d) Other meiotic mutants, (e) Role of heterochromatin in chromosome pairing, (f) Diploid-like meiosis in allopolyploids - (i) The 5-B system in wheat ($2n = 6x = 42$), (ii) Origin of Ph, (g) Haploidy- (i) Mechanism of chromosome elimination, (ii) Genetics of chromosomes elimination, (iii) Haploid-initiator gene in Barley. (h) Male sterility- (i) Classification of male sterility, (ii) Mechanism of male sterility
5. The Chromosomal basis of sex determination in plants: (a) System of sex determination- (i) Male heterogametic (female XX; male XY; X-Y system), (ii) Male heterogametic (female XX; male XO; X-O system), (iii) Male heterogametic (but with one extra chromosome), (iv) Female heterogametic (female XX (ZW); male XX (ZZ) (Z-W System), (v) Compound chromosomes (interchanges among X, Y, and autosomes), (b) Determination of heterogametic sex in plants- (i) Cytological identification. (ii) Sex linkage inheritance. (iii) Crosses between dioecious and monoecious *Bryonia* species. (iv) Competition tests in pollination, (v) Self-pollination of plants

- that are normally unisexual, (vi) Crosses between diploids and autotetraploids, (c) Sex ratio among progeny of primary trisomics, (d) Sex expression. (e) The evolution of dioecism, (f) Evolution of sex chromosomes.
- Chromosomal aberrations in cell and tissue culture: (a) Introduction, (b) Chromosomal aberrations in callus - (i) Media composition, (ii) Age of callus, (iii) Nature of callus (Morphogenic vs. Nonmorphogenic), (iv) Kind of media (solid vs. liquid), (c) Mechanism of chromosomal aberrations in culture, (d) Chromosomal aberrations in regenerated plants: (a) Diploid vs. polyploid species - (i) Potato (*Solanum tuberosum*), (ii) Wheat (*Triticum aestivum*), (iii) Triticale ($2n = 6x = 42$), (b) Age of callus. (c) Source of explant materials, (d) Culture conditions, (e) Chromosomal aberrations in haploid callus and their regenerants. (f) Chromosomal aberrations in somatic hybrids - (i) Stable somatic hybrids, (ii) Partially stable somatic hybrids, (iii) Unstable somatic hybrids, (iv) Chromosomal aberrations in transgenic crops, Genetic background of the explant, Cytological basis of gene silencing

References

- Akhtaruzzaman M 2000. Kosh Bangshagatibiddaya. Hassan Book House, Dhaka.
 Schwaszacher T and Heslop-Harrison P 2000. Practical *in situ* hybridization. Springer-Verlag New York, Inc. 70010-7858 abd BIOS Scientific Publishers Ltd.
 Singh Ram J 2003. Plant Cytogenetics. CRC Press, London.
 Sumner AT 1990. Chromosome banding. Unwin Hyman, London.

Course No. BOT 619: Molecular Cytogenetics - II

Marks 100, 4 Credit hours

- Genome organization in the light of chromosome banding - (a) heterochromatic bands, (b) euchromatic bands, (c) molecular correlations with euchromatic banding, (d) structural correlations with euchromatic banding.
- Chromosome banding polymorphism, heteromorphism and variants - (a) Mechanism of formation heteromorphism. (b) Quantitative assessment of heteromorphic bands. (c) Heteromorphism in plants. (d) Human chromosome heteromorphism (chromosome No 1, 3, 4, 6, 9, 16, Y chromosome).
- Banding with nucleases- (a) Digestion of chromosomes with non-specific nucleases, (b) Digestion of chromosomes with restriction endonucleases, (c) (i) Banding pattern produced by restriction endonucleases with conventional staining, (ii) Restriction enzyme/ nick translation, (iii) Studies on the mechanism of action of restriction endonucleases on chromosomes.
- Banding demonstrated by immunocytochemical methods- (a) Antibodies to the four unsubstituted bases of DNA, (b) Anti-5-methylcytosine, (c) Antibodies to single and double-stranded DNA. (d) Antibodies to histone, (e) Antibodies to non-histone chromosomal proteins.
- Fluorescence *in situ* Hybridization (FISH) - (a) Chromosome preparation, (i) Collection, pretreatment, and fixation of root, (ii) Preparation of buffer, (iii) Enzyme solution, (iv) Preparation of slides. (b) Fluorescence *in situ* Hybridization procedure - (i) Prehybridization method, (ii) Hybridization, (iii) Observation and photography, (c) Genomic *in situ* Hybridization (GISH), (d) Multicolor genomic *in situ* Hybridization (McGISH), (e) Primed *in situ* (PRINS) DNA labeling
- Total DNA extraction - plant genomic DNA: (a) Solutions, (b) Procedure, (c) Determination of nuclear DNA content of plants by flow cytometry - (i) Stock solutions, (ii) Final solutions, (iii) Procedure, (iv) Flow cytometry after DAPI staining, (v) Flow cytometry after propidium iodide (PI) staining, (vi) Materials for flow cytometry, (vii) Fluorescent staining of nuclear DNA, (viii) Cell cycle in higher plants, (ix) Nuclear DNA content and the cell cycle, (x) Determination of nuclear genome size, (xi) Resolution of DNA content histograms, (xii) Instrument calibration, (xiii) Determination of ploidy in plants by flow cytometry, (xix) Identification of interspecific hybrids.

References

- Akhtaruzzaman M 2008. Kosh Bangshagatibiddaya. (3rd Edn.). Bangla Academy, Dhaka.
 Schwaszacher T and P Heslop-Harrison 2000. Practical *in situ* hybridization. Springer-Verlag New York, Inc. 70010-7858 abd BIOS Scientific Publishers Ltd.
 Singh Ram J 2003. Plant Cytogenetics. CRC Press, London.
 Sumner AT 1990. Chromosome banding. Unwin Hyman, London.

Course No. BOT 620: Plant Breeding and Biotechnology - I

Marks 100, 4 Credit hours

1. Mechanisms controlling pollination and their consequences: self-incompatibility and its significance, genetic and molecular basis of self-incompatibility, pollen-stigma interaction; apomixes, genetics and application of apomixes.
2. Crop genetic resources: characterization, conservation and utilization.
3. Breeding for biotic and abiotic stress tolerance: sources of stress tolerance and methods of breeding for stress tolerance.
4. Distant hybridization: concept, barriers to distant hybridization, application and limitations.
5. Production of hybrid seeds: utilizations and limitations.
6. Marker Aided Selection (MAS) in plant breeding: kinds of markers, achievements and limitations.
7. Components of genetic variance: quantitative variations, estimation of variance, factors affecting gene action, role of quantitative trait loci (QTL) in plant breeding.
8. Aids to selection: Correlation co-efficient, path analysis and diallel cross analysis.
9. Plant Breeder's Rights: Breeders Rights, Farmers Rights, features of UPOV, advantages and disadvantages of PBR.
10. Contribution of different national and international centres for the development of improved crop plants.

References

- Allard RW 1964. Principles of Plant Breeding. John Willey & Sons, New York.
- Briggs FN and PF Knowles 1978. Introduction to Plant Breeding. Reinhold Publishing Corporation. New York/London.
- Chaudhary RC 2001. Introduction to Plant Breeding. Oxford & IBH Publishing Co., New Delhi.
- Chopra VL 2005. Plant Breeding: Theory and Practice. Oxford & IBH Publishing Co., New Delhi.
- Falconer DS 1983. Introduction to quantitative genetics. Longman, London, New York
- Gomez KA and AA Gomez 1984. Statistical Procedures for Agricultural Research. John Willey & Sons, Inc. New York.
- Nettancourt D de 1977. Incompatibility in angiosperms. Springer-Verlag
- Sharma JR 2002. Principles and Practice of Plant Breeding. Tata McGraw-Hill Publishing Co. Ltd. New Delhi/New York/Tokyo/Toronto.
- Singh BD 2009. Plant Breeding: Principles and Methods. Kalyani Publishers. Ludiana/New Delhi/Kolkata
- Singh Phundan 2004. Essentials of Plant Breeding. Kalyani Publishers. Ludiana/New Delhi/Kolkata
- Singh RK and BD Chaudhary 1979. Biometrical Methods in Quantitative Genetic Analysis. Kalyani Publishers. Ludiana/New Delhi/Kolkata

Course No. BOT 621: Plant Breeding and Biotechnology - II

Marks 100, 4 Credit hours

- Plant Cell and Tissue Culture: Cell and tissue culture, micropropagation and somaclonal variation.
2. Plant Tissue Culture Media: ingredients and their functions.
 3. Plant Growth Regulators, other additives and their function in plant tissue culture
 4. Types of Culture: Cyto-differentiation, embryo culture, callus culture, organ culture and protoplast culture
 5. Status of Commercial Tissue Culture Enterprises in Bangladesh and in the neighbouring countries
 6. Gene Cloning: cDNA and genomic cloning and analysis of cloned DNA sequences.
 7. Gene Transfer Methods in Plants
 8. Contained, Confined and Open Field Trials of transgenic Plants
 9. Molecular Pharming
 10. Regulatory Systems for Plant Biotechnology: Biosafety Regulations, Intellectual Property Rights (IPR)
 11. Global Status of Biotech Crops
 12. Bioinformatics.

References

- Bhojwani SS1990. Plant Tissue Culture: Applications and Limitations. Elsevier. Amsterdam/Oxford/New

- York/Tokyo.
- Chawla HS 2005. Introduction to Plant Biotechnology. Oxford & IBH Publishing Co., New Delhi.
- Chrispeels MJ and DE Sadava 1994. Plants, Genes and Crop Biotechnology. Jones and Bartlett Publishers. Boston/Toronto/London/Singapore.
- Dixon RA and RA Gonzales 1994. Plant Cell Culture: A Practical Approach. Oxford University Press, Oxford/New York/Tokyo.
- Dubey RC 2006. A Text Book of Biotechnology. S. Chand & Company Ltd. New Delhi.
- Gupta PK 2004. Biotechnology and Genomics. Rastogi Publications. Meerut.
- Pierik RLM 1998. *In Vitro* Culture of Higher Plants. Kluwer Academic Press, Dordrecht/Boston/London.