

UNIVERSITY OF GOUR BANGA

**(Established under West Bengal Act XXVI of 2007)
N.H.-34 (Near Rabindra Bhawan), P.O.: Mokdumpur,
Dist.: Malda, West Bengal, Pin-732 103**

CHOICE BASED CREDIT SYSTEM B.Sc. BOTANY GENERAL COURSE

DRAFT

(w.e.f. June 2019)

Scheme for CBCS in B.Sc. General Program- Botany						
ACADEMIC SEMESTERS	DISCIPLINE CORE (DC) (4+2=6)	DISCIPLINR SPECIFIC ELECTIVE (DSE) (4+2=6)	ABILITY ENHANCEMENT COMPULSORY (AEC) (2)	SKILL ENHANCEMENT COURSE (SEC) (2)	CREDITS	MARKS
SEM-I	DC 1: A1: Biodiversity (Microbes, Algae, Fungi and Archegoniate) DC 2: (B1) DC 3: (C1)	-	ENVS	-	20	200
SEM-II	DC4: A2: Plant Taxonomy and Ecology DC 5: (B2) DC 6: (C2)	-	Communicative English/ Bengali/ MIL	-	20	200
SEM-III	DC 7: A3: Plant Anatomy and Embryology DC 8: (B3) DC 9: (C3)	-	-	SEC-1	20	200
SEM-IV	DC 10: A4: Plant Physiology and Metabolism DC 11: (B4) DC 12: (C4)	-	-	SEC-2	20	200
SEM-V	-	DSE 1: A1 DSE 2: B1 DSE 3: C1	-	SEC-3	20	200
SEM-VI	-	DSE 4: A2 DSE 5: B2 DSE 6: C2	-	SEC-4	20	200
TOTAL					120	1200

Marks and Question type distribution for Botany General course of studies								
No. of Courses	Credit for Each course	Total Marks	Full Marks of Each Course	Internal Assessment (IA)		End Semester Examination (ESE)		
				Attendance (4%)	Cont. Evaluation (6%)	Theoretical	Practical	
						Descriptive	MCQ	
DC 04 courses	6	4x50=200	50	4+6=10		25	nil	15
DSE 02 Courses	6	2x50= 100	50	4+6=10		25	nil	15
SE 04 Courses	2	4x50=200	50	4+6=10		40	nil	nil
AEC-1 (ENVS)	2	1x50=50	50	10 (project)		nil	40	nil
AEC-2 Communicative Bengali/English	2	1x50=50	50	4+6=10		nil	40	nil

1. Each course is of 50 marks for examination
2. DC/DSE: each course is of 6 credits for course work per week
3. (Theory-4 credits + Practical- 2 credits)
4. 1 Credit = 1 hour duration of teaching (Lecture/Tutorial) or 2 hours duration of practical period.
5. SE: Covering any two Discipline Cores (DC) out of A,B & C with two courses each 2x 2= 4 SEs
6. DSE: two DSEs for each DC i.e. 3x2=6 DSEs. A student has to opt one course out of the two courses provided for each DST in SEM V and SEM VI.
7. Students have to opt 3 different disciplines as Core disciplines at the time of admission. Discipline once selected in SEM-I should be continued up to SEM-VI without any alternation or change.
8. *MIL: Modern Indian Language

DETAILED COURSE STRUCTURE

DISCIPLINE CORE (DC)

YEAR 1

SEMESTER I

DC 1: A1: Biodiversity (Microbes, Algae, Fungi and Archegoniate)

SEMESTER II

DC 4: A2: Plant Taxonomy and Ecology

YEAR 2

SEMESTER III

DC 7: A3: Plant Anatomy and Embryology

SEMESTER IV

DC 10: A4: Plant Physiology and Metabolism

YEAR 3

DISCIPLINE SPECIFIC ELECTIVE (DSE)

YEAR 3: SEMESTER V: DSE-1: A1, SEMESTER VI: DSE-4:A2

- 1. Cell biology and Genetics**
- 2. Analytical Techniques in Plant Sciences**
- 3. Plant breeding and biostatistics**
- 4. Economic botany and biotechnology**

SKILL ENHANCEMENT COURSES (SEC)

YEAR 2, SEMESTER III: SEC-1; SEMESTER IV: SEC-2

YEAR 3, SEMESTER V: SEC-3; SEMESTER VI: SEC-4

- 1. Floriculture**
- 2. Mushroom Culture Technology**
- 3. Biofertilizers**
- 4. Ethnobotany**
- 5. Plant Diversity and Human Welfare**
- 6. Medicinal Botany**
- 7. Herbal Technology**

DISCIPLINE CORE (DC)

Biodiversity (Microbes, Algae, Fungi and Archegoniate)

Plant Taxonomy and Ecology

Plant Anatomy and Embryology

Plant Physiology and Metabolism

DESCIPLINE CORE

Biodiversity (Microbes, Algae, Fungi and Archegoniate)

(Credits: Theory-4, Practical-2)
THEORY

DC 1: A1: (PAPER 1) Theory (Lecture 60)

1. Microbes:

Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and Lysogenic cycle, RNA virus (TMV); Economic importance.

Bacteria – Discovery, General characteristics and cell structure; Cell wall – chemical structure and differences between Gram +ve & Gram –ve bacteria; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance with respect to uses of microbes as Biofertilizer, Bioplastic and Biopesticides.

2. **Algae:** General characteristics; Ecology and distribution; Range of thallus organization and reproduction; classification of Lee (only upto groups) with characteristic features of each group; Morphology and life- cycles of the following: *Nostoc*, *Oedogonium*, and *Chara*. Economic importance of algae.

3. **Fungi:** Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction. Classification according to Ainsworth 1973; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Ascobolus* (Ascomycota), *Agaricus* (Basidiomycota) **Symbiotic Associations-Lichens:** General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.

4. **Introduction to Archegoniate:** Unifying features of archegoniates, Transition to land habit, Alternation of generations.

5. **Bryophytes:** General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia*, *Anthoceros* and *Funaria*.(Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

6. **Pteridophytes:** General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), Heterospory and seed habit, stellar evolution. Ecological and economical importance of Pteridophytes. Morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris* (Developmental details not to be included).

7. **Gymnosperms:** General characteristics; Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus* (Developmental details not to be included). Ecological and economical importance.

DC 1: A1: (PAPER 2) Practical

1. Electron Micrographs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Observation of Bacterioids in root Nodule/Curd (Simple staining: Methylene blue).
3. Study of vegetative and reproductive structures of *Nostoc*, *Oedogonium* (Macrandrous), and *Chara* through temporary preparations and permanent slides.
4. Asexual stage from temporary mounts of *Rhizopus*, *Ascobolous/ Peziza* and *Agaricus*.
5. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
6. Type study using semi permanent mounts: *Marchantia* (antheridial and archegonial heads); *Anthoceros* (Sporophyte); *Funaria* (Capsule)
7. Type study using semi permanent mounts: *Selaginella*- morphology; Stem (T.S), Strobilus (L.S); *Equisetum*- morphology, internode (T.S), strobilus (L.S). *Pteris*- morphology, t.s. rachis (T.S), sporophyll (L.S), Morphological studies of Megasporephyll and Microsporephyll.
8. *Cycas*- morphology and anatomical features of Leaflet (T.S), morphology of Megasporephyll and Microsporephyll.
9. *Pinus*- morphology (long and dwarf shoots, Needle (T.S), Morphological studies of Male and Female Cones

Suggested Readings

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson
3. Benjamin Cummings, U.S.A. 10th edition.
4. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan
5. Publishers Pvt. Ltd., Delhi.
6. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John
7. Wiley and Sons (Asia), Singapore. 4th edition.
8. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
9. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
10. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd
11. Publishers, New Delhi, India.
12. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

DISCIPLINE CORE
Plant Ecology and Taxonomy
(Credits: Theory-4, Practical-2)
THEORY

DC 4: A2: (PAPER 3) Theory (Lecture 60)

A. Plant Ecology

- 1. Introduction: Ecological factors-** Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.
- 2. Plant communities:** Characters; Ecotone and edge effect; Succession; Processes and types
- 3. Ecosystem:** Structure; energy flow trophic organization; Food chains and food webs, Ecological pyramids, production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous
- 4. Phytogeography:** Principle biogeographical zones; Endemism

B. Taxonomy

- 1. Introduction to plant taxonomy:** Identification, Classification, Nomenclature.
- 2. Identification:** Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access
- 3. Taxonomic hierarchy:** Ranks, categories and taxonomic groups
- 4. Botanical nomenclature:** Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.
- 5. Classification:** Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).
- 6. Biometrics, numerical taxonomy and cladistics:** Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).
- 7. Diagnostic features of Families: Dicotyledons:** Brassicaceae, Malvaceae, Leguminosae (sensu lato), Euphorbiaceae, Solanaceae, Lamiaceae, Cucurbitaceae, Asteraceae; **Monocotyledons-** Poaceae, Liliaceae, and Orchidaceae.

DC 4: A2: (PAPER 4) Practical

1. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper)
2. Determination of organic matter of different soil samples by Walkley & Black rapid titration method.
3. Determination of dissolved oxygen and dissolved carbon dioxide of water samples from polluted and unpolluted sources.
4. Study of morphological adaptations of hydrophytes and xerophytes (four each).
 - a. Hydrophyte: *Eichhornia*, *Nymphaea*, *Hydrilla*, *Pistia*, *Ludwigia adscandens*.
 - b. Xerophyte: *Nerium*, *Casuarina*, *Opuntia*, *Euphorbia tirucauli*.
5. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification):
 - Brassicaceae- *Brassica*, *Alyssum* / *Iberis*
 - Malvaceae- *Sida* / *Abutilon*
 - Solanaceae- *Solanum* / *Physalis* / *Nicotiana*
 - Lamiaceae- *Salvia* / *Ocimum* / *Leucas* / *Leonurus*
 - Cucurbitaceae: *Cephalandra* / *Nukia*
 - Rubiaceae: *Dentella* / *Spermacoce* / *Oldenladia*
 - Euphorbiaceae: *Jatropha* / *Croton* / *Acalypha*
 - Asteraceae- *Sonchus* / *Launaea*, *Vernonia* / *Ageratum* / *Tridax*

Mounting of a properly dried and pressed specimen of at least 20-30 collected Angiospermic plants with herbarium label and arranged according to Bentham and Hookers system of classification (Preferably)

Suggested Readings

1. Odum, E.P.Fundamentals of Ecology [Saunders]
2. Ambasht, R.S and Ambasht, N.KA Text book of plant Ecology [CBS Publ.]
3. Kumar, H.D.Modern Concept of Ecology [Vikas Pub House]
4. Mukherjee, S.College Botany Vol. III [New Central Book Agency]
5. Mitra, D., Guha, J. & Chowdhury, S.K...Studies in Botany, Vol. I [Moulik Library]
6. Heywood, V.H.Flowering Plants of India [Oxford University Press]
7. Stace, C.A.Plant Taxonomy and Biosystematics [Arnold Publishers]
8. Prain, D.Bengal Plants Vol. I & II [Bishen Singh, Mahendra Pal Singh]
9. Sivarajan, V.V.Introduction to Principles of Plant Taxonomy [Oxford & IBH]

DISCIPLINE CORE
Plant Anatomy and Embryology
(Credits: Theory-4, Practical-2)
THEORY
Lectures: 60

DC 7: A3: (PAPER 5) Theory (Lecture 60)

- 1. Meristematic and permanent tissues:** Root and shoot apical meristems; Simple and complex tissues
- 2. Organs:** Structure of dicot and monocot root stem and leaf.
- 3. Secondary Growth:** Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood)
- 4. Adaptive and protective systems:** Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.
- 5. Structural organization of flower:** Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.
- 6. Pollination and fertilization:** Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.
- 7. Embryo and endosperm:** Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm relationship
- 8. Apomixis and polyembryony:** Definition, types and Practical applications

DC 7: A3: (PAPER 6) Practical

1. Stem: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (Work out).
2. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (Work out).
3. Leaf: Dicot and Monocot leaf (only Permanent slides).
4. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem) (Work out)
5. Structure of anther (young and mature), Tapetum (amoeboid and secretory) (Permanent slides).
6. Ultrastructure of mature egg apparatus cells through electron micrographs.
7. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
8. Dissection of embryo/endosperm from developing seeds (Work out)

Suggested Readings

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
3. Mitra, D., Guha, J. & Chowdhury, S.K....Studies in Botany, Vol.I [Moulik Library]
4. Nair, P.K.K.Pollen Morphology of Angiosperms [Scholar Publication]

DISCIPLINE CORE
Plant Physiology and Metabolism
(Credits: Theory-4, Practical-2)
THEORY
Lectures: 60

DC 10: A4: (PAPER 7) (Theory)

1. **Plant-water relations:** Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.
2. **Mineral nutrition:** Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.
3. **Translocation in phloem:** Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading
4. **Photosynthesis:** Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C₃, C₄ and CAM pathways of carbon fixation; Photorespiration.
5. **Respiration:** Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.
6. **Enzymes:** Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.
7. **Nitrogen metabolism:** Biological nitrogen fixation; Nitrate and ammonia assimilation.
8. **Plant growth regulators:** Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.
9. **Plant response to light and temperature:** Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

DC 10: A4: (PAPER 8) Practical

1. Determination of stomatal frequency and rate of transpiration per stomata per hour.
2. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
3. Measurement of oxygen uptake by respiring tissue (per gram / hr.) by germinating seeds.
4. Measurement of osmotic pressure in the leaf cells of *Rhoeo discolor* by plasmolytic method.
5. Effect of carbon dioxide on the rate of photosynthesis. (varying HCO₃⁻ concentration using bicarbonate in an aquatic plant to find out the optimum and toxic concentration)
6. Comparison of the rate of respiration in any two parts of a plant.

Suggested Readings

1. Sinha, R.K.Modern Plant Physiology [Narosa Publishing House]
2. Taiz, L & Zeiger, E.Plant Physiology [Sinauser Associates Inc. Publishers]
3. Verma, S.K.A Text book of Plant Physiology & Biochemistry [S. Chand & Co.]
4. Voet, D. & Voet, J.G.Biochemistry [John Wiley]
5. Wilkins, M.B.Advanced Plant Physiology [ELBS, Longman]

Discipline Specific Elective

(DSE)

Cell biology and Genetics

Analytical Techniques in Plant Sciences

Plant breeding and biostatistics

Economic botany and biotechnology

**Discipline Specific Elective
Cell Biology and Genetics
(Credits: Theory-4, Practical-2)**

Theory: Lectures 60

1. Cytoskeleton: Ultra structure of nucleus; mitochondria- chloroplast. Structure and function of ribosome, peroxisome and endoplasmic reticulum .
2. Chromosome organization: Structure of centromere and kinetochore, telomere; heterochromatin and euchromatin.
3. Chromatin structure: nucleosome morphology and higher level organization.
4. Cell Cycle: Different stages and importance of each stages of cell cycle. Brief idea about regulation of Cell Cycle in eukaryotes.
5. Principles of inheritance: Mendel's Laws, concepts of dominance, segregation, independent assortment, deviation from Mendelian inheritance (Co-dominance, incomplete dominance, epistasis, hypostasis, complementary gene factor, polygenic inheritance).
6. Linkage - types and detection; crossing over.
7. Changes in chromosome number and structure: Euploidy and aneuploidy, chromosomal rearrangements deletion, duplication, inversion, and translocation-their origin, meiotic behaviour and genetic effects.
8. Concept of gene: Fine structure of gene, split genes, overlapping gene, pseudogene concept of allele, multiple allele, pseudoallele. Operon concept with reference to Lac Operon and Tryptophan- Operon.
9. Population and Evolutionary Genetics: Basic concepts of: Allele frequencies, Genotype frequencies and Hardy-Weinberg Law.

Practical

1. Introduction to chromosome preparation: Pre-treatment, Fixation, Staining, Squash and Smear preparation,
2. Preparation of permanent slides.
3. Study of Mitotic Chromosomes: Metaphase chromosome preparation, free hand drawing, determination of $2n$ number
4. and comment on chromosome morphology of *Allium cepa*.
5. Smear preparation of meiotic cells, identification of different stages and free hand drawing of the following specimens from flower buds of *Allium cepa*.
6. Identification from permanent slides : Meiosis – (i) normal stages (ii) abnormal stages – laggard, anaphase bridge, ring chromosome (*Rhoeo discolor*); Mitosis – (i) normal stages, (ii) abnormal stages- early separation, late separation, multipolarity , sticky bridge, laggard, fragmentation, (ii) pollen mitosis.

Suggested Readings

1. Cooper, G.M.The Cell - A Molecular Approach [ASM Press]
2. De Robertis, E.D.P. & De Robertis, E.M.M.Cell and molecular Biology
3. Gardner, E.J., Simmons, M.J. & Snustad, D.P...Principles of Genetics [John Wiley]
4. Gupta, P.K.Genetics [Rastogi Publications]
5. Lewin, B.Genes (any one: - VI or VII or VIII or IX) [Oxford University Press]
6. Lodish, H. et al.Molecular Cell Biology [Freeman Publishers]
7. Powar, C.B.Cell Biology [Himalaya Publishing House]
8. Russell, P.J.Genetics [Benjamin / Cumming Publ. Co.]
9. Stent, G.S. & Calendar, R. ...Molecular Genetics-An Introductory Narrative [CBS]
10. Stickberger, M.W.Genetics [McMillan]
11. Verma, P.S. & Agarwal, V.K.Concept of Cell Biology [S. Chand & Co.]
12. Watson, J.D. et al. Molecular Biology of the Gene [Benjamin/Cumming Publ. Co.]
13. Weaver, R.F. & Hedrick, P.W.Genetics [WCB Publications]

Discipline Specific Elective
Economic Botany and Plant Biotechnology
(Credits: Theory-4, Practical-2)

Theory: Lectures 60

1. **Origin of Cultivated Plants:** Concept of centre of origin, their importance with reference to Vavilov's work.
2. **Cereals:** Wheat -Origin, morphology, uses.
3. **Legumes:** General account with special reference to Gram and soybean.
4. **Spices:** General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses).
5. **Beverages:** Tea (morphology, processing, uses)
6. **Oils and Fats:** General description with special reference to groundnut/Mustard oil
7. **Fibre Yielding Plants:** General description with special reference to Jute (Botanical name, family, part used, morphology and uses)
8. **Introduction to biotechnology**
9. **Plant tissue culture:** Micropropagation ; haploid production through androgenesis and gynogenesis; brief account of embryo and endosperm culture with their applications
10. **Recombinant DNA Techniques:** Blotting techniques: Northern, Southern and Western Blotting, DNA Finger printing; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy.

Practical

1. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove
2. Tea, Cotton, Groundnut through specimens, sections and microchemical tests
3. Detection of Sugar and proteins from cereals and pulses
4. Familiarization with basic equipments in tissue culture.
5. Study through photographs: Anther culture, somatic embryogenesis, endosperm and
6. embryo culture; micropropagation.
7. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

Suggested Readings

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Dubey, R.C.Biotechnology [S. Chand & Co.]
4. Gamborg, O.L. & Philips, G.C.Plant Cell, Tissue and Organ Culture -Fundamental Method [Narosa Publications]
5. Razdan, M.K.An Introduction to Plant Tissue Culture [Oxford & IBH]

Discipline Specific Elective
Plant Breeding and Biostatistics
(Credits: Theory-4, Practical-2)

Theory: Lectures: 60

Plant Breeding

1. Plant Breeding: Introduction; Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.
2. Methods of crop improvement: Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization basic concepts and application.
3. Heterosis and Hybrid vigour; Male sterility in plants- types and application.
4. Quantitative inheritance: Concept, mechanism, examples of inheritance of Kernel colour in wheat.
5. Inbreeding depression and heterosis: Concept and Applications.
6. Role of biotechnology in crop improvement.

Biostatistics

7. Introduction to Biostatistics: Characteristics, Usefulness and Limitation, Types of Data.
8. Sampling methods-concept of sampling of population, measures of central tendency and dispersal: determination of mean, mode, median, variance, standard deviation and standard error.
9. Rules of probability (Addition and Multiplication theorem), Null-hypothesis, Tests of significance: chi-square test, t-test (student and paired t-test).

Practical

1. Study of germplasm.
2. Study of floral structure of self-pollinated and cross pollinated crops.
3. Emasculation and hybridization techniques in self and cross pollinated crops.
4. Artificial pollination in self-pollinated crop (any one crop).
5. Study on probability and Chi-square test and heritability analysis.
6. Univariate analysis of statistical data: Statistical tables, mean mode, median, standard deviation, and standard error (using seedling population/leaflet size).

Suggested Readings

1. Allard, R.W.Principles of Plant Breeding [John Wiley]
2. Bailey, N.T.J.Statistical Method in Biology [Cambridge University Press]
3. Chawdhuri, H.K.Elementary Principles of Plant Breeding [Oxford & IBH]
4. Poehlman, J.M. & Barthakur, D.Plant Breeding [Oxford & IBH]
5. Singh, B.D.Plant Breeding: Principles and Methods [Kalyani Publishers]
6. Sokal, R.R. & Rohlf, F.J.Introduction to Biostatistics [W H Freeman]

Discipline Specific Elective
Economic botany and Biotechnology
(Credits: Theory-4, Practical-2)

Theory: Lectures: 60

1. **Origin of Cultivated Plants:** Concept and their importance.
2. **Cereals:** Wheat - morphology, uses.
3. **Legumes:** General account with special reference to Gram.
4. **Spices:** General account with special reference to black pepper (Botanical name, family, part used, morphology and uses).
5. **Beverages:** Tea (morphology, processing, uses)
6. **Oils and Fats:** General description with special reference to Mustard oil
7. **Fiber Yielding Plants:** General description with special reference to Jute (Botanical name, family, part used, morphology and uses)
8. **Introduction to biotechnology**
9. **Plant tissue culture:** Micropropagation; haploid production through androgenesis and gynogenesis; brief account of embryo and endosperm culture with their applications
10. **Recombinant DNA Techniques:** Blotting techniques: Northern, Southern and Western Blotting, DNA Finger printing; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Basic concepts of: Hybridoma and monoclonal antibodies, ELISA and Immunodetection.

Practical

1. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove
2. Tea, Cotton, Groundnut through specimens, sections and microchemical tests (Ca,Mg,Fe and S)
3. Detection of Sugar and proteins from cereals and pulses
4. Familiarization with basic equipments in tissue culture.
5. Study through photographs: Anther culture, somatic embryogenesis, endosperm and
6. embryo culture; micropropagation.
7. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE: Demonstration through presentations and photographs.

Suggested Readings

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India
2. Ltd., New Delhi. 4th edition.
3. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice.
4. Elsevier Science Amsterdam. The Netherlands.
5. Dubey, R.C.Biotechnology [S. Chand & Co.]
6. Gamborg, O.L. & Philips, G.C.Plant Cell, Tissue and Organ Culture -Fundamental Method [Narosa Publications]
7. Razdan, M.K.An Introduction to Plant Tissue Culture [Oxford & IBH]

Skill Enhancement Courses (SEC)

**Floriculture
Mushroom Culture Technology
Biofertilizers
Ethnobotany
Plant Diversity and Human Welfare
Medicinal Botany
Herbal Technology**

Skill Enhancement Course

Floriculture

(Credits: 2)

Lectures: 30

1. **Introduction:** History of gardening; Importance and scope of floriculture and landscape gardening. Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators.
2. **Ornamental Plants:** Flowering annuals; Herbaceous perennials; Climbing vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai. Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India.
3. **Landscaping Places of Public Importance:** Landscaping highways and Educational institutions.
4. **Commercial Floriculture:** Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Liliun, Orchids).
5. Diseases and Pests of Ornamental Plants.

Suggested Readings

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

Skill Enhancement Course
Mushroom Culture Technology
(Credits: 2)
Lectures: 30

1. **Introduction:** History, Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - *Volvariella volvacea*, *Pleurotus citrinopileatus*, *Agaricus bisporus*.
2. **Cultivation Technology :** Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag.
3. **Pure culture:** Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation
4. Low cost technology, Composting technology in mushroom production.
5. Storage and nutrition: Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.
6. Food Preparation: Types of foods prepared from mushroom. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

Suggested Readings

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

Skill Enhancement Course

Biofertilizers

(Credits: 2)

Lectures: 30

1. General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.
2. *Azospirillum*: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. *Azotobacter*: classification, characteristics – crop response to *Azotobacter* inoculum, maintenance and mass multiplication.
3. Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation.
4. Plant Growth Promoting Rhizobacteria (PGPR) and Plant Growth Promoting Fungi (PGPF): Characterization, mode of action and effect on plant growth and disease suppression. Induction of resistance in host against plant pathogens-mechanism and pathway involved.
5. Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.
6. Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.

Suggested Readings

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay _Publication, New Delhi.
4. Sathé, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New _Delhi.
6. Vayas, S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic _Farming AktaPrakashan, Nadiad

Skill Enhancement Course
Ethnobotany
(Credits 2)
Lectures: 30

1. **Ethnobotany:** Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.
2. **Methodology of Ethnobotanical studies:** a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.
3. **Role of ethnobotany in modern Medicine:** Medico-ethnobotanical sources in India; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) (a) *Azadirachta indica*; (b) *Ocimum sanctum*; (c) *Vitex negundo*; (d) *Gloriosa superba*; (e) *Tribulus terrestris*; (f) *Pongamia pinnata*; (g) *Cassia auriculata*; (h) *Indigofera tinctoria*. Role of ethnobotany in modern medicine with special example *Rauvolfia serpentina*, *Trichopus zeylanicus*, *Artemisia*, *Withania*. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).
4. **Ethnobotany and legal aspects:** Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

Suggested Readings

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. S.K. Jain (ed.) Glimpses of Indian. Ethnobotany, Oxford and I B H, New Delhi – 1981 Lone et al., Palaeoethnobotany
3. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
4. S.K. Jain, 1990. Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.
5. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
6. Rama Rao, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra
7. Pradesh, India. Botanical Survey of India. Howrah. _8) Rajiv K. Sinha – Ethnobotany The
8. Renaissance of Traditional Herbal Medicine – INA – SHREE Publishers, Jaipur-1996_9)
9. Faulks, P.J. 1958. An introduction to Ethnobotany, Moredale pub. Ltd.

Skill Enhancement Course
Plant Diversity and Human Welfare
(Credits 2)

Lectures: 30

1. **Introduction:** Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for evaluation, Uses of plants, Uses of microbes.
2. **Loss of Biodiversity:** Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss,
3. **Management of Plant Biodiversity:** Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.
4. **Conservation of Biodiversity:** Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.
5. **Role of plants in relation to Human Welfare;** a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.

Suggested Readings

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi

Skill Enhancement Course
Medicinal Botany
(Credits 2)
Lectures: 30

1. History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope- Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridoshaconcepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations.
2. Conservation of endangered and endemic medicinal plants. Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.
3. Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interactants, Palaeo-ethnobotany. Folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.

Suggested Readings

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.

Skill Enhancement Course
Herbal Technology
(Credits 2)
Lectures: 30

1. Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage -marketing and utilization of medicinal plants.
2. Pharmacognosy - systematic position medicinal uses of the following herbs in curingvarious ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.
3. Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster).
4. Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation -Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).
5. Medicinal plant banks micro propagation of important species (*Withania somnifera*,Neem and Tulsi- Herbal foods-future of pharmacognosy)

Suggested Readings

1. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R.,New Delhi.
 2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International
 3. Book _Distributors.
 4. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
 5. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994.
 6. Oxford IBH _publishing Co.
 7. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
 8. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
 9. Pharmacognosy, Dr.C.K.Kokate et al. 1999. Nirali Prakashan.
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B.Sc. Botany, General : THEORETICAL MARKS Distribution		
Discipline Core (DC-1, 4,7 &10)	Marks per question	Total
Short Answer types (Answer five out of seven questions)	01	1x5=05
Long Answer types (Answer four out of seven questions)	03	3x4=12
Descriptive Answer types (Answer one out of two questions)	08	8x1=08
Full marks	-	25
Discipline Specific Elective (DSE 1, 2 and 3)		
Discipline Specific Elective (DSE 1, 2 and 3)	Marks per question	Total
Short Answer types (Answer five out of seven questions)	01	1x5=05
Long Answer types (Answer four out of seven questions)	03	3x4=12
Descriptive Answer types (Answer one out of two questions)	08	8x1=08
Full marks	-	25
Skill Enhancement Courses (SEC)		
Skill Enhancement Courses (SEC)	Marks per question	Total
Short Answer types (Answer five out of seven questions)	02	2x5=10
Long Answer types (Answer four out of seven questions)	05	5x4=20
Descriptive Answer types (Answer one out of two questions)	10	10x1=10
Full marks	-	40

Distribution of marks for B.Sc. Botany : General Course: Internal Assessment			
COURSES	Internal Assessment		Total Marks
DC/DSE/SE	Attendance (4)	Cont. Evaluation (6) <ul style="list-style-type: none"> • Laboratory Note books • Field Diaries • Submissions (if Any) • Excursion diary/ report with photographs) 	10

Discipline Core (DC) for General- UG

Biodiversity (Microbes, Algae, Fungi and Archegoniate) : Practical

DC 1 Paper 2	Work out with Drawing & labelling (Algae/Fungi)				Work out with Drawing & labelling (Microbiology/Pteridophytes/Bryophyte)			Identification (Lichens)	Viva	Full Marks
	Slide	Drawing and labelling	Comment and identification	Total	Gram staining/ Drawing and labelling morphological and reproductive parts	Comment and identification	Total			
	01	02	02	05	03	03	05			

Plant Ecology and Taxonomy: Practical

DC 2 Paper 4	Taxonomical work out				Ecology	Identification from Taxonomy: Family and Genus (One dicot and one monocot)	Viva	Full Marks
	Drawing	Floral formula and diagram	Identification	Total				
	02	02	02	06				

Plant Anatomy and Embryology: Practical

DC 3 Paper 6	Anatomy				Embryology (Dissection of embryo/ endosperm from developing seeds)	Identification from permanent slides/ micrographs/phot ographs (One feom anatomy and one from embryology)	Viva	Full Marks
	Slide preparation	Drawing and labelling	Comment	Total				
	02	02	02	06				

Plant Physiology and Metabolism: Practical

Requisition	Principle	Result and Calculation	Comment	Total	Viva	Full Marks
02	02	05	03	12	03	15

Discipline Specific Elective

Distribution of marks for all DSE (Practical)

Analysis/ Demonstration	Viva-voce	Submission	Full Marks
10	03	02	15
