NATIONAL UNIVERSITY

Syllabus

Department of Botany

One Year Master's Course

Effective from the Session: 2013-2014

National University

Subject: Botany

Syllabus for One-Year Master's Course

Effective from the Session: 2013-2014

Paper Code	Paper Title	Credits
313001	Taxonomy of Angiosperms	4
313003	Advanced Plant Physiology	4
313005	Plant Ecology and Environment	4
313007	Molecular Genetics	4
Elective Courses (Any three paper the followings)		
313009	Microbiology and Microbial Biotechnology	4
313011	Applied Mycology	4
313013	Advanced Phycology	4
313015	Higher Cryptogams	4
313017	Hydrobiology and Limnology	4
313019	Plant Pathology and Crop Protection	4
313021	Cytogenetics	4
313023	Plant Breeding and Biometry	4
313025	Plant Biotechnology	4
313027	Medicinal Plants and Herbal Medicines	4
313028	Practical	6
	Practical Part-I (Taxonomy of Angiosperms, Ecology and Environment)	
	Practical Part-II (Advanced Plant Physiology, Molecular Genetics)	
	Practical-III (Any two of the elective courses)	
313030	Thesis	6
313032	Viva-Voce	2
	Total =	**36**

Detailed Syllabus

Paper Code	313001	-----	**Credits: 4**	**Class Hours: 120 hrs.**
Paper Title:	**Taxonomy of Angiosperms**			

1. History of the Botanical Exploration in the Indian Subcontinent and Taxonomic Research done in Bangladesh.
2. Floristic regions of Bangladesh.
3. Systems of Plant Classification: L.D. Benson, A. Cronquist and A.L. Takhtajan, and a comparative account of these systems.
4. Palynology: Pollen structure and their ornamentations; use of pollen characters in the taxonomy and phylogeny of angiosperms.
5. Biochemical and molecular systematics: Nuclear and chloroplast DNA in systematics and phylogenetics; application of DNA markers in molecular systematics and phylogentics, DNA bar coding.
6. Naming of cultivated plants, general rules for governing grafts, hybrids and cultivar names.
7. Practical naming of plants: Naming by comparison; Naming by means of bracket keys and indented keys; Naming by an expert; Faults and limitations of keys.
8. Anatomical evidences: Leaf, Stem, and Stelar anatomy and their significance in plant systematics
9. Reproductive biology and systematics: Population size and density; breeding systems in relation to systematics; study methods of reproductive biology, isolating mechanism and endemism.
10. Concept of flora, monographs and revisions.
11. Role of taxonomy in the conservation of biodiversity
12. Study of the following families: Cannaceae, Zingiberaceae, Orchidaceae, Asclepiadaceae and Asteraceae.

Books Recommended:

Ahmed ZU, Begum, ZNT, Hassan MA, Khondker M, Kabir SMH, Ahmed M, Ahmed ATA, Rahman AKA and Haque EU (eds) 2007-2009, Encyclopedia of Flora and Fauna of Bangladesh Vols. 6-13, Asiatic Society of Bangladesh, Dhaka

Burkill IH 1965, Chapters on the history of Botany in India, Govt. of India Press, Delhi

Cronquist A 1969, The Evolution and Classification of Flowering Plants, Honghton, Mifflin Co. Mass, USA

Davis PH and VH Heywood 1963. Principles of Angiosperm Taxonomy =. Oliver Boyd. Edinburgh and London.

Heywood VH 1993, Flowering Plants of the World Oxford UniversityPress, New York.

Hooker JD 1872-1897, Flora of British India, Vols. 1-7

Jeffrey C 1986, An Introduction of Plant Taxonomy, 2nd ed. Cambridge Univ. Press

Khan MS 1991, Angiosperms. In: Two centuries of Plant studies in Bangladesh and Adjacent Regions (Islam A.K.M Nurul ed.) Asiatic Soc. Bangladesh, Dhaka

Khan MS (ed.) 1973-2002, Flora of Bangladesh Fascicles 1-51 Bangladesh National Herbarium, BARC, Dhaka

Prain D 1903, Bengal Plants. Vols. 1-2, Botanical Survey of India, Calcutta

Radford AE, WC Dickson, JR Massey and CR Bell 1974, Vascular Plant Systematics, Harper & Raw Publishers, NY
Soltis PS, DE Soltis and JJ Doyle 1998, Plant Molecular Systematics II, Chapman Hall, New York
Stace CA 1989, Plant Taxonomy & Biosystematics, 2nd ed. Edward Amold, London
Stuessey TF 1990, Plant Taxonomy, The Systematic Evaluation of Comparative Data Columbia University Press, Oxford.

Paper Code	313003	-----	**Credits: 4**	**Class Hours: 120 hrs.**
Paper Title:	**Advanced Plant Physiology**			

1. Photosynthesis: Mechanism of photosynthesis, factors affecting photosynthesis, emersion effect, photooxidation, relation of thermodynamics with photosynthesis, bacterial photosynthesis and chemosynthesis, photosynthesis productivity co-relation of net photosynthesis with productivity.
2. Respiration: Pentose phosphate pathway, interrelationship of respiration with other metabolic processes, energy production through oxidation of carbohydrates and lipids.
3. Photorespiration: Site of photorespiration, biochemistry and significance of photorespiration, difference between respiration and photorespiration.
4. Mechanisms of ion absorption in plants: Dual Mechanism of ion transport and chemiosmotic theory.
5. Translocation: Mechanism of translocation of ions in plants, Crafts and Broyer hypothesis.
6. Secondary metabolites: Principal function of secondary plant products, major pathways of secondary product biosynthesis and their interrelationship with primary metabolism; distribution of secondary metaboli product in plants; importance of secondary metabolites.
7. Fertilizer and crop nutrition: Types of fertilizers, calculation of fertilizer application rates, timing of application and application procedures.
8. Biological clock: Types of biological clock, clock mechanism circadian rhythms and the biological clock in nature.
9. Phytohormones: Mechanism of hormone action, practical application of hormones, synthesis of auxin and gibberellins.
10. Fruit development and ripening: Chemical changes during fruit development, fruit ripening and artificial fruit ripening.
11. Stress physiology: Physiological responses of plants in relation to-
    a) Water deficit and drought resistance
    b) Heat stress and heat shock
    c) Salt stress and salt resistance
    d) Cold injury and cold resistance

Books Recommended:

Conn EE and PK Stumpf 1972. Outlines of Biochemistry, 3rd Edition, John Wiley and Sons Inc., New York.
Devlin RM and FH Witham 1997. Plant Physiology 4th edition, CBS publishers and Distributors, Delhi

Evans, CL. 1964, Quantitative analysis of Plant Growth, Blackwell Scientific Publications. Oxford.

Paper Code	313005	-----	**Credits: 4**	**Class Hours: 120 hrs.**
Paper Title:	**Plant Ecology and Environment**			

1. Factors controlling the distribution of vegetation: Temperature, light, water and wind.
2. Concepts of vegetation structure, phenological aspects in plant communities.
3. Methods of studying vegetation, life form classes and biological spectrum; plant community structure.
4. Species diversity, measurement of species diversity, determination of rare and common species.
5. Plants and micro-climate in relation to-
   a) The modification of light climate by vegetation
   b) Temperature profiles within vegetation
   c) Air movement above the ground and within vegetation
   d) The distribution of dust and gases near the ground
6. Energy balance and gaseous exchange in plants:
   a) Radiation balance
   b) The diffusive resistance in leaves
   c) Stomatal movement in relation to sun and shade habitats
   d) Energy calculation in forest canopies
7. C_3 and C_4 adaptation; distribution of C_4 species in North America, Central Europe, Kenya; Ecological aspects of CAM.
8. Greenhouse gases and aerosols, key greenhouse gases influenced by human activities, long term atmospheric carbon dioxide variations, atmospheric distribution, sinks and sources of methane.
9. Effects of increased atmospheric carbon dioxide and climate change on terrestrial ecosystems.
10. Climate change: Evidence for global warming, the earth's energy balance; flow of energy and water between land, sea & atmosphere.
11. Adaptation to wetland environments, metabolic aspects of flood tolerant and flood intolerant plants; their ecological significance.
12. Eutrophication: Eutrophic ecosystems, sources of excess nutrients.

Books Recommended:

Baindbridge R and GC 1964. Light as an ecological Factor, Blackwell Sci. Pub
Bannister P 1976, Introduction to Physiological Plant Ecology, Balckwell Sci. Pub
Etherington JR 1976. Environment and Plant Ecology, John Wiley & Sons.
Gates DM 1993. Climate change and its Biological consequences. Sinauer Associate, Inc.
Harborne JB 1982. Introduction to Ecological Biochemistry, Academic Press.
Jefferies M and G Mills 1985. Freshwater Ecology: Principles and Application, Belhaven Press
Jones Hamlym G 1983. Plants and Microclimate, Cambridge University Press
Kozlowski TT 1984, Physiological Ecology: Flooding and Plant Growth. Academic Press
Lambers H and FS Chapin 1997. Plant Physiological Ecology, Springer.
Larcher WL 1975. Physiological Plant Ecology. Springer Verlag

Livit J 1968. Physiological Ecology: Responses of Plant to Environmental Stress. Volume 1 & 2. Academic Press.
Rosenbe G and J Norman 1974. Microclimate: The Biological environment. John Wiley & Sons.
Sandheimer S and JS Simeone 1970. Chemical Ecology. Academic Press
Sen DN 1978. Environment and Plant Life in Indian Deserts. Geobios international
Sunderland Mintzer IM 1993. Controlling Climate Change. Cambridge Univ. Press.
Townsend CR and C Peter 1981. Physiological Plant Ecology. Blackwell Sci. Pub

Paper Code	313007	-----	**Credits: 4**	**Class Hours: 120 hrs.**
Paper Title:	**Molecular Genetics**			

1. Replication of circular DNA: (i) The cairns structure, (ii) the replicating supercoil or butterfly replication, (iii) the circle with D-loops, (iv) the rolling circle or sigma model, (v) replication of single stranded DNA molecule.
2. Molecular mechanism of mutation and mutagenesis: (i) Different types of mutation, mutants and their isolation, (ii) molecular basis of mutation, (iii) mechanism of mutagenesis.
3. RNA processing and transport, molecular basis of post transcriptional modifications of mRNA, tRNA and rRNA
4. Regulation of eukaryotic gene expression: Hormonal control of gene expression, promoter, enhancer and silencer modulated gene expression.
5. Protein synthesis: Protein synthesis apparatus – structure of tRNA and ribosomes, transcription and translation.
6. Transposable genetic elements: Genetic instability and discovery of transposable elements, transposable elements in bacteria and eukaryotes, significance of transposable elements.
7. Molecular biology of plasmids: (i) General features, detection, isolation, purification and classification, (ii) mapping of plasmid genes.
8. Genomics and Proteomics: Genome sequencing, methods of genome sequencing, Protein isolation and separation of protein, protein – protein interaction using traditional and advanced methods, protein-DNA interaction.
9. Genetic engineering and Biotechnology: Recombinant DNA and gene cloning, genetic transformation and application of plant transformation for the improvement of crops.

Books Recommended:

Klug, W.S., Cummings, M.R. Spencer, C.A. and Palladino, M.A. Concepts of Genetics (9th edition). Pearsons International Edition.
Watson, J.D. Michael Levine, Tania A. Baker, Alexander Gann and Stephen P.Bell 2007. Molecular Biology of Gene, Benjamin-Cummings Pub. Co
Robert F. Weaver 2005, Molecular Biology. McGraw-Hill International edition
Lewin Benjamin 2005, Genes IX. Prentice Hall
Malini, G.S. 2000 Basic Genetics. Narosa Publishing House
Gardner, E.J. Simmons, M.J. and Snustad, D.P. 1991. Principles of Genetics. John Wiley and Sons Inc.

Paper Code	313009	-----	Credits: 4	Class Hours: 120 hrs.
Paper Title:	Microbiology and Microbial Biotechnology			

1. **Introduction**: Historical development of Microbiology and Microbial biotechnology, scope of microbiology and microbial biotechnology in agriculture, industry, health and environment,
2. **Rhizosphere microbiology**: Interactions with plant roots, rhizosphere and rhizoplane; characteristics of rhizosphere microflora, R:S ratio, interaction between plants and microbes.
3. **Microbial nitrogen fixation**: Microorganisms associated with nitrogen fixation, mechanisms of symbiotic and non-symbiotic nitrogen fixation, mechanism of nodule formation, characteristic features of *Rhizobium, Azotobacter*.
4. **Single Cell Protein**: Introduction to Single Cell Protein (SCP), production and application of SCP, acceptability and toxicology of SCP.
5. **Microbiology of foods**: Microorganisms associated with foods, microbial spoilage of foods, preservation of foods by temperature, canning, drying, chemicals and radiation.
6. **Dairy microbiology**: Introduction to major dairy products (yogurt and cheese), Microorganisms associated with milk and milk-products, Starter culture, commercial production of yogurt and cheese; pasteurization and important milk borne diseases.
7. **Fermentation microbiology**: Introduction to fermentation, media and microorganisms of fermentation, production of penicillin, alcohol, citric acid.
8. **Biodegradation of organic compounds**: Introduction to biodegradation and mineralization, biodegradation of cellulose and lignin.
9. **Microbiology of domestic water**: Concept of potable and polluted water, microbial water pollution, indicator and coliform organisms, bacteriological analysis of water by MPN and membrane filtration technique.
10. **Microbiology of waste water**: Characteristics of waste water, waste water treatment by activated sludge and trickling filter system, anaerobic digestion and composting.
11. **Control of microorganisms**: Fundamentals of control, Physical control with heat, filtration and radiations; chemical control with phenol, halogen and alcohol; control with chemotherapeutic agents and antibiotics.
12. **Serological concepts**: Antigens and antibodies; vaccines and toxoids, ELISA technique for identification of microorganisms.

Books Recommended:

Atlas, R.M. and R. Bartha. 1997, Microbial Ecology: Fundamentals and applications. Benjamin/Cummings Science Publishing, California.

Bitton G 1999. Wastewater Microbiology. (2nd ed.) A John Wiley & Sons. New York.

Bulock J and Kristiansen B (eds.) 1987, Basis Biotechnology, Academic Press, London

Casida Jr. L.E. 1968. Industrial Microbiology. John Wiley & Sons. New York

Dubey RC 1993. A Text Book of Biotechnology. S. Chand & Co. Ltd. New Delhi.

Glazer A.N. and Nikaido H 1995. Microbial Biotechnology. Fundamentals of Applied Microbiology. W.H. Freeman and Co. New York.

Medigan MT. JM Martinko and Parker 1997. Brock Biology of Microorganism (8th ed.) Prentice Hall, Upper Saddle River, New Jersey.

Reed G (ed.) 1982, Prescott and Dunn's Industrial Microbiology (4th ed.) AVI Publishing C. Inc. USA

Rehm HJ and Reed G (eds.) 1986. Biotechnology (Vol. 8) VCH Publishers, New York.
Smith J.E. 1988, New Studies in Biotechnology (2nd ed.) Edward Arnold – A division of Hodder & Stoughtor, London
Tortora GJ Funke BR and Case CE 1997. Microbiology– An Introduction. Addison Wesley Longman, California
Wood BJB (ed) 1985. Microbiology of Fermented Foods (Vol. 1) Elsevier Applied Science Publishers, New York.

Paper Code	313011	-----	**Credits: 4**	**Class Hours: 120 hrs.**
Paper Title:	**Applied Mycology**			

1. Introduction, historical background and scope of applied mycology
2. Food mycology: Mushrooms: Types, nutritive value and cultivation, poisonous and hallucinogenic mushrooms, Fungi in food processing, Food spoilage by fungi and its preservation, Mycotoxin in food and feed.
3. Agricultural mycology: Fungi as a Biocontrol agent and their biofertilizer potential in agriculture, important soil fungi, fungal insecticides and herbicides.
4. Mycorrhizae: Introduction and short history, plant-fungus symbiosis, types and importance of mycorrhizae.
5. Industrial mycology: Primary and secondary products of metabolisms, basis and development of industrial fermentation, isolation of organisms, screening and strain development, antibiotics, vitamins, organic acids, enzymes, alcoholic beverage and alkaloids.
6. Fungal polysaccharides: Pullulan, scleroglucan, yeast glucan and their commercial importance.
7. Biosynthesis and physiology of ergot alkaloids.
8. Fungal Ecology: Succession of coprophillous fungi, amphibious fungi, aero-aquatic fungi in ponds, aeromycoflora and other habitats, macrofungal ecology.
9. Wood decay: Fungi involved, types of decay, mechanism of wood decay, preventive and control measures.
10. Medical Mycology: Human pathogenic fungi: superficial mycoses, sub-cuticular mycoses and systemic mycoses.
11. Myconanotechnology: A new and emerging science: Concept of nanotechnology, biosynthesis of silver nanoparticles by fungus *Trichoderma reesei*, nanotechnology offers new insights into plant pathology, anti-microbial interior coating based on nanotechnology.

Books Recommended:

Alexopoluos, C.J.C.W. Mims and M. Blackwell 1996, Introductory Mycology. 4th Edition John Wiley and Sons. New York.
Blackman, J.P. 1981, Microbial Ecology of the phylloplane, Academic Press, London subsidiary of Harcourt Brace Jovanovich.
CAB (Commonwealth Agricultural Bureau). 1968. Plant Pathologist's Pocket Book 1st ed. The Commonwealth Mycologica Institute, Kew, Surrey, England
Dilip, K. Arora: R.P Elander and K.G. Mukerji, 1992, Handbook of Applied Mycology, Fungal Biotechnology. Vol.4,
Dikinson, J.P. and T.F. Preece (ed.) 1976, Microbiology of aerial plant surfaces. Academic Press, London & New York.

Dilip, K.A. 2004, Fungal biotechnology in agriculture, food and environment
Fendrik. B 2002. The Fifth Kingdom, 3rd ed. Focus Publishing R. Pullins Co.
Preece. T.F. & Dickinson C.H. 1968, Ecology of leaf surface & Micro-organisms. Academic Press, London & New York
Raj. M. and P.D Bridge, 2009, Applied Mycology CABI Publishing.

Paper Code	313013	-----	**Credits: 4**	**Class Hours: 120 hrs.**
Paper Title:	**Advanced Phycology**			

1. Research trends in Phycology: Algal researches in Bangladesh; comparative study of algal researches of Bangladesh with those of other countries of the world.
2. Algal classification: Comparative study of at least four recent classification systems of algae.
3. Algal distribution patterns:
   (i) General geographical regions: Cosmopolitan, regional (tropical, temperate and tundra); endemic and discontinuous.
   (ii) Special type of habitats: Thermal, cryogenic and desert.
   (iii) Reef and mart forming algae
   (iv) Fossil algae
   (v) Algal distribution within Bangladesh
4. Algal ecology: Freshwater, brackish water and marine; physical and chemical factors operating in those habitats; ecology of estuarine and marine algae of Bangladesh.
5. (i) Range of reproductive structures and life cycle pattern in algae.
   (ii) Algal epiphytism, heterotrophism, parasitism commensalisms and symbiosis.
   (iii)Vitamins and growth regulators in algae
6. Algal biochemistry: Physical and chemical properties of cell wall; alginic acid, agar-agar, carragineen.
7. Algal culture: Methods of algal culture; growth curve of algae; importance of algal culture.
8. Algalization: Definition, methods of algalization; role of algalization on soil properties, rice yield and soil microflora; algalization in different countries of the world including Bangladesh.
9. Importance of algae: Ecological, biological, biotechnological and socio-economic development.
10. Preliminary knowledge of algal cytology, genetics and their importance
11. Study of the following groups of algae (General and Special Characteristics)
    (i) Cyanophyta: Nostocales, Stigonematales
    (ii) Chlorophyta: Volvocales, Ulotrichales, Chaetophorales, Oedogoniales, Zygnemales, Trentepohliales and Siphonales.
    (iii) Bacillariophyta
    (iv) Euglenophyta
    (v) Phaeophyta: Ectocarpales, Laminariales, Fucales
    (vi) Rhodophyta: Nemalionales, Gigartinales, Coramiales and Cryptonemiales
12. Algae in pollution control (Sewage and industrial effluents) and land reclamation.
13. Toxic algae and algal antibiotics: Human health issue.

Books Recommended:

Aderson RA 2008. Algal cultural technique. Phycological Soc. America, Elsevier/Acad. Press
Aziz A and AKMN Islam 1979. Marine dinoflagellates from the Bay of Bengal, Bangladesh. Bangladesh J. Acad. Sci. 3(1-2): 41-49
Aziz A and BA Whitton 1988. Influence of light flux on nitrogenase activity of the deepwater rice-field cyanobacterijm Gloeotrichia pisum in field and laboratory, Microbios 53: 7-19
Barsanti I and P Gualtieri 2006. Algae: Anatomy, Biochemistry and biotechnology CRC, N.Y. 301 pp

Paper Code	313015	-----	**Credits: 4**	**Class Hours: 120 hrs.**
Paper Title:	**Higher Cryptogams**			

1. A critical review on the different systems of classification of Bryophyta and Pteridophyta. Position of Higher Cryptogams in the modern classification of living organisms.
2. Fossil bryophytes, fossil pteridophytes and a consideration of their phylogeny
3. A review on the evolutionary trends within Hepaticae and Pteridophyta.
4. Perennation and vegetative propagation in bryophytes.
5. Structure and dehiscence of capsules and liberation of spores in bryophytes.
6. Spore-bearing organs and spore dispersal mechanisms in pteridophytes.
7. Modern trends of the taxonomic studies of bryophytes and pteridophytes with special emphasis on mosses and ferns. A critical review of the research works done on the higher cryptogams of Bangladesh
8. Structure, reproduction, phylogeny and economic importance of Sphagnobrya, Andreaeobrya and Eubrya.
9. Structure and phylogeny of the sub-class Primofilices
10. Structure, reproduction, phylogeny and economic importance of sub-class- (a) Eusporangiatae: Order (i) Ophioglossales and (ii) Marattiales.
    (b) Leptosporangiatae: Order (i) Filicales: Osmundaceae; Gleicheniaceae Cyatheaceae; Polypodiaceae; Parkeriaceae Order (ii) Marsileales and (iii) Salviniales.
11. Aquatic higher cryptogams of Bangladesh: Name of taxa, adaptations, distribution and economic importance

Books Recommended:

Eams, A.J. 1964, Morphology of Vascular Plants. Tata McGraw Hill Pub. Co. Ltd, Bombay
Parihar, N.S. 1955. An Introduction of Embryophyta. Vol I & II Central Book Depot. Allahabad
Smith, G.M. 1955, Cryptogamic Botany. Vol. II Mc Graw Hill Co. Inc. New York, London
Vashista, P.C. 1993, Botany for Degree Students: Pterodophyta. SC. Chand and Co. Ltd. Ramnagar, New Delhi.

Paper Code	313017	-----	Credits: 4	Class Hours: 120 hrs.
Paper Title:	Hydrobiology and Limnology			

1. Introduction and scope
2. Aquatic Botany: Classification of aquatic macrophytes and their diversity, biochemical components of macrophytes, meso-scale culture and their uses.
3. Wetland ecosystem: Concept and classification of wetlands, wetlands in Bangladesh, characteristics of wetland soils, socio-economic characteristics of wetlands, functions and benefits of wetland
4. Primary productivity: Factors affecting productivity; interrelationships of macrophytes, algae and bacteria in the aquatic environment and their use in bio-fuel and organic manure production; nutrient recycling.
5. Contaminants in freshwater bodies in Bangladesh with special emphasis on: arsenic, fluoride, pesticides, manganese and cyanotoxins and their bioremediation
6. Oceanography: Principles; elements of physical, chemical, biological and geological oceanography; essentials of marine ecology; fisheries and aquaculture; marine conservation; marine pollution; global climate change; effects of climate and sea-level changes on the natural resources of Bangladesh, socio-economic implications of climate change for Bangladesh
7. Sustainable use of aquatic resources as food, feed and other purposes.
8. Applied limnology: Sewage and sewage treatment, origin, composition; pond systems, mechanical, biological, third stage and sludge treatment, contaminated waters, self purification effect, indicator organisms, and rehabilitation of water.
9. Photosynthetic behavior of isolated and non-isolated communities of phytoplankton, light attenuation, light limitation, light saturation, photo-inhibition, effects of temperature and carbon supply, respiration, interaction; photosynthetic models.
10. Chemical composition of aquatic plants, the productivity of hydrophyte communities, measurement techniques and interactions between hydrophytes, their environment and other aquatic organisms; global and aquatic primary production.

Books Recommended:

Abel DC and RL McConnell 2010. Environmental Oceanography, Topics and analysis. Jones and Bartlett publishers, Massachusetts. 312

Alam ABMS, MSM Chowdhury and I Sobhan 2012, Biodiversity of Tanguar Haor: A Raamsar Site of Bangladesh Volume 1: Wildlife, IUCN Bangladesh, Dhaka, Bangladesh. pp. xi+234

Dugan PJ (ed) 1990, Wetland conservation: a review of current issues and required action, IUCN, Gland, Switzerland. 96pp

Giesen W (ed) 1997, Wetlands, Biodiversity and development, Proceedings of Workshop 2 of te international conference on wetlands and development held in Kuala Lumpur, Malaysia, 9-13 October 1995, Wetlands International Kuala Lumpur 211 pp

Hutchinson GE 1975, Limnological Botany. Willey, New York. pp 1960

Khan MS and M Halim 1987. Aquatic angiosperms of Bangladesh, Bangladesh National Herbarium, Dhaka. 120 pp

Khondker M 1994. Limnology, University Book Publ., Dhaka. pp 464 (in Bangla)

Martens K (ed) 1994, A basic guide to understanding the environmental impacts of rural roads on the wetlands of Bangladesh, CARE international in Bangladesh, ISBN 984-30-0111-7. 114 pp+6 Annex

Odum EP 1971, Fundamentals of Ecology. W.B Saunders Co. Philadelphia. pp. 574

Riemann B and M Sondergaard 1986, Carbon dynamics in Eutrophic, temperate lake, Elsevier, Amsterdam.
Schwoerbel J 1987, Handbook of Limnology, Ellis Horwood Ltd. Chichester. pp. 228
Sculthrope CD 1971, The Biology of Aquatic Vascular plants, Edward Amold (Publ.) Ltd. London. pp. 610
Sim CH 2003, The use of constructed wetlands for wastewater treatment. Wetlands international-Malaysia office ISBN 983-40960-2-X24 pp
Tyagi R 2010, Textbook of Hydrobiology, Discovery publishing house, ISBN 13:9788183565578, 181pp
Wetzel RG and GE 1979, Limnological analysis, W.B Saunders Co. Philadelphia, 337 pp
Riemann, B. and Sendergaard, M. 1986, Carbon dynamics in Eutrophic Temperate lake, Elsevier Sc. publ B.V Amsterdam. pp. 284
Schwoerbel, J. 1987, Handbook of Limnology, Ellis Horwood Ltd. Chichester. pp. 228
Reynolds, C.S. 1984, The ecology of freshwater phytoplankton. Cambridge Univ. Press, Cambridge. pp. 384
Hutchinson, G.E. 1975, Limnological Botanyu. Willey, New York. pp.660
Sculthorpe, C.D. 1971, The Biology of Aquatic Vascular plants. Edward Amold (publ.) Ltd. London.pp.610
Khondker, M. 1994, Limnology. University Book Publ., Dhaka.pp.464(in Bangla)
Odum, E.P 1974, Fundamentals of Ecology. W.B. Saunders Co. Philadephia.pp.574
Vollenweider. R.A. (ed.) 1974, A manual on methods for measuring primary production in aquatic environments. Blackwell Sc. Publ. Oxford.pp.225
Wetzel RG and Likens GE 2000. Limnological analysis. 3rd Edn. Springer, New York.pp.429

Paper Code	313019	-----	**Credits: 4**	**Class Hours: 120 hrs.**
Paper Title:	**Plant Pathology and Crop Protection**			

1. Historical background and scope of Plant Pathology.
2. Stages in the development of plant disease: Inoculation, infection, growth and reproduction, dissemination, over wintering and /or oversummering of the pathogen.
3. Pathogen's attack on host plants:
   (i) Mechanical forces exerted by pathogens on host tissues.
   (ii) Chemical weapons of pathogens (enzymes and growth regulators).
4. Effects of pathogens on physiology of host: Effects on photosynthesis, respiration, transpiration and translocation of water & nutrients.
5. Genetics of disease:
   (i) Genes and disease
   (ii) Mechanisms of variability in pathogens
   (iii) Types of resistance of pathogens
   (iv) Genetics of virulence in pathogens and resistance in host plants: The gene-for-gene concept, the nature of resistance to disease.
6. Environmental effects on the development of infectious disease: Effects of temperature, moisture, light and wind.
7. Plant disease epidemiology: The elements structure, patterns and development of epidemic; measurement of plant disease.
8. Plant disease control:

a) Chemical control of plant disease- type of chemicals used and specification of a good fungicide; mechanisms of action, evaluation and methods of application of fungicides; resistance of plant pathogens to fungicides.
b) Biological control of plant diseases: Hyperparasits, Cross protection and interference, trap crop ad antagonistic plants, the breeding and use of resistant host variety.
c) Integrated pest management.

9. Seed pathology: Scope of seed pathology; different mode of seed-plant-seed transmission of pathogens; methods of seed health testing and identification of seed borne diseases; microbial spoilage of seeds in storage; management of seed in storage.
10. Selected diseases of plants: Causal organisms, symptoms, etiology and control measures of the followings:
    (i) Rice – False smut and sheath blight
    (ii) Maize – Brown spot
    (iii) Barley – Loose smut
    (iv) Chilli – Anthracnose
    (v) Potato – Scab
    (vi) Jackfruit – Soft rot
    (vii) Cucurbits – Powdery mildew
11. Application of biotechnology in plant pathology

Books Recommended:

Agrios GN 2005. Plant Pathology (5th ed.) Academic Press, New York.
Lucas JA 1998, Plant Pathology and Plant Pathogens. Blackwell Sci. Pub. London
Mehrotra RS 1987. Plant Pathology. Tata McGrew Hill Co. New Delhi
Singh RS 1980, Introduction to Principles of Plant Pathology, Oxford & IBH Publishing Co. New Delhi
Zadoks JC and RD Schein 1979, Epidemiology and Plant Disease management Oxford University Press, New York.

Paper Code	313021	-----	**Credits: 4**	**Class Hours: 120 hrs.**
Paper Title:	**Cytogenetics**			

1. Karyotype: Definition, symmetrical, asymmetrical and bimodal karyotype, karyotype analysis, idiogram-a graphical presentation of karyotype.
2. Principal events of cell division: Theories regarding metakinesis, separation of disjunction of chromosomes.
3. Abnormalities in cell division: Non-disjunction in mitosis, meiosis I & II, endopolyploidy polytene, cytomixis, formation of cross spindle, elimination of single or set of chromosome in insects (*Sciaridae*).
5. Monosomy: Definition, origin, meiotic behaviour, location of gene with the help of monosomy.
6. Nullisomy: Definition, origin, phenotypes, location of gene with the help of nullisomy.
7. Haploidy: Definition, classification, artificial induction, meiotic behaviour.
8. Synthetic classification of polyploids.
9. Cytology of polyploids:
    (i) Triploidy: Definition, kinds, phenotypes, meiosis, application in agriculture.
    (ii) Autotetraploidy: Definition, kinds, meiotic behaviour, segregation and genetic ratios.

(iii) Allopolyploidy: Definition, natural and artificial allopolyploid, meiotic behaviour, role of allopolyploidy in speciation of – Triticale, *Raphanobrassica*, *Primula kewensis*, *Spertina townsendii*, *Nicotiana tabacum*, *Brassica spp*., *Gossypium* spp. and *Triticum aestivum*.

(iv) Autoallopolyploidy: Definition and examples

(v) Segmental allopolyploidy: Definition and examples.

10. Chromosome banding: Definition, origin and evolution of chromosome banding method, classification and nomenclature of chromosome bands.
11. Banding and Chromosome evolution:
    (i) Speciation with no apparent changes in banding pattern
    (ii) Differences in heterochromatin between species.
    (iii) Rules governing the evolution of heterochromatin.
    (iv) Rearrangement of euchromatic parts of chromosomes.

Books Recommended:

Akhtaruzzaman M 2008, Kosh Bangshagtibidaya (3rd ed.), Hassan Book House, Dhaka

Jeakins G.J. Maluszynska and D Schweizer 2001, Advanced Molecular Cytogenetics, Wydaynitwo, University tetu Slaskiego, Katowice

Schwaszacher T and P Heslop-Harrison 2000. Practical in situ hybridization, Springer-Verlag. new York.

Leitch AR. T Schwarzacher, D Jackson and IJ Leitch 1994, In situ hybridization, BIOS Scientiic Publishers Ltd. NY

Singh RJ 2003. Plant Cytogentics (2nd ed.) CRC Press, New York.

Stebbins GL 1971, Chromosome evolution in higher plants, Addition-Wesley Publishing Co. London

Sumner AT 1990, Chromosome Banding, Unwin Hyman, London

Paper Code	313023	-----	**Credits: 4**	**Class Hours: 120 hrs.**
Paper Title:	**Plant Breeding and Biometry**			

1. Plant Breeding: Nature, scope and achievements.
2. Origin and evolution of crop plants such as rice, wheat and maize.
3. Germplasm conservation, characterization and their utilization; global system on conservation and utilization of germplasm.
4. Incompatibility system in plants, types of incompatibility, mechanism of self-incompatibility, structural and molecular basis of self-incompatibility; significance of self-incompatibility.
5. Apomixes: Genetics and application of apomixes.
6. Breeding for resistance to abiotic stresses, acclimation and crop adaptation to water and salinity stress; development of salinity, flood and drought tolerant crop varieties.
7. Breeding for resistance to biotic stresses, plant response to pathogens; biochemical and molecular basis of host plant resistance; development of disease and insect resistance crop varieties.
8. Molecular markers and their application in plant breeding.
9. Experimental designs: CRD, RBD, Latin square design, factorial experiments and split plot design, comparison of treatments by LSD test and Duncan's Multiple Range test.

10. Quantitative inheritance; components of variation; estimation of variation in F_2, F_3 and back-cross progenies; estimation of heritability and genetic advance.
11. Diallel analysis: Principles of diallel analysis, components of variation in diallels, analysis of variance in diallels, partial diallel analysis, Wr=Vr graph.
12. Path analysis: Theory, interpretation and application of path analysis.

Books Recommended:

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.
Sharma JR 2002. Principles and Practice of Plant Breeding. Tata McGraw-Hill Publishing Co. Ltd. New Delhi
Singh P 2004. Essentials of Plant Breeding. Kalyani Publishers, Kolkata
Singh BD 2005. Plant Breeding: Principles and Methods. Kalyani Publishers, Kolkata
Simmonds NW 1984. Evolution of crop plants, Longman.

Paper Code	313025	-----	**Credits: 4**	**Class Hours: 120 hrs.**
Paper Title:	**Plant Biotechnology**			

1. Scope and importance of Plant Biotechnology.
2 Plant Tissue Culture as a basis for genetic engineering in plants.
3. Plant Genetic Engineering: Historical background, global status of commercial biotech crops, transgene traits (insect resistance, herbicide tolerance, nutritional quality enhancement, virus resistance, etc.)
4. Genetic transformation methods: Direct transformation of protoplasts using PEG, electroporation, microinjection, transformation by particle gun bombardment.
5. Promoters used in plant genetic engineering: constitutive, inducible and tissue specific promoters, their merits and limitations.
6. *Agrobacterium*-mediated genetic transformation: Agrobacterium biology, crown gall and hairy root disease, Ti-and Ri-plasmids, Vir gene induction and their function, mechanism of T-DNA transfer, binary vector.
7. Transient and stable gene expression: Plant selectable markers, Reporter genes (GUS, GFP and Luciferase), selectable marker genes (Kanamycin, hygromycin and Bialaphos).
8. Molecular characterization of transgenes: PCR based, Southern, Northern and Western blotting.
9. Biosafety concerns of transgenic plants: Elements of standard biosafety guidelines, Biosafety Guidelines of Bangladesh.
10. Intellectual Property Rights: Protection of intellectual property forms of protection, Patent application, plant breeder's rights, Farmers rights, Plant Variety Protection.

Books Recommended:

Bhojwani SS and MK Razdan 1983, Plant Tissue Culture: Theory and Practice, Elseriver, Amsterdam, Oxford, New York, Tokyo
Chowdhury MKA, MI Hoque and A Sonnino 2009. Biosafety of Genetically Modified Organisms: Basic concepts, methods and issues: FAO, Rome
Gamborg OL and GC Philips, 1995, Plant Cell Tissue and Organ Culture: Fundamental methods, Springer.

Pierek RLM 1987, In vitro culture of higher plants. Martinus Nijhoff Publishers, Dordrecht.
Razdan MK 1993, An Introduction to Plant Tissue Culture, Oxford & IBH Pub. Co. (Pvt), Ltd, New Delhi
Ronald L, Philips and IK Vasil 1994, DNA based markers in plants, Kluwer Academic Publishers, Amsterdam.
Sambrook J. EF Fritsch and T Mainatis 1989, Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press, New York.
Vasil IK (ed) 2003, Plant Biotechnology 2002 and Beyond. Kluwer Academic Pub. Dordrecht.

Paper Code	313027	-----	**Credits: 4**	**Class Hours: 120 hrs.**
Paper Title:	**Medicinal Plants and Herbal Medicines**			

1. Medicinal plants: Introduction, important medicinal plants of the world and Bangladesh.
2. Classification of medicinal plants: On the basis of habit, parts used, diseases treated.
3. Medicinal plants with profound antibacterial activities.
4. Plant derived antimycotics: Antifungal drugs currently in use and their mode of action, mechanism of action of antifungal agents, antifungal agents isolated from plants.
5. Introduction to the Herbal medicine, traditional medicine, ethnobotanical medicine and folk medicine.
6. Criteria for standardization and quality control of herbal medicine in Bangladesh.
7. WHO guidelines on good manufacturing practices (GMP) for herbal medicine:
   (i) Quality assurance in the manufacture of herbal medicines, (ii) Good manufacturing practices for herbal medicines, (iii) Sanitation and hygiene, (iv) Qualification and validation (v) Complaints (vi) Product recalls (vii) Contract production and analysis (viii) Self-inspection (ix) Personnel (x) Training (xi) Personal hygiene (xii) Premises (xiii) Equipments (xiv) Materials (xv) Documentation (xvi) Good practices in production and in quality control.
8. WHO guidelines for assessing quality of herbal medicine with reference to contaminants and residues.
9. Some important anticancerous, antidiarrhoeal and antidiabetic plants of Bangladesh.
10. Phytochemicals responsible for medicinal properties: Carbohydrates, Lipids, Amino acids and their derivatives, Alkaloids, Phenols and Phenolic glycosides, Terpenoids and steroids.
11. Medicinal plants and modern drugs.
12. Preparation of an Herbal monograph e.g. *Andrographis paniculata*. WHO monographs on selected medicinal plants.
13. IUCN guidelines for conservation of medicinal herbs.
14. Some selected herbal recipes of herbal medicine.

Books Recommended:

Al-Jauziyal IIQ 2003, Healing with the Medicine of the Prophet, Darussalam.
Bakhru HK 1995, Herbs that Heals: Natural Remedies for Good Health (5th rept.) Orient Paper backs, Delhi.
Bakshi DNG, P. Sensarma and DC Pal 1999. A Lexicon of Medicinal plants in India. Vol. 1. Naya Prokash, Calcatta
Baskhi DNG, P Sensarma and DC Pal 1999. A Lexicon of Medicinal plants in India. Vol. 2. Naya Prokash, Calcatta

BHMA 1990, British Herbal Pharmacopoeia, Vol-1, British Herbal Medicine Association
Das DB 1995. Anurvedic Cures for Common Diseases. Hind Pocket Books, Delhi
Dasture JF 1970, Medicinal Plants of India and Pakistan (3rd ed.) BD Taraporvala song & Co. Pvt. Ltd. Bombay, India
Dastur JF 1978, Everybody's Guide to Ayruvedic Medicine (3rd ed.) BD Taraporevala Song & Co. Pvt. Ltd. Bombay, India
dePadua LS, N Bunyaprapatsara dnd RHMJ Lemmens (ed.) 1999. Plant Resources of south-east Asia No 12(1): medicinal and Poisonous Plants 1. Backhuys Publishers. Leiden, The Netherlands.
Ghani A 2003. Medicinal plants of Bangladesh: Chemical constituents and uses Asiatic Society of Bangladesh
Guang Xu 1996, Chinese Herbal Medicine. Vemilion, London
Indian Herbal Pharmacopoeia (Revised new Edition (2002. Indian Drug Manufacturer's Associantion, Mumbai
IUCN 1993, guidelines on the Conservation of Medicinal plants, IUCN Gland
Kurian DJC 1995, Plants that heal, Oriental Watchman ublishing House, Pune, India
Lemmen RHMJ and N Bunyapraphatsar (ed.) 2003. Plant Resoruces ofSouth-East Aisa No 12(3), Medicinal and Poisonous plants 3. Backhys Publishers Leiden. The Netherlands
Pal DC and SK Jain. 1998, Tribal medicine. Nayaprokash. Calcutta
Rai M and D Mares (ed.) 2003. Plant Derived Antimycoties. Ford Product Press, New York, Oxford
Sinha SC 1996, Medicinal Plant of Monipur, MASS, Imphal
Van Yalkenburg, JLCH and N Bunyapraphatsara 2002. Plant Resources of south-east Asia No 12(2). Medicinal and Poisonous Plants 2. Prosea Foundation. Bogorr, Indonesia
WHO 2001. Traditional Medicine. WHO, Dobe Centre
WHO 2007. WHO Guidelines on good manufacturing practices (GMP) for herbal medicines. WHO Press, Geneva, Switzerland
Yusuf M. JU Chwdhury, MA Wahab and J Begum 1994. Medicinal Plants of Bangladesh, BCSIR, Dhaka.
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dRj nvKxg D¤g~j 1992, BDbvbx g‡Z N‡ivqv Ilya| †m›Uªvj KvDwÝj di wimvP© Bb BDbvbx †gwWwmb, bqv w`j-x
MwY Ave`yj Ges GgGg nvmvb (m¤úv`K) 2002, cÖv_wgK ¯^v¯'¨ cwiPh©vq †fRl Dw™¢`| ¯^v¯'¨ I cwievi Kj¨vY gš¿Yvjq, MYcÖRvZš¿x evsjv‡`k miKvi
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nvmvb G G Ges Rwmg DwÏb 1988, MvQ MvQov w`‡q wPwKrmv| nvmvb eyK nvDR, XvKv
nvmvb GgG (m¤úv`K) 2005, cÖv_wgK ¯^v¯'¨ cwiPh©vq †flR Dw™¢`-2, ¯^v¯'¨ I cwievi Kj¨vY gš¿Yvjq, MYcÖRvZš¿x evsjv‡`k miKvi
nvmvb GgG 1998, evsjv‡`‡ki †jvKR e‡bŠlwa, nvmvb eyK nvDm, XvKv
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Paper Code	313028		**Credits: 6**	
Paper Title:	**Practicals**			

Practical Part-I (Taxonomy of Angiosperms, Ecology and Environment), 2 Credits

Angiosperm Systematics

1. Dissection and study of the vegetative and floral characters of Angiosperm species available in various seasons and their identification up to species.

2. Preparation of artificial Keys
3. Preparation of pollen slides.
4. Permanent slide preparation for anatomical studies in relation to Angiosperm Systematics

Ecology and Environment

1. Determination of field capacity in a range of soil types and to calculate the various moisture percentages to set up an experiment
2. Determination of organic carbon in soil by Walkly and Black Method
3. Study of exchangeable cations in soils.
4. Study of stomatal frequency and index and index and stomatal movement in relation to environmental condition.
5. Determination of conductivity in soil and water samples
6. Determination of total alkalinity in water samples
7. Dominant pant species of the Sundarban Mangrove forests and Modhupur Sal Forest.
8. Measuring moisture status of plant materials and relative turgidity.
9. Experiments with germination ecology and stomatal movement in a range of plant species & Report Preparation.

Practical Part-II (Advanced Plant Physiology and Molecular Genetics), 2 Credits

Advanced Plant Physiology

1. Determination of diffusion pressure deficits (DPD) by gravimetric method
2. quantitative determination of photosynthetic pigments by spectrophotometer
3. Measurement of carbohydrate in plant tissue
4. Determination of the temperature coefficient (Q10) on physiological processes
5. Effect of different chemicals on germination
6. Coleoptiles straight growth test and curvature test
7. Estimation of amino acids by colorimetric method
8. Separation of amino acids by chromatographic technique

Molecular Genetics

1. Isolation and purification of genomic DNA from plant or bacteria using various techniques
2. Isolation of RNA from bacteria or plant samples
3. Total protein isolation and quantification by Bradford and Lowry methods
4. Prepare a restriction map of supplied DNA sample through restriction digestion, gel electrophoresis and imaging of the gel
5. Preparation of vector and insert DNA for cloning
6. A short project on selected topic.

Practical Part-III (Any two courses from the offered elective courses), 2 Credits

Microbiology and Microbial Biotechnology

1. Isolation of biotechnologically important bacteria from nature
2. Demonstration of fermentation using different carbohydrates
3. Laboratory scale of yoghurt production.
4. Acquaintance with different groups of antibiotics
5. Work out of Culture and Sensitivity (CS) test
6. Microbial hydrolysis of starch and protein
7. Measurement of microbial biomass (dry weight.)

Applied Mycology

1. Preparation of culture media: PDA. WA, Host extract agar, at meal agar
2. Common techniques practiced in Mycology Laboratories: Isolation and purification of fungi
3. Collections, identification and preservation of fungi
4. Selected techniques of mushroom cultivation
5. Preparation of dichotomous key to the fungi studied in the practical course
6. Visit of Mushroom cultivation centre, Savar, Dhaka
7. Isolation of mycorhizae

Advanced Phycology

1. Influence of N & P on the morphology of BGA
2. Polluted-eater algae and study of indicator species
3. Commercially important algae
4. Commercial products of algae
5. Measuring salinity
6. Effects of light intensity on biomas, pigmentation and nitrogenase activity (Acetylene Reduction Assay technique) of Azolla-Anabaena complex

Higher Cryptogams

1. Identification of specimens upto species (based on local and foreign flora)
2. Preparation of key on the basis of those species
3. Use of camera lucida
4. Measurement techniques (use of stae micrometer and oculometer)
5. Herbarium preparation and preservation of bryophytic and pteridophytic materials
6. Field study and collection of specimens from different places of Bangladesh.

Hydrobiology

1. Collection, identification and characterization of aquatic macrophytes.
2. External and internal morphology of different aquatic macrophytes
3. Floristic study of haor, baor, river, ponds and lakes in Bangladesh
4. Comparison of qualitative and quantitative aspect of phytoplankton in different aquatic haitats of Bangladesh
5. Short project on a selected topc (10 – 15 marks)
6. Field visit of different wetland habitats, ex-situ culture and herbarium preparation of aquatic plants

Limnology

1. Biological analysis of contaminated waters (both plankton and acrophytes)
2. Determination of photosynthetic active radiation (PAR) by using quantum meter and calculation of vertical extinction co-efficient
3. Biovolume determination of phytoplankton and biomass determination of aquatic macrophytes.
4. Calculation of daily and annual productivity of phytoplankton

Plant Pathology and Crop Protection

1. Isolation purification and identification of plant pathogens obtained from diseased plant parts
2. Counting of fungal spores
3. Pathogenicity test with fungal isolates obtained from diseased plant parts
4. Evaluation of fungicides and plant extracts
5. Demonstration of dual culture technique
6. Demonstrations of fungistasis
7. Collections, identification and preservation of diseased plant specimens
8. Visit to plant pathology laboratories of BJRI, BRRI and BARI

Cytogenetics

1. Preparation of different pre-fixatives (PDB, 8-hydroxyquinoline, colchicines, a-bromonapthalene) and fixatives (acetic acid, Carny's fluid, modified Carnoy's fluid, propionic acid alcohol solution)
2. Use of different pre-fixatives on the chromosomes of Allium cepa for a comparative chromosome morphology study
3. Photomicrograpy of well-spread mitotic metaphase plates
4. Preparation of karyotype ad idiogram from those photomicrographs
5. Comparative karyotype analysis among different species from the supplied data
6. Study of chromosomal aberration and phylogenetic relationship by CMA-and DAPI-karyotype analysis from the supplied data

Plant Breeding and Biometry

1. Study of pollen-pistil interactions using fluorescent microscope
2. Identification of self-and cross-incompatibility mechanisms in crop plants
3. Characterization of various germplasms using isozyme and DNA markers
4. Construction of different experimental designs. Analysis of variance following experimental designs
5. Determination of heritability from various segregating populations
6. Working out the problems involving path coefficient analysis
7. Study tour to research institutes like, BARI, BINA BJRI, BSRI, BTRI, BFRI etc

Plant Biotechnology

1. Explants preparation from various plant materials for transformation
2. Agrobacterium-mediated genetic transformation using marker gene
3. Transient gene expression through histo-chemical assay
4. PCR-based technique for the detection of transgene following transformation
5. Agarose el electrophoresis

Medicinal Plants and Herbal medicine

1. Collection of selected medicinal plants
2. Study on the reproductive biology of any selected medicinal plants
3. Market survey on drug materials
4. Detection on alkaloids and other secondary compounds
5. Toxicity text of any medicinal plants through Brine Shrimp Culture or Project work on any specific herbal recipe
6. Visit to any herbal manufacturing complex and medicinal garden

Paper Code	313030	**-----**	**Credits: 6**	
Paper Title:	**Thesis**			

Research Work and Dissertation, 4 Credits
Presentation, 2 Credits

Paper Code	313032	**-----**	**Credits: 2**	
Paper Title:	**Viva-Voce**			