Indira Gandhi National Tribal University
Amarkantak (M.P.)

SYLLABI

(Based on CBCS Pattern)

Department of Botany
Faculty of Science

B.Sc. Programme in Botany

(Effective from 2019-2020)

Structure of B.Sc. Biological Sciences under CBCS

	CORE COURSE (4+2)	**Ability Enhancement Compulsory Courses (2)**	Skill Enhancement Courses (SEC) (2)	**Discipline Specific Elective DSE (4+2)**
I	CC-Botany I	English communication		
	CC-Zoology I			
	CC-Chemistry I			
II	CC-Botany II	Environmental Science		
	CC-Zoology II			
	CC-Chemistry II			
III	CC-Botany III		SEC-I	
	CC-Zoology III			
	CC-Chemistry III			
IV	CC-Botany IV		SEC-II	
	CC-Zoology IV			
	CC-Chemistry IV			
V			SEC-III	DSE-Botany I
				DSE- Zoology I
				DSE-3 Chemistry I
VI			SEC-IV	DSE-Botany II
				DSE- Zoology II
				DSE-3 Chemistry II

Core Courses –Botany

1. BBT-01 : Biodiversity
2. BBT-02 : Plant Ecology and Taxonomy
3. BBT-03 : Plant Anatomy and Embryology
4. BBT-04 : Plant Physiology and Metabolism

Discipline Specific Electives–Botany (Any two)

1. DBBT-01 : Cell and Molecular Biology
2. DBBT-02 : Plant Pathology and Biotechnology
3. DBBT-03 : Genetics and Plant Breeding
4. DBBT-04: Biostatistics, Bioinformatics and Analytical Techniques

Skill Enhancement Courses–Botany (Any four)

1. SBBT-01 : Biofertilizers
2. SBBT-02 : Herbal Technology
3. SBBT-03 : Plant Diversity and Human Welfare
4. SBBT-04 : Economic Botany
5. SBBT-05 : Mushroom Culture Technology

Core Course: Botany
Paper I
BBT-01:Biodiversity
(Credits: Theory-4, Practicals-2)
THEORY
Lectures: 60

Unit 1: Viruses, Bacteria and Fungi (20 Lectures)

Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage), Lytic and lysogenic cycle, RNA virus (TMV), Economic importance of viruses,
Bacteria – Discovery, General characteristics and cell structure, Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction), Economic importance of bacteria.
Fungi – Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification, True Fungi-General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota), *Alternaria*(Ascomycota), *Puccinia, Agaricus*(Basidiomycota), Symbiotic Associations-Lichens, Mycorrhiza.

Unit 2: Algae (10 Lectures)
General characteristics, Ecology and distribution, Range of thallus organization and reproduction, Classification of algae, Morphology and life-cycles of the following: *Nostoc, Chlamydomonas, Vaucheria, Polysiphonia*. Economic importance of algae.

Unit 3: Bryophytes (10 Lectures)
General characteristics, Classification, Range of thallus organization.Morphology, anatomy and reproduction of *Marchantia, Anthoceros* and *Funaria* (Developmental details not to be included). Ecology and economic importance ofbryophytes.

Unit 4: Pteridophytes (10 Lectures)
General characteristics, classification.Morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar system.

Unit 5: Gymnosperms (10 Lectures)
General characteristics, classification.Morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included).

BBP-01:Practicals

1. EMs/Models of viruses: T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs, EM bacterium, Binary Fission, Conjugation, Structure of root nodule.
3. Gram staining.
4. Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas* (electron micrographs),*Oedogonium, Vaucheria, and Polysiphonia* through temporary preparations and permanent slides.
5. *Rhizopus and Penicillium*: Asexual stage from temporary mounts and sexual structuresthrough permanent slides.
6. *Alternaria:* Specimens/photographs and tease mounts.
7. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat, Section/tease mounts of spores on Wheat and permanent slides of the host.
8. *Agaricus*: Specimens of button stage and full grown mushroom, Sectioning of gills of *Agaricus*.
9. Lichens: Study of growth forms of lichens.
10. Mycorrhiza: ectomycorrhiza and endomycorrhiza (Photographs).
11. *Marchantia*: morphology of thallus, WM rhizoids and scales, VS thallus throughgemma cup, WMgemmae, VSantheridiophore, archegoniophore, LS sporophyte (Temporary/permanent slides).
12. *Funaria*: morphology, WM leaf, rhizoids, operculum, peristome, annulus, spores(temporary slides), permanent slides showing antheridial and archegonial heads, LS capsule and protonema.
13. *Selaginella*: morphology, WM leaf with ligule, TS stem, WM strobilus, WM microsporophyll and megasporophyll (temporary slides), LS strobilus (permanent slide).
14. *Equisetum*: morphology, TS internode, LS strobilus, TS strobilus, WMsporangiophore, WM spores (wet and dry) (temporary slides),TS rhizome (permanent slide).
15. *Pteris*: morphology, TS rachis, VS sporophyll, WM sporangium, WM spores(temporary slides), TS rhizome, WM prothallus with sex organs and young sporophyte (permanent slide).
16. *Cycas*: morphology (coralloid roots, bulbil, leaf), TS coralloid root, TS rachis, VS leaflet, VS microsporophyll, WM spores (temporary slides), LS ovule, TS root (permanent slide).
17. *Pinus*: morphology (long and dwarf shoots, WM dwarf shoot, male and female), WMdwarf shoot, TS needle, TS stem, LS/TS male cone, WM microsporophyll, WM microspores (temporary slides), LS female cone, TLS& RLS stem (permanent slide).

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

Core Course Botany

Paper–II

BBT-02:Plant Ecology and Taxonomy

(Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

Unit 1: Ecological factors (12 Lectures)

Biotic (producers, consumers and decomposers) and abiotic factors and their variations (Light, temperature, humidity, soil- formation, composition, soil profile).Precipitation types.Adaptation of hydrophytes, halophytes and xerophytes, Global warming.

Unit 2: Ecosystem & Phytogeography (12 Lectures)

Concept, Structure, energy flow trophic organisation, Food chains and food webs, Ecological pyramids, Net primary productivity, Biogeochemical cycles (Carbon and Nitrogen), Ecotone and edge effect, Concept of Population, Ecosystem, Succession, Life forms.

Phytogeography: Principles, Continental drift, Endemism, Brief description of major terrestrial biomes (one each from tropical, temperate and tundra), Phytogeographical division of India.

Unit 3: Taxonomy and Botanical nomenclature (12 Lectures)

History of Plant taxonomy, principles and rules of plant nomenclature, typification, categories and taxonomic hierarchy, Herbarium concept and techniques, Botanical Survey of India, Role of botanical garden.

Unit 4: Systems of classification (8 Lectures)

Outline classification of Bentham & Hooker, Engler & Prantal and Hutchinson's with their principle, merits and demerits.

Unit 5: Plant families (16 Lectures)

A detailed account of following families: Brassicaceae, Papavaraceae, Malvaceae, Fabaceae, Asteraceae, Asclepiadiaceae, Cucurbitaceae, Solanaceae, Lamiaceae, Euphorbiaceae, Poaceae.

BBP-02: Practicals

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in different soil types.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (b)Study of biotic interactions of the following: Stem parasite (*Cuscuta),* Epiphytes, Predation (Insectivorous plants).
5. Determination of minimal quadrat size for the study of herbaceous vegetation by species area curve method.
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law. Study of vegetative and floral characters of angiosperm families (Description, VS flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification).
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Suggested Readings

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). *Plant Systematics:* Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

Core Course Botany

Paper-III

BBT-03:Plant Anatomy and Embryology

(Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

Unit 1: Meristematic and permanent tissues (18 Lectures)

Classification of tissues (Simple and complex), Root and shoot apical meristems, Organization of shoot and root apex (Apical cell theory, Histogen theory, Tunica Corpus theory, Korper-Kappe theory), Quiescent centre, Root cap. Epidermis, cuticle, stomata and their classification, Structure of dicot and monocot root, stem and leaf.

Unit 2: Secondary Growth (12 Lectures)

Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Sapwood and heartwood, Early and latewood, Dendrochronology, tyloses, lenticels.

Unit 3: Structural organization of flower (08 Lectures)

Structure of anther and pollen, Structure and types of ovules, Types of embryo sacs, organization and ultrastructure of mature embryo sac.

Unit 4: Pollination and fertilization (10 Lectures)

Types of Pollination, mechanisms and adaptations, Double fertilization and triple fusion.

Unit 5: Embryo and endosperm (12 Lectures)

Endosperm types, structure and functions, Embryogeny in Dicot and monocot
Seed-structure and dispersal, Apomixis and polyembryony.

BBP-03: Practicals

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma), Macerated xylary elements, Phloem (Permanent slides, photographs).
3. Stem: Monocotand Dicot (Temporary/Permanent slides).
4. Root: Monocotand Dicot (Temporary/Permanent slides).
5. Leaf: Monocotand Dicot (Temporary/Permanent slides).
6. Adaptive anatomy: Xerophyte/Hydrophyte.
7. Structure of anther, (Permanent slides).
8. Types of ovules: Permanent slides.
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

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.

Core Course Botany
Paper-IV
BBT-04:Plant Physiology and Metabolism
(Credits: Theory-4, Practicals-2)
THEORY
Lectures: 60

Unit 1: Plant-water relations (8 Lectures)
Importance of water, water potential and its components, Transpiration and its significance, Factors affecting transpiration, Root pressure and guttation.

Unit 2: Mineral nutrition & Solute transport (12 Lectures)
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. Composition of phloem sap, girdling experiment, Pressure flow model, Phloem loading and unloading.

Unit 3: Phytohormones and photomorphogenesis (10 Lectures)
Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene. Photoperiodism (SDP, LDP, Day neutral plants), Phytochrome (discovery and structure), Red and far-red light responses, Vernalization.

Unit 4: Photosynthesis and respiration (18 Lectures)
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.Glycolysis, anaerobic respiration, TCA cycle, Oxidative phosphorylation, Oxidative Pentose Phosphate Pathway.

Unit 5: Enzymes and Nitrogen metabolism (12 Lectures)
Structure and properties, Mechanism of enzyme catalysis and enzyme inhibition. Biological nitrogen fixation, Nitrate and ammonia assimilation.

BBP-04: Practicals

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
5. To study the effect of light intensity and bicarbonate concentration on O_2 evolution in photosynthesis.
6. Comparison of the rate of respiration in any two parts of a plant.
7. Separation of pigments and amino acids by paper chromatography.

Demonstration experiments (any four)

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots

Suggested Readings

1. Taiz, L., Zeiger, E. (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P. (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D. (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.
4. Heldt, Plant Biochemistry.
5. Nelson and Cox.
6. Instant notes in Biochemistry.

Discipline Specific Elective Botany
DBBT-01:Cell and Molecular Biology
(Credits: Theory-4, Practicals-2)
THEORY
Lectures: 60

Unit 1: Cell and Organelles (18 Lectures)
The Cell Theory, Prokaryotic and eukaryotic cells, Cell size, shape and components. Mitochondria: Structure, Semiautonomous nature, Symbiont hypothesis, mitochondrial DNA. Chloroplast: Structure, semiautonomous nature, chloroplast DNA.Endoplasmic reticulum, Ribosomes, Golgi body, Lysosomes, Peroxisomes and Glyoxisomes: Structures and roles. Nucleus: Structure and function, Chromatin, molecular organization, Euchromatin and heterochromatin. Overview of Cell cycle, Mitosis and Meiosis.

Unit 2: Cell Membrane and Cell Wall (6 Lectures)
The functions of membranes, Models of membrane structure, Selective permeability of the membranes, Cell wall: Structure and composition.

Unit 3: Genetic material (12 Lectures)
DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): Enzymes, Initiation, elongation and termination process.

Unit 4: Transcription and gene regulation **(14 Lectures)**
Types of RNA (mRNA, tRNA, rRNA) and RNA polymerase. Transcription- Initiation, elongation and termination process (Prokaryotes and eukaryotes), Regulation: Lac operon and Tryptophan operon.

Unit 5: Translation **(10 Lectures)**
Genetic code, Translation- Initiation, elongation and termination process (Prokaryotes and eukaryotes).

DBBP-01: Practicals

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs of cell organelles.
3. To study the structure of plant cell through temporary mounts.
4. To prepare temporary stained preparation of chloroplast from plant cells.
5. Study of mitosis and meiosis (temporary mounts and permanent slides).
6. Demonstration of dialysis of starch and simple sugar.
7. Study of plasmolysis and deplasmolysis on leaf.
8. Measure the cell size (either length or breadth/diameter) by micrometry.
9. Study the structure of nuclear pore complex by photograph.
10. Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
11. Study DNA packaging by micrographs.
12. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

Suggested Readings

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.,Sinauer Associates, MA.
4. Becker, WM, Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Principles of genetics, Simmons and Snusted.
6. P. K. Gupta Genetics.

Discipline Specific Elective Botany

DBBT-02:Plant Pathology and Biotechnology

(Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

Unit 1: **Plant Pathology: Introduction** **(10 Lectures)**

Terms and concepts: General symptoms, Etiology, Symptomology, Host-pathogen relationships, prevention and control of plant diseases.

Unit 2: **Plant Diseases** **(16 Lectures)**

Causal organism, symptoms, disease cycle and control measures of the following plant diseases: (Late and earlyblight of potato, White rust of crucifers, Black rust of wheat, Tikka disease of groundnut, Citrus canker, Yellow vein mosaic of okra).

Unit 3: Plant tissue culture **(12 Lectures)**

Sterilization methods and types of media, Micropropagation, Concept of cellular differentiation and totipotency, Somatic Embryogenesis: Induction and controlling factors.

Unit 4: Recombinant DNA Technology **(14 Lectures)**

Gene cloning: Enzymes used in gene cloning, cloning and expression vectors, method of Transformation (Direct and indirect), selection, identification, recombinant DNA libraries.

Unit 5: Application of Biotechnology **(08 Lectures)**

Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Biosafety concerns, bioethics.

DBBP-02: Practicals

1. *Rhizopus/Mucor*: study of asexual stage from temporary mounts and sexual structures through permanent slides.
2. *Aspergillus* and *Penicillium*: study of asexual stage from temporary mounts and sexual stage through permanent slides/photographs.
3. *Alternaria*: Specimens/photographs and temporary mounts.
4. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
5. *Agaricus*: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*, fairy rings and bioluminescent mushrooms to be shown.
Herbarium specimens of - bacterial diseases (Citrus canker), Viral diseases (TMV, Vein clearing), Fungal diseases (Early blight of potato, Black stem rust of wheat and White rust of crucifers).
6. (a) Preparation of MS medium.
(b)Demonstration of *invitro* sterilization and inoculation methods using leaf and nodal explants of tobacco, *Datura*, *Brassica* etc.
7. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
8. Study of methods of gene transfer through photographs: *Agrobacterium*-mediated, directgene transfer by electroporation, microinjection, microprojectile bombardment.
9. Study of steps of genetic engineering for production of Btcotton, Goldenrice, FlavrSavr tomato through photographs.
10. Isolation of plasmid DNA.
11. Restriction digestion and gel electrophoresis of plasmid DNA.

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. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

Discipline Specific Elective Botany

DBBT-03:Genetics and Plant Breeding

(Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

Unit 1: Mendelian genetics and itsextension (16 Lectures)

Mendelism: History, Principles of inheritance, Chromosome theory of inheritance, Autosomes and sex chromosomes, Incomplete, dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Polygenic inheritance.

Unit 2: Genetic recombination: (**12 Lectures)**

Linkage and crossing over, cytological basis of crossing over, Recombination frequency, two -and three-factor crosses, Interference and coincidence, Sex Linked inheritance.

Unit 3: Chromosomal aberrations: (**12 Lectures)**

Numerical and structural changes in chromosomes: Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy.

Unit 4: Gene mutations (10 Lectures)

Types of mutations, Molecular basis of Mutations, Mutagens – physical and chemical, Role of Transposons.

Unit 5: Plant breeding (10 Lectures)

Objectives of plant breeding, selection of self and cross-pollinated plants, hybridization, self and cross-pollinated plants, anthesis, self-sterility, male sterile lines, single, double and multiplecrosses.

DBBP-03: Practicals

1. Study of Mendel's laws through seed ratios.
2. Laboratory exercises in probability and chi-square.
3. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
4. Incomplete dominance and gene interaction through seed ratio (9:7,9:6:1,13:3,15:1,12:3:1,9:3:4).
5. Photographs/Permanent slides showing Translocation Ring, Laggards and Inversion Bridge.

Suggested Readings

1. A Text Book of Cytology, Genetics and Evolution, Gupta, PK, Rastogi Publication, Meerut.
2. Principles of Genetics, Gardner EJ, Simmons MJ, Snustad DP (2010), John Wiley & Son, India, 5thedn.
3. Genetics: Classical to Modern, Gupta PK (2007), Rastogi Publication, Meerut
4. Principles of Genetics, Snustad DP, Simmons MJ, (2010), 5th edition, John Wiley & Sons Inc., India.
5. Concepts of Genetics, Klug WS, Cummings MR, Spencer CA, (2012), 10th edition, Benjamin Cummings, USA.
6. Introduction to Genetic Analysis, Griffiths AJF, Wessler SR, Carroll SB, Doebley J, (2010), 10th edition, W.H. Freeman and Co., USA.
7. Variation and Evolution in Plants, Stebbins GL.
8. Griffiths AJF, Wessler SR, Carroll SB, Doebley J (2010) Introduction to GeneticAnalysis, WH Freeman & Co, USA, 10thedition.
9. Plant Breeding, BD Singh (1994), Kalyani Publications, New Delhi.

Discipline Centric Elective Botany
DBBT-04:Biostatistics, Bioinformatics and Analytical Techniques
(Credits: Theory-4, Practicals-2)
THEORY
Lectures: 60

Unit 1:Biostatistics (12 Lectures)
Importance and application, tabulation and classification of data, frequency distribution and graphical distribution of data, measures of central tendencies: Mean, Median and Mode, sampling methods.

Unit 2: Measures of Dispersion (12 Lectures)

Mean deviation, variance, standard deviation, standard error and coefficient of variation, hypothesis testing: Student's t-test and Chi-square test.

Unit 3: Introduction and Databases in Bioinformatics (12 Lectures)
Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics.
Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System.

Unit 4:Microscopy (12 Lectures)
Principles and applications of - Light, Fluorescence, Confocal, Transmission, Scanning electron.

Unit 5: Spectrophotometry and chromatography (12 Lectures)
Principles and applications of UV-Vis, IR spectroscopy, Paper and column chromatography.

DBBP-04: Practicals

1. Calculation of mean, standard deviation and standard error.
2. Calculation of correlation coefficient values and finding out the probability.
3. Calculation of 'F' value and finding out the probability value for the F value.
4. Nucleic acid and protein databases.
5. Sequence retrieval from databases.
6. To separate sugars by thin layer chromatography.
7. Isolation of chloroplasts by differential centrifugation.
8. To separate chlorophyll pigments by column chromatography.
9. Study of different microscopic techniques using photographs/micrographs.

Suggested Readings

1. Biostatistic, Danniel WW, 1987.New York,JohnWileySons.
2. An introduction to Biostatistics, 3rd edition, Sundarrao PSS, Richards J, Christian Medical College, Vellore.
3. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
4. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
5. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.
6. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.
7. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
8. Ausubel, F., Brent R., Kingston R. E., Moore D.D., Seidman J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.

Skill Enhancement Courses
SBBT-01:Biofertilizers
(Credits 2)Lectures: 30

Unit 1: General account about the microbes used as biofertilizer, Rhizobium: isolation, identification, mass multiplication, carrier based inoculants. **(4 Lectures)**

Unit 2: *Azospirillum:* isolation and mass multiplication, carrier based inoculant, associativeeffect of different microorganisms. *Azotobacter*: classification, characteristics, crop response to *Azotobacter* inoculum, maintenance and mass multiplication. **(8 Lectures)**

Unit 3: Cyanobacteria (blue greenalgae), *Azolla*and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation. **(4 Lectures)**

Unit 4: Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrenceand 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. **(8 Lectures)**

Unit 5: Organic farming: Green manuring and organic fertilizers, Recycling of biodegradable, agricultural and Industrial wastes, Method vermicomposting and their field application.
(6 Lectures)

Suggested Readings

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

Skill Enhancement Courses
SBBT-02: Herbal Technology
(Credits 2) Lectures: 30

Unit1: **(8 Lectures)**
Herbal medicines: history and scope; cultivation, harvesting, processing, storage, marketing and utilization of medicinal plants.

Unit2: **(6 Lectures)**
Phytochemistry: active principles and methods of their testing, Identification and utilization of the medicinal herbs: *Catharanthus roseus, Withania somnifera, Aloevera* and *Centella asiatica*.

Unit3: **(10 Lectures)**
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).

Unit4: **(6 Lectures)**
Medicinal plant banks, micro propagation of Kaalmegh, Neem and Tulsi.

Suggested Readings:

1.Glossary of Indian medicinal plants, RN Chopra, SL Nayar, IC Chopra,1956,CSIR, New Delhi.
2. Herbal plants and Drugs ,Agnes Arber,1999.MangalDeepPublications.
3. Ayurvedic drugs and their plant source. VV Sivarajan, Balachandran, Indra1994, Oxford IBH publishing Co.
4. Ayurveda and Aromatherapy, Miller Light and Miller Bryan, 1998, Banarsidass, Delhi.
5.Principles of Ayurveda, AnneGreen,2000.Thomsons,London.

Skill Enhancement Course
SBBT-03:Plant Diversity and Human Welfare
(Credits 2)Lectures: 30

Unit 1: Plant diversity and its scope: Genetic diversity, Species diversity, Plant diversity attheecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values. **(8 Lectures)**

Unit 2: Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss. **(4 Lectures)**

Unit 3: Management of Plant Biodiversity: Organizations associated with biodiversity management, Methodology for execution: IUCN, UNEP, UNESCO, WWF, NBPGR, Biodiversity legislation and conservations. **(4 Lectures)**

Unit 4: Conservation of Biodiversity: Conservation of genetic diversity, species diversityand ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development. **(8 Lectures)**

Unit 5: Role of plants in relation to Human Welfare,
Importance of forestry their utilization and commercial aspects, Avenue trees, Ornamental plants of India. Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses. **(6 Lectures)**

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.
2. S.K. Jain, 1990. Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.
3. Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester.
4. Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah.
5. Rajiv K. Sinha – Ethno botany The Renaissance of Traditional Herbal Medicine – INA – SHREE Publishers, Jaipur-1996.

Skill Enhancement Course
SBBT-04:Economic Botany
(Credits 2)Lectures: 30

Unit 1: Ethnobotany
Introduction, concept, scope and objectives, Ethnobotany as an interdisciplinary science. The relevance of ethno botany 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. **(6 Lectures)**

Unit 2: 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.
(8 Lectures)

Unit 3:**Conservation**
Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management), Sacred grooves. **(4 Lectures)**

Unit 4: Origin of Cultivated Plants
Vavilov's Centres of Origin, Crop domestication and loss of genetic diversity; evolution of new crops/varieties. **(6 Lectures)**

Unit 5: Cereals, Legumes, Sugars, Beverages and Spices
Origin, morphology & uses: Wheat, Rice, millets, Legumes, sugarcane, Tea, Coffee. Important spices: fennel, saffron, clove and black pepper etc. **(6 Lectures)**

Suggested Readings

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

Skill Enhancement Course

SBBT-05:Mushroom Culture Technology
(Credits 2)Lectures: 30

Unit 1: Introduction, history. Nutritional and medicinal value of edible mushrooms, Poisonous mushrooms. Types of edible mushrooms available in India –*Volvariella volvacea, Pleurotuscitrino pileatus, Agaricus bisporus*. **(5 Lectures)**

Unit 2: Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray. **(6 Lectures)**

Unit 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. **(6 Lectures)**

Unit 4: Storage and nutrition: Short-term storage (Refrigeration - upto 24 hours) Long term storage (canning, pickels, papads), storage in saltsolutions. **(8 Lectures)**

Unit 5: Food Preparation: Types of foods prepared from mushroom. Research Centres -National level and Regional level. Marketing strategies in India and abroad. **(5 Lectures)**

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.