Department of Botany
Faculty of Science
M.Sc. Programme in Botany

(Effective from June 2016-onwards)

Course Layout:

Course Components	Paper Code	Paper Title	Credits		
			L	T	P
SEMESTER -I					
Core Course (CC)	MBT 101	Phycology & Bryology	04		
	MBT 102	Mycology & Plant Pathology	04		
	MBT 103	Pteridophytes, Gymnosperm & Paleobotany	04		
	MBT 104	Instrumentation, Techniques & Biostatistics	04		
	MBP 101	*Laboratory work based on course MBT 101 & 102*			02
	MBP 102	*Laboratory work based on course MBT 103 & 104*			02
Generic Elective/Open Elective	GMBT01	History & Philosophy of Science	03		
Total			**23**		
SEMESTER- II					
Core Course (CC)	MBT 201	Plant Systematics	04		
	MBT 202	Microbiology	04		
	MBT 203	Cytogenetics & Plant Breeding	04		
	MBT 204	Plant Ecology & Phytogeography	04		
	MBP 201	*Laboratory work based on course MBT 201 & 202*			02
	MBP 202	*Laboratory work based on course MBT 203 & 204*			02
Generic Elective/Open	GMBT02	Plant Diversity & Human Welfare	03		

Elective					
Total			**23**		
SEMESTER - III					
Core Course (CC)	MBT 301	Plant Physiology	04		
	MBT 302	Plant Biochemistry	04		
	MBT 303	Cell & Molecular Biology	04		
	MBT 304	Plant Biotechnology & Bioinformatics	04		
	MBP 301	*Laboratory work based on course MBT 301 & 302*			02
	MBP 302	*Laboratory work based on course MBT 303 & 304*			02
Discipline Specific Elective (Any one)	DMBT01	Conservation & Restoration Ecology	04		
	DMBT02	Agriculture Ecology: Principles & Applications			
	DMBT03	Applied & Environmental Microbiology			
	DMBT04	Climate Change & Environmental Management			
	DMBP01	*Field & lab works based on course DMBT01/ DMBT02/DMBT03/DMBT04*			02
Total			**26**		
SEMESTER - IV					
Core Course (CC)	MBT 401	Traditional Knowledge, Intellectual Property Right & Entrepreneurship Development	04		
	MBT 402	Bioresourse Utilization	04		
	MBP 401	*Field & lab works based on course MBT 401 & 402*			02
Discipline Specific Elective	DMB 05	Dissertation/Project Work	04	02	
# Excursion			02		
Total			**18**		
Grand Total (Semester I-IV)			**72**	**02**	**16**
			90		

The Excursion tour to different parts of the country for phyto-geographical study and observation/collection of plant materials will be undertaken any time in between III & IV Semesters. However, the study report will be evaluated during IV semester.

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

SYLLABI

(Based on CBCS Pattern)

Department of Botany
Faculty of Science

M.Sc. Programme in Botany

(Effective from 2015-2016)

MBT 101: PHYCOLOGY & BRYOLOGY

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit-I **12h**

Modern concepts of algal classification; distribution of algae in the diverse habitats, life cycle patterns in algae, algal blooms and phycoviruses.

Unit-II **12h**

Cyanophyta: cell structure, heterocyst and akinete development, chromatic adaptation, thallus organization and reproduction.

A brief account of Prochlorophyta, Euglenophyta, Eustigmatophyta, Prasinophyta, Xanthophyta, Chrysophyta, Bacillariophyta and Pyrrophyta.

Unit-III **12h**

A brief account of thallus organization, reproduction, evolutionary tendencies and economic importance of - Chlorophyta, Phaeophyta and Rhodophyta

Unit-IV **12h**

Bryophytes: General account, origin and evolution of heterotrichy in plants, theories on origin and evolution of bryophytes, evolution of sporophyte, fossil bryophytes

Unit-V **12h**

Comparative account of the gametophytes and sporophytes of Hepaticopsida, Anthocerotopsida and Bryopsida, Peristome structure and its significance in the classification of Mosses.

Suggested Readings:

1. Algae: An Introduction to Phycology, CVD Hoek & DG Chapman (1995), Cambridge University Press, Cambridge
2. The Structure and Reproduction in Algae, FE Fritsch (1935, 1948), Vol I & II, Cambridge University Press, Cambridge
3. An Introduction to the Algae, Ian Morris, Hutchinson University Press
4. The Biology of Algae, FE Round (1986) Cambridge University Press, U.K.
5. Introduction to Algae: Structure and Reproduction, Harnold C Bold, Michael J Wynne (1985), 2nd Edition, Prentice-Hall Inc.
6. Phycology, RE Lee (2008) Fourth edition, Cambridge University Press
7. Introduction to Phyclogy, GR South & Alan Whittick (1998) Blackwell Scientific Publication
8. Biology of Rhodophyta, R Dixon, Koelt Science Publisher, West Germany
9. An Introduction to Bryophytes, NS Parihar, Central Book Depot, Allahabad
10. Bryophytes: Morphology, Growth & Differentiation, P Puri,
11. Biology of Bryophytes, RN Chopra, PK Kumara (1988), Wiley Eastern Ltd.
12. Biology of Mosses, DHS Richardson (1981) Blackwell Scientific publications, Oxford.
13. Bryophyta, BR Vashishta, AK Sinha, A Kumar (2003). S Chand & Co. Ltd.
14. Bryophytic Biology, B Goffinet, A J Shaw (2009), second Edn, Cambridge University Press.

MBT 102: MYCOLOGY & PLANT PATHOLOGY

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**

A general account of fungi, principles of classification, mode of nutrition.
A brief account of Myxomycotina.
Mastigomycotina: General account with reference to Chytridiales, Blastocladiales, Saprolegniales and Pernosporales, hormonal regulation of sexuality in Mastigomycotina.

Unit - II **12h**

A general account of Zygomycotina
Ascomycotina: Thallus structure, spore producing organs and life cycle pattern with reference to Endomycetales, Protomycetales, Taphrinales, Eurotiales, Erysiphales, Sphaeriales and Pezizales

Unit - III **12h**

Basidiomycotina: General account with reference to Uredinales, Ustilaginales, Lycoperdales, Phallales, Agaricales, Aphyllophorales, Auriculariales, Lycoperdales and Nidulariales

Deuteromycotina: General account with reference to Sphaeropsidales, Melanconiales, Moniliales and mycelia sterilia

Unit - IV **12h**

Defense mechanisms of plants against infection: Preexisting structural and chemical defense, induced structural and chemical defense, hypersensitive reaction, role of phytoalexins and other phenolic compounds

Unit - V **12h**

Molecular plant pathology: Molecular aspects of host pathogen interactions - PR proteins, degradation of phytoalexins, systemic resistance mechanism
Symptoms, causal organisms, disease cycle and control measures of some of the important diseases of Sal and Teak.

Recommended Books:

1. Introductory Mycology, CJ Alexopoulos, CW Mims, M Blackwell (1996), JohnWiley & Sons.
2. The Fungi: An Advanced Treatise, GC Ainsworth, KF Sparrow, AS Sussman.
3. An Introduction to Fungi, HC Dube (1983), VikasPubl, New Delhi.
4. The Fungi, PD Sharma (2003), Rastogi Publications, Meerut
5. Fungi: Experimental Methods in Biology, R Maheshwari (2012), CRC Press, Boka Raton, Florida
6. Introduction to Fungi, J Webster & WS Roland (2007), Cambridge University Press.
7. A Text Book of Modern Plant Pathology, KS Bilgrami, HC Dube.
8. Plant Pathology, RS Mehrotra.
9. Fungi and Plant Disease, VK Gupta, TS Paul
10. Diseases of Crop Plants in India, Rangaswamy & Mahadevan.
11. Plant Pathology, GN Agrios (2006), fifth Edn, Elsevier Academic Press.
12. Molecular Plant Pathology, Dickinson CM (2003), Bios Scientific Publisher
13. Plant Pathology: Concepts and Laboratory Exercises, NT Robert, MT Windham, AS Windham (2003), CRC Press.
14. Plant Diseases, RS Singh (2008), Oxford and IBH Publishing Co. Pvt Ltd
15. Principles of Plant Pathology, RS Singh (2008), Oxford and IBH Publishing Co. Pvt Ltd.

MBT 103: PTERIDOPHYTES, GYMNOSPERMS & PALEOBOTANY

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**

Pteridophytes: Classification of Pteridophytes, evolution of vascular systems in plants, stellar system, telome concept, apogamy and apospory, heterospory and seed habits in Pteridophytes

Unit - II **12h**

Early vascular plants: Rhyniophyta, Trimerophytophyta, Zosterophylophyta, Lepidodendron, Lyginopteris.
Comparative morphology and anatomy of gametophytes and sporophytes of Psilopsida, Lycopsida, Sphenopsida and Filicopsida

Unit - III **12h**

Gymnosperms: Modern trends in classification of Gymnosperms, evolutionary tendencies among the Gymnosperms, distribution of Gymnosperms in India
General account of Glossopteridaceae and Cycadeoidea

Unit - IV **12h**

A comparative study of the vegetative (both morphological and anatomical) and reproductive structures (including mode of reproduction) in Cycadales, Coniferales, Taxales and Gnetales

Unit - V **12h**

Types of fossils, process of fossilization, techniques for studying fossil plants, relative age determination of fossils, and mode of the preservation of fossil plants.

Suggested Readings:

1. The Biology and Morphology of Pteridophytes, NS Parihar (1996), Central Book Depot, Allahabad.
2. Pteridology in the New Millennium, S Chandra, M Srivastava (2003), Kluwar Acad Publishers.
3. Morphology and Evolution of Vascular plants, EM Gifford, AS Foster (1989), third edition, WH Freeman & Co.
4. An Illustrated Fern Flora of West Himalayas (Vol I, II), SP Khullar (2000), International Book Distributers.
5. An Introduction to Pteridophytes, A Rashid (1976), Vikas Publishing House.
6. Morphology of Pteridophytes, KR Sporne (1982), Hutchinson University Press.
7. Cryptogamic Botany (Vol. II), G Smith (1972), Tata McGraw Hill Publications.
8. The Morphology of Gymnosperme, KR Sporne, B.I. Publications, New Delhi.
9. Gymnosperms, SP Bhatnagar, A Moitra (1996), New Age Int Pvt Ltd, New Delhi.
10. Gymnosperm Phylogeny, CE Beck (1995), Bot Rev, 51-176.
11. Gymnosperms, OP Sharma, S Dixit (2002), Pragati Prakashan.
12. Morphology of Gymnosperms. JM Coulter, CJ Chamberlain (1977), University of Chicago Press.
13. Palaeobotany. SN Agashe (1995), Oxford and IBH publishing House.
14. Introduction to Palaeobotany. CR Arnold (1977), McGraw Hill Book Com.

MBT 104: INSTRUMENTATION, TECHNIQUES & BIOSTATISTICS

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**

Microscopy: Bright-field microscope, Dark-field, Phase-contrast, Differential interference contrast, Fluorescence, Transmission and scanning electron microscopy, confocal microscopy

Unit - II **12h**

Chromatography: Thin layer, ion exchange, gel filtration, affinity chromatography, GLC, HPLC.
Spectroscopy: Beer-Lambert's law, molar extinction coefficient and calculation, Absorption spectrum, Colorimeter and UV-Vis Spectrophotometer, Nuclear Magnetic Resonance (NMR). ESI-MS, MALDI- TOF
Application of tracer techniques in biology, radioactive isotopes, autoradiography

Unit - III **12h**

Electrophoresis: Polyacrylamide Gel Electrophoresis (PAGE), Agarose Gel Electrophoresis (AGE), native-Page, SDS-PAGE, Isoelectric focusing (IEF), 2D-electrophoresis
Isolation and purification of genomic and plasmid DNA, RNA and proteins
Blotting Technique: Southern, Northern and Western blottings

Unit - IV **12h**

DNA Amplification: PCR, RT-PCR, genome mapping and expression analysis, RFLP, RAPD, AFLP, *In situ* hybridization, FISH, EST, Microarray

Unit - V **12h**

Biostatistics: Hypothesis testing (t-test, Chi-square test), R x C Contingency table, skewness, kurtosis and their measures, Analysis of variance (ANOVA) - One way and two way, post hoc test, correlation, regression.

Suggested Readings:

1. Biotechnology: A Laboratory Course, JM Becker, GA Caldwell, EA Zachgo (1996), Academic Press, Inc, San Diego,California
2. Principles and Techniques of Biochemistry and Molecular Biology, K Wilson, J Walker (1997), Cambridge University Press, Cambridge
3. Molecular Cloning: A Laboratory Manual, J Sambrook, EF Fritsch, T Maiatis (2000), Cold Spring Harbor Laboratory Press, New York
4. Molecular Biotechnology, SB.Primrose (1994), Blackwell Scientific Pub, Oxford.
5. Analysis of Genes and Genomes, RJ Reece (2004), Wiley
6. An Introduction to Practical Biochemistry, DT Plummer, third edition, Tata-McGraw Hill
7. Modern Experimental Biochemistry and Molecular Biology, R Boyer, second edition, Benjamin/Cumin
8. Physical Biochemistry, DM Freifelder, second edition, Freeman Press
9. Analytical Biochemistry, D Holme, J Peck, third edition, Tata McGraw Hill
10. Statistical methods, GW Snedecor, WG Cochran, eigth edition, East-West Press
11. Biomtery, RR Sokal, FJ Rohlf, third edition, Freeman
12. Statistical Methods, SP Gupta (1984), S Chand & Company.
13. Biostatistical Analysis, JH Jarr (2006), Prentice-Hall.

MBP 101: Laboratory work based on course MBT 101 & 102

Credit: 02
Maximum Marks: 50

Phycology:
Identification of the following genera:
Cyanophyceae - *Gloeocapsa, Gloeotrichia, Spirulina, Microcystis, Oscillatoria, Lyngbya, Anabaena, Nostoc, Rivularia, Scytonema*.
Chlorophyceae - *Chlamydomonas, Gonium, Eudorina, Pandorina, Volvox, Tetraspora, Ulothrix, Microspora, Ulva, Cladophora, Pithophora. Coleochaete, Chaetophora, Drapernaldia, Drapernaldiopsis, Trentepohlia, Fritschiella, Oedogonium, Bulbochaete, Zygnema, Mougeotia, Sirogonium. Desmedium, Bryopsis, Codium, Caulerpa, Chara, Nitella*
Xanthophyceae - *Vaucheria*
Bacillariophyceae - *Navicula, Pinnularia*
Phaeophyceae – *Ectocarpus, Dictyota, Pediana, Sargassum, Turbinaria*
Rhodophyceac - *Batrachospermum, Gelidium, Amphiroa, Gracilaria, Polysiphonia*

Bryology:
Identification of the following genera (using morphological, anatomical and reproductive features) - *Plagiochasma, Marchantia, Porella, Anthoceros, Sphagnum, Funaria, Polytrichum*

Excursion: Collection of local algae and bryophytes from different habitats

Mycology:
Critical study of the following genera, with help of suitable micro-preparations -
Saprolegnia, Phytophthora, Albugo, Mucor, Aspergillus, Penicillium, Pilobolous, Saccharomyces, Rhizopus, Curvularia, Fusarium, Colletotrichum. *Xylaria, Peziza, Puccinia, Termitomyces, Pleurotus, Auricularia, Polyporus, Lycoperdon, Cyathus, Fusarium, Alternaria, Cladosporium, Pestalotia, Graphis, Parmelia, Cladonia, Usnea*

Plant Pathology:
Identification of causal organisms through suitable micro-preparations, identification of the diseases with emphasis on symptoms and causative organisms of diseases of Sal and Teak trees

Field trips: collection and identification of common diseases of tree plants of the region.
Microscopic study of plant-pathogen interactions using stained sections of diseased materials

MBP 102: Laboratory work based on course MBT 103 & 104.

Credit: 02
Maximum Marks: 50

Pteridophytes:

1. Morphological and anatomical study of the vegetative and reproductive parts of the following genera, with the help of whole mounts/sections - *Lycopodium, Selaginella, Equisetum, Marsilea, Salvinia, Azolla, Lygodium, Gleichenia, Pteris, Adiantum, Polypodium* etc.
2. Study of fossil Pteridophytes with the help of specimens and permanent slides

Gymnosperms:

1. Morphological and anatomical study (through C.S., RLS & TLS) of vegetative and reproductive parts of following genera – *Cycas, Pinus, Araucaria, Ephedra, Gnetum* etc.
2. Study of fossil gymnosperms through specimens and permanent slides.
3. Field trip to Ghughua Fossil Park to familiarize students with fossil Pteridophytes and Gymnosperms

Instrumentation, Techniques & Biostatistics:

1. Micrometry: Calibrate the ocular micrometer stage micrometer on a light microscope and measurement of the size of an object (e.g., diameter of spore/pollen grains, width of algal filaments)
2. Estimate the concentration of a given sample using calorimeter or spectrophotometer.
3. Prepare a plant extract and perform TLC
4. Calculation of standard deviation and standard error from a given data
5. Test the significance of a given data using t-test, X^2 test, F-test and ANOVA
6. Determination of probability for different types of events.

MBT 201: PLANT SYSTEMATICS

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**

Taxonomic principles and procedures, botanical nomenclature: binomial system, ICN rules and recommendations, priority, typification, rules of effective and valid publications, retention and rejection of names and epithets; Herbaria: concepts and function

General outline and comparative study of Takhtajan, Hutchinson, Cronquist and Angiosperm Phylogenic Group (APG) classifications; their merits and demerits

Unit - II **12h**

Taxonomic features, systematic phylogeny and economic importance of following dicot families: Ranunculaceae, Magnoliaceae, Caryophyllaceae, Solanaceae, Convolvulaceae, Brassicaceae, Malvaceae, Rosaceae, Fabaceae, Lamiaceae, Asteraceae, Euphorbiaceae, Amaranthaceae, Lentibulariaceae, Droseraceae and Balanophoraceae

Unit - III **12h**

Taxonomic features, systematic phylogeny and economic importance of following monocot families**:** Orchidaceae, Zingiberaceae, Araceae, Liliaceae, Musaceae, Cyperaceae and Poaceae

Unit - IV **12h**

Changing trends in plant taxonomy: Molecular approaches to plant taxonomy: molecular phylogeny, Angiosperm phylogeny groups; Numerical taxonomy; Chemotaxonomy; Embryology in relation to taxonomy, role of cytological data and anatomical characters in taxonomic studies

Unit - V **12h**

Species concept in taxonomy, isolating mechanism and speciation; Adaptive radiation in angiosperms

Suggested Readings:

1. Principle of Angiospermic Taxonomy, PH Davis, VH Heywood (1991), Today & Tomorrow Publications, New Delhi
2. Fundamentals of Plant Sytematics, AE Radford (1986), Harper & Row Publications, USA.
3. Principles of Plant Taxonomy, VV Sivarajan (1999), Oxford & IBH Publishing Co., New Delhi.
4. Contemporary Plant Systematics, DW Woodland (1991) Prentice Hall, New Jersey
5. Plant Taxonomy, OP Sharma (2009) Tata McGraw Hill, Mumbai
6. Taxonomy of Angiosperms, BP Pandey (2007) S Chand & Co., New Delhi
7. Plant Systematics - Theory and Practices, Gurucharan Singh, Oxford and I.B.H. Publishing Co. New Delhi
8. Embryology of Angiosperms, SS Bhojwani & SP Bhatnagar, Vikash Publishing House, New Delhi
9. Plant Systematics: A Phylogenetic Approach WS Judd, S Christopher, Campbell, AE Kellogg, PF Stevens (1999), Sinauer Associates Inc. Publishers.
10. Plant Systematics, MG Simpson (2006), Elsevier Academic Press.
11. Variations and Evolution in Plants: G L Stebbins

MBT 202: MICROBIOLOGY

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**

A brief idea of microbial diversity: present status and future challenges; principle of bacterial taxonomy, Bergey's manual, rRNA sequencing, DGGE and molecular phylogeny, a general account of Archaea, Actinomyctes and Mycoplasma

Unit - II **12h**

Nutritional types of microorganisms, symbiotic and non-symbiotic nitrogen fixation, *Rhizobium*-legume symbiosis and mycorrhiza

Unit - III **12h**

Anoxygenic photosynthesis with special reference to light reaction in purple bacteria, methanogenesis

Genetics of bacteria: Genetic recombination- an overview; mechanisms of transformation, conjugation and transduction in bacteria, role of microorganisms in agriculture and medicines

Unit - IV **12h**

Lytic cycle in T even phages and its regulation; lysogeny and its regulation in lambda phage; a brief account of viroids and prions

Unit - V **12h**

Culture media, sterilization and disinfection, isolation, cultivation and maintenance of microorganisms, batch culture, synchronous culture and continuous culture methods, bacterial growth curve and factors affecting growth rates.

Fermentation process and downstream processing; Basic design of a fermentor.

Suggested Readings:

1. General Microbiology, HG Schlegel (2001), Cambridge University Press, UK
2. Microbiology: An Introduction, GJ Tortora, BR Funke, CL Chess (2003), Benjamin Cummins.
3. Foundations in Microbiology, KP Talaro, B Chess (2011), 8th edition, McGraw-Hill.
4. General Microbiology, RY Stanier, JL Ingraham, ML Wheelis, PR Painter (1994), The McMillan Press Ltd. London
5. An Introduction to Microbiology, P Tauro, KK Kapoor, KS Yadav (1997), New Age International Pvt Ltd, New Delhi
6. A Text Book of Microbiology, RC Dubey, DK Maheswari (1999), S Chand & Sons, New Delhi
7. Microbiology: A Text Book of Microorganisms, General & Applied, CH Marshall (2012), General Books Ltd.
8. A Textbook of Basic & Applied Microbiology, KR Aneja, P Jain, R Aneja (2009), New Age International Pvt Ltd, New Delhi
9. A Textbook of Industrial Microbiology, J Cruger (2004), Panima Publishing Corporation, New Delhi
10. Brock Biology of Microorganisms, MT Madigan, JM Martinko, PV Dunlap, DP Clark (2011), 13th edition, Pearson Education Inc.
11. Prescott's Microbiology, JM Willey, L Sherwood, CJ Woolverton (2010), 8th edition, McGraw-Hill.

MBT 203: CYTOGENETICS & PLANT BREEDING

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**
Cell cycle: control mechanism, role of cyclins and cyclin-dependent kinesis
Mitosis: stages, mitotic apparatus, cytokinesis
Meiosis: stages, synaptonemal complex
General account of cell-cell interaction

Unit – II **12h**
Chromatin organization and replication: Nucleosome and higher order organization, conformational changes and genetic activity, assembly/disassembly of histones during replication.
Karyotype analysis, chromosome-banding patterns: Linear differentiation of chromosome segments, types of chromosome banding, uses of chromosome banding in cytogenetics

Unit – III **12h**
Modifications of Mendelian inheritance, linkage and crossing over, cytoplasmic inheritance, mechanisms of sex determinations in plants, linkage groups, sex-linked inheritance, X-chromosome inactivation

Unit – IV **12h**
Structural and numerical changes in chromosome, polyploidy and evolution, spontaneous and induced mutations, physical and chemical mutagens, molecular basis of spontaneous and induced mutations, transposable elements

Unit - V **12h**
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 multiple crosses, mutation breeding

Suggested Readings:

1. The Cell: A Molecular Approach, GM Cooper (2000), Oxford University Press
2. Cell and Molecular Biology, G Karp (2002), John Wiley & Sons
3. Molecular Cell Biology, H Lodis (2000), WH Freeman Ltd.
4. The Cell Biology, SR Bolsover *et al* (2004), John Wiley & Sons. UK
5. The Cell, K Rogers (2011), Britannica Educational Publishing, UK
6. Cell & Molecular Biology, EDP DeRobertis, EMF DeRobertis (2001), Lippineott Williams & Wilkins, Bombay.
7. Principles of Genetics, DP Snustad, MJ Simmons (2000), John Wiley & Sons Inc. USA.
8. Cytogenetics, PK Gupta, Rastogi Publication.
9. Principles and Procedures of Plant Breeding: Biotechnological & Conventional Approaches, GS Chahal, SS Gosal, Narosa Publishing House, New Delhi.
10. Plant Breeding: Analysis and Exploitation of Variation, D Roy (2000), Narosa Publishing House, New Delhi.
11. Essentials of Plant Breeding, P Singh (2001), Kalyani Publishers, Hyderabad
12. Plant Breeding, BD Singh (1994), Kalyani Publications, New Delhi.

MBT 204: PLANT ECOLOGY & PHYTOGEOGRAPHY

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**
Autecology and Population concepts: Characteristics, dynamics, density dependent and independent factors; population control

Unit - II **12h**
Vegetation organization and characteristics: Concepts of community and continuum; community coefficients, ordination, ecological niche, species diversity (α, β, γ)

Unit - III **12h**
Ecosystem organization: Structure and functions, primary production (methods of measurement, global pattern, controlling factors); energy dynamics (trophic organization, energy flow pathways, ecological efficiencies), decomposition (mechanism, controlling factors), comparative account of nutrient cycles

Unit - IV **12h**
Ecosystem stability: Concept (resistance and resilience), ecological perturbations (natural and anthropogenic) and their impact on ecosystems, ecology of plant invasion

Ecological succession: Models and mechanisms of ecological succession, changes in ecosystem properties during succession

Unit - V 12h
Phytogeography: definition and scope, Continental drift, endemism, factors governing distribution of plants, phytogeographical regions of India, plants endemic to Indian subcontinent.

Suggested Readings:

1. Fundamentals of Ecology, EP Odum (1996), Natraj Publishers, Dehradun
2. A Text Book of Plant Ecology, RS Ambasht (1990), Students Friends Publishers, Varanasi
3. A Textbook on Ecology & Environmental Science, PP Mahendran, P Rajan (2008), Agrotech Publishing Academy
4. Ecology, M Begon, JL Harper, CR Townsend (1996), Blackwell Science, Cambridge, USA.
5. Ecology and Environment, PD Sharma (2001), Rastogi Publications, Meerut

MBP 201: Laboratory work based on course MBT 201 & 202**.**

Credit: 02

Maximum Marks: 40

Taxonomy:

1. Study of at least two members from each family with suitable sketches and description in technical terms
2. Description of specimens from locally available representative families
3. Collection and study of specimens for intra-specific variation
4. Field trips to nearby areas, compilation of field notes and preparation of herbarium sheets from collected plants (wild as well as cultivated)
5. Use of floras and herbarium for the identification (up to genus level) of specimens

Microbiology:

1. Sterilization, preparation of media, inoculation and staining (Gram staining)
2. Isolation of bacteria from soil, air and water; Streaking onto an agar plate and isolation of colonies
3. Isolation and enumeration of actinomycetes and fungi from rhizospheric soils and seeds.
4. Isolation of *Rhizobium* bacterioids from legume root nodules
5. Antibacterial assay – disc-diffusion/agar-well method.
6. Oxidase test, Catalase test, Litmus milk test, Hydrogen Sulphide test
7. Carbohydrate fermentation test, Multiple-Tube Fermentation test.
8. Isolation of streptomycin – resistant mutants of bacteria
9. Screening and isolation of microbes for the production of organic acids and enzymes

MBP 202: Laboratory work based on course MBT 203 & 204

Credit: 02

Maximum Marks: 50

Ecology:

1. Determination of minimum quadrate size by species area curve method
2. Determination of minimum quadrate number by species area curve method
3. Determination of frequency of various species by quadrate method and preparation of frequency diagram
4. Determination of plant density by quadrate method
5. Determination of species abundance by quadrate method
6. Determination of relative frequency by quadrate method
7. Determination of relative density by quadrate method
8. Determination of basal area by quadrate method
9. Determination of relative dominance by quadrate method
10. Determination of IVI by quadrate method
11. Determination of community coefficient of two sties by quadrate method
12. Quantitative and qualitative community analysis: Carry out a project to determine the vegetative structure using characteristics such as frequency, abundance, density of different species and similarity index of different communities in a natural system
13. Field visit to natural ecosystems, identification of trophic levels, food webs and food chains

Cell Biology:

1. Preparation of fixatives and nuclear strains
2. Study of mitosis in plant material
3. Study of meiosis in pollen mother cell
4. Study of meiosis of translocation heterozygote, observation of special types of chromosomes, salivary gland chromosomes
5. Study of characteristics and behavior of B chromosomes using maize or any other appropriate material
6. Study of chromosomal aberration from micro-preparations and photo-micrographs
7. Observation of ultrastructural details of organelles (Photographs)

Genetics & Plant Breeding:

1. Induction of polyploidy using colchicines
2. Solving genetic problems laws of inheritance, gene interaction, recombination and gene mapping.
3. Use of hybridization techniques in self and cross-pollinated plants.

MBT 301: PLANT PHYSIOLOGY

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**

Water and Mineral transport: water potential, mechanism of water transport through xylem, uptake and transport of ion and solutes across membranes (passive and active transport)
Phloem transport: mechanisms of loading and unloading of photo-assimilates

Unit - II **12h**

Photosynthesis: Basic principles of light absorption, light harvesting complexes, excitation energy transfer, photo-oxidation of water, mechanism of electron and proton transport, carbon assimilation- C_3, C_4 and CAM pathways of CO_2 fixation, photorespiration.

Unit - III **12h**

Respiration: Glycolysis, TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, alternative oxidase system

Unit - IV **12h**

Plant growth regulators: Biosynthesis, storage and mechanism of action of plant growth hormones (Auxins, Gibberellins, Cytokinins, Abscisic acid, Ethylene and Brassinosteroids), hormone receptors, signal transduction and gene expression

The flowering process: Photoperiodism and its significance, endogenous clock and its regulation, initiation of flower primordial and its development, flowering stimulus, vernalization

Unit - V **12h**

Sensory Photobiology: structure and function of phytochrome, phytochrome induced plant responses, molecular mechanism of phytochrome action, cryptochrome and its role in photomorphogenesis
Seed germination and seed dormancy, climacteric fruit ripening
Leaf senescence, physiological effect of salt and water stress, heat stress and heat shock proteins.

Suggested Readings:

1. Seed Physiology and Biochemistry, JD Bernle, M Black (1992), Springer-Verlag.
2. Introduction to Plant Physiology, WG Hopkins, NPA Hunter (2009), fourth edition, John Wiley & Sons, USA.
3. Photosynthesis, DW Lender (2001), Mercel Deker.
4. Plant Physiology, L Taiz, E Zeiger (2010), fifth edition, Sinurer Associates.
5. Plant Physiology, S Mukherji, AK Ghosh (1996), Tata McGraw Hill.
6. Introductory Plant Physiology, GR Noggle, CJ Fritz (1989), Prentice Hall
7. Biochemistry and Physiology of Plant Hormones, TC Moore (1989), Springer Verlag, New York, USA,

MBT 302: PLANT BIOCHEMISTRY

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**

Law of mass action, dissociation of water and its ion product (K_w), pH, ionization of weak acids and weak bases, the Henderson-Hasselbalch equation, physiological buffers

Biochemical energetics: General concept, laws of thermodynamics, entropy, enthalpy, free energy, redox-potential, energy rich phosphorus compounds, ATP as universal currency of energy

Unit - II **12h**

Biosynthesis and degradation of carbohydrates in higher plants
Structures of protein, Ramchandran plot
Biosynthesis of fatty acids, β-oxidation of fatty acids, glyoxylate cycle

Unit - III **12h**

Enzymology: General aspects, prosthetic groups and coenzymes, mechanism of catalysis, kinetics, Michaelis-Menton equation, bi-substrate reactions, active sites, factors contributing to the catalytic efficiency, enzyme inhibition, regulatory enzymes, isoenzymes, ribozymes

Unit - IV **12h**

Biological nitrogen fixation: Nitrogenase enzyme, substrates for nitrogenase, reaction mechanism, regulation of nitrogenase. Inorganic nitrogen metabolism: Introduction, nitrate transport, nitrate and nitrite reductases, inhibitors, localization and regulation of nitrate and nitrite reductases, pathways of ammonia assimilation, regulation of nitrogen assimilation

Unit - V **12h**

Sulphur and phosphorus metabolism: Sulphate uptake, activation and transfer, assimilatory pathways of sulphate reduction, transport and assimilation of phosphate.

Suggested Readings:

1. Plant Biochemistry, PM Gressholf (2000), John Wiley.
2. Plant Biochemistry, PM Dey, JB Harborne (2000), Academic Press.
3. Concept in Biochemistry, R Boyer R (1999), Brooks/Cole Publ.
4. Biochemistry and Molecular Biology of Plants, B Buchanan, W Gruissem, RL Jones (2004), Amer. Soc. Plant Physiol.
5. Outlines of Biochemistry, EE Conn, PK Stumpf (1994), Wiley Eastern.
6. Plant Metabolism, DT Dennis (1998), Longman.
7. Plant Biochemistry and Molecular Biology, H Heldt (1997), Oxford Univ Press.
8. Plant Biochemistry and Molecular Biology, PJ Lea, RC Leagood (1999), Wiley.
9. Lehningers Principles of Biochemistry, DL Nelson, MM Cox (2008), fifth edition, W. H. Freeman & Co, New York, USA
10. Biochemistry, L Stryer (1993), W.H. Freeman.
11. Biochemistry, G Zubay (1993), W.C. Brown.
12. Biochemistry, JM Berg, JL Tymoczko, L Stryer (2011), Seventh Edition, Freeman & Co. New York, USA.

MBT 303: MOLECULAR BIOLOGY

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**

DNA double helix, supercoiling, denaturation, fine structure of gene, coding and non-coding sequences, repetitive sequences, satellite DNA, overlapping gene

Unit - II **12h**

DNA replication: creation of replication fork in prokaryotes and eukaryotes, elongation and termination of replication in prokaryotes and eukaryotes, rolling circle and D-loop models of DNA replication, DNA polymerases, ligases, topoisomerases

Unit - III **12h**

Protein Synthesis: Transcription and translation, reverse transcription
RNA Processing: Post-transcriptional processing of rRNA, tRNA and mRNA among eukaryotes
Genetic code, post-translational modifications
Protein Targeting and Sorting: Concept of signal peptide, Signal recognition particle (SRP), SRP receptor, transport of soluble and membrane bound proteins in Endoplasmic Reticulum

Unit - IV **12h**

DNA recombination (Holliday model), DNA damage and repair (Photo repair and excision repair), Molecular mechanism of apoptosis

Unit - V **12h**

Cellular Receptors and Signaling: Cell surface receptors, Signaling via G-Protein Linked receptors, cAMP, IP_3, Diacylglycerol as second messengers, adenylate cyclase system, inositol phosphate pathway, role of Ca^{2+} ions in signaling process, signal transduction via enzyme-linked surface receptors, receptor tyrosine kinases, steroid receptors.

Suggested Readings:

1. Molecular Biology of the Cell, B Alberts *et al.* (2002), Gerland.
2. Biochemistry and Molecular Biology of Plants, BB Buchanan *et al.* (2004). Amer. Soc. Plant Physiol.
3. Genes VIII, B Lewin (2002), Oxford.
4. DNA Structure and Function, PRR Sinden (1994), Academic Press.
5. Molecular Biology and Biotechnology, JM Walker, R Rapley (2002), Panima.
6. Molecular Biology of the Gene, JD Watson *et al.* (2004), Pearson Education.
7. Molecular Cell Biology, H Lodish *et al.* (2000), WH Freeman and Co., New York, USA.
8. Instant Notes on Molecular Biology, PC Turner, AG McLennan, AD Bates, MRH White (2001).

MBT 304: PLANT BIOTECHNOLOGY & BIOINFORMATICS

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**

Plant cell and tissue culture: Concept of cellular differentiation and totipotency
Somatic Embryogenesis: Induction and controlling factors,
Organogenesis: Process, molecular mechanism of organogenesis and its controlling factors,
Haploids: Androgenic and gynogenic, role of haploids and polyploids in plant improvement

Unit - II **12h**

Isolation, culture and fusion of protoplasts, regeneration of hybrids and cybrids
Clonal propagation: Micropropagation; somaclonal and gametoclonal variation and their selection; artificial seeds, cryopreservation

Unit - III **12h**

Gene cloning: Enzymes used in gene cloning, cloning and expression vectors, method of transformation, selection, identification, recombinant DNA libraries

Unit - IV **12h**

Plant genetic engineering: *Agrobacterium*-mediated gene transfer, Ti plasmid, co-integrate and binary vectors, plant viruses as vector, direct DNA transfer techniques, selection of transgenics, advantages and disadvantages of transgenic plants, molecular farming

Unit - V **12h**

Bioinformatics: Bioinformatics in genome sequencing and annotation; Databases - NCBI, EMBL, DDBJ, Genbank, Pubmed, Patent databases, TAIR, PDB, ATIDB.
Online tools - BLAST, ORF finder, Primer3, protein motif and structure prediction tools.

Suggested Readings:

1. Plant Tissue Culture: Theory and Practice, SS Bhojwani, MK Razdan (1996), a revised edition, Elsevier Science Publishers, New York, USA.
2. Plant Tissue Culture: Applications and Limitations, SS Bojwani (1990), Elsevier Science Publisher, New York, USA.
3. Plant Cell Culture, HA Collins, S Edwards (1998), Bios Scientific Publishers, Oxford, UK.
4. Plant Tissue Culture: Techniques and Experiments, RD Hall (1999), Academic Press, New York.
5. Cryopreservation of Plant Cells and Organs, KK Kartha (1985), CRC Press, Boca Raton, Florida.
6. Plant Cell and Tissue Culture, IK Vasil, TA Thorpe (1994), Kluwer Academic Press, The Netherlands.
7. Biotechnology: Fundamentals and Applications, SS Purohit (2000), Agrobios, New Delhi.
8. Plant propagation by tissue culture, Volume 1, EF George, MA Hall, G-J De Klerk, (2008), The background (3rd ed.), Dordrecht: Springer.
9. Plant Tissue and Cell Culture, HE Street (1973), Blackwell Scientific Publ., London
10. Cell Culture and Somatic Cell Genetics of Plants, Vol. 5, F Constabel, Academic Press, Inc.
11. Plants from Test Tubes: An Introduction to Micropropagation, L Kyte, J Kleyn (1996)
12. Introduction to Bioinformatics, TK Attwood, DJ Parry-Smith (2004), Pearson Education (Singapore) Pvt. Ltd.
13. Plant Bioinformatics: Methods and Protocols, David Edwards (2007), Humana Press, New Jersey, USA.

MBP 301: Laboratory work based on course MBT 301 & 302.

Credit: 02
Maximum Marks: 50

Plant Physiology:

1. Determination of water potential.
2. Determination of osmotic potential by tissue weight method.
3. Demonstration of osmosis by using egg membrane.
4. Determination of osmotic potential of cell sap by plasmolytic method.
5. Effect of osmotic potential of external solution on the rate of imbibition.
6. Determination of stomatal index, frequency and pore area.
7. Effects of chemicals and temperature on the permeability of protoplasmic membrane.
8. Effect of various environmental factors on rate of photosynthesis.
9. Determination of gibberellic acid by half seed (cereal) method.
10. Effects of hormones on senescence.
11. Seed viability test.
12. Separation of anthocyanin pigment by paper and thin layer chromatography
13. Assay of auxin activity by *Avena* hypocotyl elongation
14. Assay of amylase induction by GA in plant tissues
15. Assay of effect of cytokinin on chlorophyll degradation by leaf disc method.

Biochemistry:

1. Preparation of buffers of various strength and pH.
2. Preparation of molal, molar, normal and percentage solutions and their dilutions.
3. Determination of reducing sugars of fruits by Nelson Somogyi's method
4. Estimation of starch from plant tissues by iodine reaction
5. Estimation of sugars from plant tissues by dinitrosalycilic acid
6. Qualitative tests for carbohydrates (Iodine, Anthrone, Fehlings, Benedict etc.)
7. Estimation of amino acids from plant tissues by ninhydrin reaction
8. Assay of phosphatase activity in plant cells
9. Assay of nitrate reducatase activity in cells
10. Preparation of standard curve of proteins (BSA) and estimation of protein content in extracts of plant material by Bradford's method.
11. Determination of specifications value of fats and oils
12. Determination of Vmax and Km
13. Determination of catalase activity
14. Demonstration of polyphenol oxidase.
15. Separation of photosynthetic pigments, lipids and amino acids by TLC/paper chromatography and calculating the Rf value
16. Demonstration of amylase activity and GA effect in germinating cereal seeds.
17. Effect of substrate concentration on activity of any enzyme and determination of its Km value.

MBP 302: Laboratory work based on course MBT 303 & 304.

Credit: 02
Maximum Marks: 50

Molecular Biology:

1. Assignments on related topics.
4. Separation of soluble proteins by (a) gel filtration (b) gel electrophoresis
2. Analysis of protein profiles through SDS-PAGE.
3. Isolation of plant DNA and its quantification by spectrophotometric method.
4. Isolation of DNA, and preparation of 'cot' curve.
5. Restriction digestion of plant DNA, its separation by agarose gel electrophoresis and visualization by ethidium bromide staining.
6. Isolation of RNA and quantification by spectrophotometric method.
7. Separation of plant RNA by agarose gel electrophoresis and visualization by EtBr staining.

Plant Biotechnology:

1. Media preparation (e.g., MS medium, White's Basal Medium).
2. Surface sterilization
3. Micro-propagation technique
4. Inoculation of seeds of *Cajanus cajan* on agar medium.
5. Determination of dry and fresh weight of *in vitro* seedlings of *Cajanus cajan*
6. Organogenesis and somatic embryogenesis using appropriate explants.
7. Isolation of protoplasts from various plant tissues and testing their viability
8. Demonstration of protoplast fusion employing PEG.
9. Demonstration of androgenesis in *Datura*.

MBT 401: TRADITIONAL KNOWLEDGE, INTELLECTUAL PROPERTY RIGHTS & ENTERPRENURSHIP DEVELOPMENT

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit – I **12h**

Methods of ethnobiological study, Definition of Traditional Knowledge (TK), Traditional Knowledge Resource Classification (TKRC), importance of traditional knowledge, Traditional plant knowledge of Indian tribes - sources and problems with reference to central India, Traditional Knowledge Digital Library (TKDL)

Unit – II **12h**

Bioprospecting at species level, biopiracy, World Trade Organisation (WTO) and TK, provisions of Conventions on Biological Diversity (CBD) related to traditional knowledge
Entreprenureship development based on ethnic knowledge of wild plants (aromatic and medicinal)

Unit - III **12h**

Intellectual Property Rights (IPR): Definition & types of IPR, general account and importance of patents, copyrights (plants, utility and design) trademarks, geographical indicators and trade secret etc.

Unit - IV **12h**

Indian patent Act: conditions for patenting, provisional and complete specification, procedure for obtaining patents, international and national laws on patents, organization of patent offices in India, World Intellectual Property Organization (WIPO) and its role

Unit - V **12h**

Commercial cultivation of edible mushrooms (*Agaricus*, *Pleurotus* and *Volvariella)*, nursery and floriculture management, sericulture, bonsai techniques, marketing strategies of plants and their products.

Suggested Readings:

1. TKDL (www.tkdl.res.in) online resources
2. WIPO online resources (www.wipo.int)
3. Mushroom Cultivation in India, BC Suman V Sharma, B Suman & VP Sharma (2007), Daya Publisher, New Delhi.
4. Mushrooms: Cultivation, Nutritional Value, Medicinal Effect, and Environmental Impact, PG Miles, S-T Chang (2004), CRC Press.

MBT 402: BIORESOURCE UTILIZATION

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**

Definition and classification of bioresources, their commercial exploitation, Access and Benefit Sharing (ABS), concept of sustainable development, conservation strategies of plant resources (*in-* & *ex-situ* conservation).

Unit - II **12h**

Origin of agriculture, primary and secondary diversity centers of cultivated plants, sources of variation, selection, crop domestication, and introduction of crop plants

Unit - III **12h**

A general account including cultivation and uses of major cereals, oil seeds, legumes, medicinal plants, forage and fodder crops, timber and non-timber (gums, resin, oil yielding) plants used by the tribes of central India, Bioenergy plants

Unit-IV **12h**

Diagnostic features, bioactive molecules and therapeutic values of some ethno-medicinally important plants - Giloy, Brahmi, Safed Musli, Kalmegh, Satavari, Bel, Sarpgandha, Ashwagandha, Kali haldi
Standardization of herbal drugs, Nutraceuticals and medicinal foods

Unit - V **12h**

Microbial Biofertilizers: Definition and types, importance of biofertlizers in agriculture.
Mass multiplication and use of blue-green algae, *Rhizobium, Azotobacter*, *Azospirillum* and *Azolla*.
Mycorrhizal fungi: benefits of mycorrhizal association, ecto- and endomycorrhiza.
Fungi as biopesticides, industrially important fungal enzymes.

Suggested Readings:

1. Cyanobacteria: An Economic Perspective, NK Sharma, AK Rai, LJ Stal (2014), Wiley-Blackwell, UK.
2. Natural Products from plants, PB Kaufman, LJ Cseke, S Warber, JA Duke, HL Brielmann (1998), CRC Press, Boca Raton, USA, pp 343
3. Economic Botany: Principles & Practices, GE Wickens (2004), Springer.
4. Mycorrhizal Symbiosis, SE Smith & DJ Read (2010), Academic Press, pp 800
5. Mycorrhiza: Role & Applications, VS Mehrotra (2005), Allied Press, New Delhi, pp 359
6. Medicinal and Aromatic Plants in India, S Maiti & KA Geetha (2008), An e-book may be downloaded from http://nsdl.niscair.res.in/dspace/handle/123456789/742.
7. The Useful Plants in India, publication by CSIR, New Delhi
8. Hills Economic Botany, OP Sharma (1996), Tata McGraw Hill, New Delhi.
9. Essentials of Conservation Biology, RB Primack (1993).
10. Fungi: Biology and Applications, Kevin Kavanagh (2011), John Wiley & Sons, UK.
11. Cultivation of selected medicinal plants published by National Medicinal Plant Board 36, Janpath, New Delhi.
12. Herbal Drugs, SC Mandal, New Central Book Agency, New Delhi.
13. A Hand Book of Medicinal Plants, ND Prajati, SS Purohit, Agrobios (India) Jodhpur.
14. Biofertlizers Technology, S Kannaiyan, K Kumar, K Govindrajan (2007), Saujanya Books, New Delhi.

MBP 401: Field & lab works based on course MBT 401 & 402.

Credit: 02

Maximum Marks: 50

1. Visit to nearby tribal area to study the plant material used by local tribes as- cereals, oil-seeds, legumes, timber etc.
2. Collection of materials used by tribal for sustenance.
3. Morphological and histochemical features of cereals, oil seed, legumes and forest trees
4. Identification of important medicinal plants of the locality, common techniques used by tribes to extract active molecules from the plants and parts thereof.
5. Identification of poisonous and non-poisonous mushrooms
6. Study of mycorrhizal specimens.
7. Study of *Azolla*

DMBT01: CONSERVATION & RESTORATION ECOLOGY

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit – I **12h**

Introduction to conservation Ecology: Principles, postulates and ethics

Population dynamics and conservation: Genetic variation and its loss, variation in natural populations, mechanisms of population regulation, habitat specific demography, population viability analysis

Unit – II **12h**

Species and habitat conservation: Prioritizing species and habitats, protected area networks, theory of reserve design

Unit – III **12h**

Conservation strategies: Planning and management, plan process for species and site management, general principles of management, models of sustainable development

Unit – IV **12h**

Ecology of disturbed ecosystems: Ecosystem dynamics and stability, disturbances, impact of disturbances on the structure and functioning of terrestrial ecosystems, process of ecosystem recovery.

Unit – V **12h**

Aims and strategies of restoration: Concepts of restoration, ecosystem reconstruction, major tools used in restoration.

Threatened species, Red Data Book.

Degradation and restoration of biological diversity & natural ecosystems.

Suggested Readings:

1. Ecosystem Rehabilitation, Mohan K. Wali (1992), SPB Academic Publishing, The Hague, The Netherlands
2. Restoration of degraded land: concepts & strategies, JS Singh (1993), Rastogi Publications, Meerut
3. The Balance of Nature? Ecological Issues in the Conservation of Species and Communities, Stuart L. Pimm (1991), The University of Chicago Press, USA
4. Ecology and Field Biology, Robert L. Smith (2001), Benjamin Cummings
5. Essentials of Conservation Biology, Richard B. Primack (2010), Fifth Edition, Sinauer Associates Inc, USA.
6. Principles of Conservation Biology, Gary K. Meffe & C. Ronald Carroll (2006), Third Edition, Sinauer Associates Inc, USA,

DMBT02: AGRICULTURAL ECOLOGY: PRINCIPLES AND APPLICATIONS

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**
Basic chemical process-carbon cycle, climate and adaptation of agricultural crops, physical factors affecting crop-water, energy flow in agro-ecosystems
Decomposition: beneficial soil organisms, plant succession and competition

Unit - II **12h**
Soil type and classification, soil properties and environmental factors, Nitrogen in agroecosystems, fertilizer elements in the environment, macro and micronutrients and their availability to crops

Unit - III **12h**
Weed ecology and management, agricultural pests and insects, and their population dynamics
Pesticides and the environment
Traditional knowledge systems and agro-diversity management

Unit - IV **12h**
Plant disease and environment: integrated pest management, conservation of genetic resources, cropping systems and agro-ecosystems in the landscape, crop rotation and cover crops, intercropping, conservation tillage, mulches and organic amendments, Dry-land agriculture

Unit - V **12h**
Impacts of salinity, intensive agriculture and GMOs on crop biodiversity and yield, impact of agricultural policies on crop biodiversity and agro-ecology, human population growth and sustainable agriculture.

Suggested Readings:

1. Agroecology: The Ecology of Sustainable Food Systems, Technology & Engineering, SR Gliesmann (2006).
2. Field and Laboratory Investigations in Agroecology. Technology & Engineering, SR Gliesmann (2006).
3. Landscape Agroecology, Paul A. Wojtkowski (2004), Haworth Press, Inc., New York.
4. Agroecology in Action: Extending Alternative Agriculture Through Social Networks, KD Warner (2007), The MIT Press, Cambridge, Massachusetts, USA.

DMBT03: Environmental & Applied Microbiology

Credit: 04
End-Term Examination Marks: 60
Continuous Internal Assessment Marks: 40

Unit - I **12h**
Microbes as tools for understanding the biological processes.
Microbes and environment: Pollution abatement, bioindicators, restoration of degraded ecosystems, biotransformation, biodegradation, bioremediation.

Unit - II **12h**
Application of microbes in fermentation processes: Types, design and maintenance of bioreactors, fermentative products; antibiotics, vitamins, enzymes
Medical microbiology: Microbes as causal agents of human and animal diseases; basic concepts of vaccines.
Fermentation, Downstream processing, product recovery and product development.

Unit – III **12h**
Role of microbes in relation to agriculture: microbial mineralization, Nitrogen & Phosphorous economy, biological control, PGPR, biodegradation of the agricultural residues.
Symbiotic associations: concepts, types and applications.
Microbes in food and dairy industry: fermented foods, microbial spoilage of food and dairy products, toxins

Unit-IV **12h**
Application of microbes in biofuel production, Extremophiles and their biotechnological applications, Microbes in nanotechnology

Unit – V **12h**
Microbes in recovery of metal (bioleaching) and oil; Cell and enzyme immobilization, microbial enzymes of industrial interest.

Suggested Readings:

1. Environmental Molecular Microbiology, Liu Wen-Tso and Janet K. Jansson (2010), Caister Academic Press
2. Mannual of Environmental Microbiology, CJ Hurst, RL Crawford, JL Garland, DA Lipson, AL Mills, LD Stetzenbach (2007), III Edition, Blackwell Publishing
3. A Text Book of Applied Microbiology, Vols. I to II, S Kannaiyan (2009), Associated Publishing Company

DMBT04: CLIMATE CHANGE & ENVIRONMENTAL MANAGEMENT

Credit: 04

End-Term Examination Marks: 60

Continuous Internal Assessment Marks: 40

Unit - I **12h**

Climate change: Drivers and assessment of climate change; Greenhouse effects, Ozone layer depletion, Use of fertilizer, pesticides and other chemicals in agriculture and hygiene and their disposal.

Consequences of global warming: sea level rise, agriculture, natural vegetation, human implications, effects of increased CO_2 on plants.

Unit - II **12 h**

Biodiversity: definition, level and types, biodiversity as natural resource, value of biodiversity, risks and its conservation, concepts of biodiversity management, biodiversity act of India and related International conventions.

Unit - III **12h**

Introduction and scope of environmental management, Environmental impact assessment (EIA), general guidelines for the preparation of environmental impact statement.

Unit - IV **12h**

Scope and types of environmental audit, energy audit, cost benefit analysis, Environmental management plan, ISO 14000 standards and certification.

Unit - V **12h**

Basic principles of environmental risk management and environmental safety norms, Basic concepts of sustainable development, Status and strategies for bio-resource management, concepts and strategies of ecological engineering.

Suggested Readings:

1. Environmental Management: Principles & Practices, CJ Barrow (2005)
2. Environmental Management and Conservation, RK Khitaliya (2008)

DMBP01: *Field and lab works based on DMBT01/02/03/04*

(Credit: 02; Maximum Marks: 50)

1. Soil sampling and analysis for macro- and micronutrients
2. Plant water requirement assessment
3. Assessment of fertilizer inputs on crop growth
4. Assessment of planting density on crop growth
5. Impact of salinity on crop growth
6. Ecological foot print analysis
7. Study of soil texture and structure
8. Isolation of microbes from extreme habitats
9. Phosphatase activity test
10. Field study to observe diversity in leaf forms, flower, and methods of their pollination.
11. Students should be made aware to the common environmental problems, their consequences and possible solutions.

Generic Electives

GMBT01: History & Philosophy of Science

Course Description

Science plays an influential role in our society. As a social institution, it commands enormous respect and social influence, as well as vast sums of funding. It produces results that are greatly sought after. At the same time, science generates great controversy when it collides with various religious, economic, and educational agendas. The adjective "scientific" garners almost immediate respectability to whatever it is applied, and, in some circles, it is a prerequisite for being taken seriously. Yet to many it also bespeaks alienation, abstraction, and a void of meaning, useless in our attempt to understand values. Some even deride science as mere ideology and power mongering, as sexist, racist, or elitist.

Science is open to interpretation and critique; as a result, it stands in need of explanation, elaboration, justification, limitation, or change. History and philosophy of science attempts to understand how and why science works, to explain its successes and occasionally uncover its failures, to interpret its results, and to discover, what, if any, are its limits. Historians and philosophers of science also try to situate science in the broader scheme of human activities and social institutions, and to understand the way in which our particular cognitive, social, political, and moral situation impacts its development.

In this course, we will try to better understand what counts as science and explore whether we can demarcate science from non-science or pseudo-science. We will ask what the aim of science is, what it is trying to produce. We will explore a variety of challenges to our common ways of understand how and why science works, as well as challenges to whether science works as we believe that it does. We will explore the too-often ignored connections between the scientific process and our ethical and political values, attempting to determine whether and to what extend such human values play a role in science, and to what extent such a role is legitimate and compatible with the objectivity or reliability of scientific knowledge.

Course Content (Credit 03, Contact Hour 45; Maximum Mark -100)

Unit I: Introduction **16h**

What is science? Distinction between science other systems of belief and knowledge; difference between pure science and technology; science as a profession;

Science from prehistory to the scientific revolution

Origins of science and philosophy in ancient times (Mesopotamia, Egypt, Greece, India) Biology, Abiogenesis and Evolution; Creationism/Intelligent Design; Classical and new physics; Modern logic and mathematics; Social/human sciences; principle of liberal inquiry.

Unit II: Epistemological basis of Science **12h**

Science, objectivity and truth; selective skepticism and scientific knowledge; the problem of

demarcating science from non-science; social epistemology; alternative science; alternative models of scientific explanation: causation, unification, and pragmatics.

Unit III: Metaphysical foundations of Science **12h**

David Hume and the problem of causation; naturalism and anti-naturalism; realism and antirealism about scientific theories; scientific explanation; and laws of nature; The "no miracle" argument and pessimistic meta-induction; Bas van Fraassen's constructive empiricism; Ian Hacking's experimental realism.

Unit IV: Debates on methods and progress made in Science **12h**

The deductive-nomological model of scientific explanation; methods by which scientific ideas are generated and validated; Logical Positivism: Unity of Science and Methodological Monism; Karl Popper: Inductivism & Falsificationism; Thomas S. Kuhn: Rationality in Paradigm Change; Normal Science & Scientific Revolutions; Imre Lakatos: Progress, Rationality and Science; Feyeraband: Scientific rationality and irrationality.

Unit V: Ethical dimensions of Science & Science & Society **8h**

Fundamental principles in ethical theory such as - subjectivism; egoism; utilitarianism; Moral rules and codes, social contracts, rights and obligations, cultural relativism, and virtue ethics; science and the State; scientific experiments and the social reality.

Suggested Readings

1. Richard Dewitt, Worldviews: An Introduction to the History and Philosophy of Science, II edition, Wiley-Blackwell (2010)
2. Timothy McGrew, Marc Alspector-Kelly, Fritz Allhoff, Philosophy of Science: An Historical Anthology, Willey Blackwell (2009)
3. JA Cover, Martin Curd & Christopher Pincock, Philosophy of Science: The Central Issues, WW Norton & Company Inc (2012)
4. Peter Godfrey-Smith, Theory and Reality: An Introduction to the Philosophy of Science, The University of Chicago Press (2003), p. 288
5. Thomas Kuhn, The Structure of Scientific Revolutions (50th Anniversary Edition), the University of Chicago Press (2012), p. 264
6. Chalmers AF, What Is This Thing Called Science? 3rd edition, Buckingham: Open University Press (1999)
7. Christopher R. Hitchcock, Contemporary Debates in the Philosophy of Science, Blackwell (2004)
8. John Losee, A Historical Introduction to the Philosophy of Science, Oxford University Press (2001)
9. Mikael Hard & Andrew Jamison, Hubris and Hybrids. A Cultural History of Technology and Science, Routledge (2005)
10. Okasha Samir, Philosophy of Science: A Very Short Introduction, Oxford: Oxford University Press (2002)
11. Erickson M, Scientists and Scientific Communities (Chapter 5) Science, Culture and Society: Understanding Science in the 21st Century, Cambridge: Polity, 2005.
12. Hacking I, What is Scientific Realism? In Hacking, Representing and Intervening, Cambridge: Cambridge University Press (1983)
13. Popper KR, Ch. 11, Conjectures and Refutations. Routledge & Kegan Paul (1963), pp. 253-292.
14. Searle J, The Building Blocks of Social Reality, In Searle *The Construction of Social Reality*, London, the Penguin Press, 1995, pp.1- 29.
15. Shapin Steven, Don't Let That Crybaby in Here Again, London Review of Books, September, 2000 (http://www.lrb.co.uk/v22/n17/shap01_.html)
16. Woolgar St, The Turn To Technology In Social Studies of Science, Science Technology and Human Values, 1991, p. 20-50.

Hyperlinks:

1. http://plato.stanford.edu.

2. www.epistemelinks.com.
3. http://nptel.iitm.ac.in

GMBT02: Plant Diversity & Human Welfare

Theory Paper (Credit – 03; Contact Hour - 45h; Maximum Marks – 100)

Course Description

This module will help students in gaining insight of the all-important role plants have played in shaping the biosphere in general and anthroposphere especially. The diversity of plants and threats that growing human population and climate change has placed on it. Students will also learn about various efforts that are underway to conserve and protect the diversity.

Course Content

Unit I **10h**

Plant diversity and its scope - Genetic diversity, Species diversity, Plant diversity at the ecosystem level; agro-biodiversity and cultivated and wild plant taxa; Values and uses of Biodiversity: ethical and aesthetic values, precautionary principle, methodologies for valuation.

Unit II **15h**

Loss of Biodiversity: loss of genetic, species and ecosystem diversity, loss of agro-biodiversity; Projected scenario for biodiversity loss; Management of Plant Biodiversity: organizations associated with biodiversity management and methodology for execution -IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations; Biodiversity information management and communication.

Unit III: **10h**

Conservation of Biodiversity: conservation of genetic, species and ecosystem diversity, *In situ* and *Ex situ* conservation; Social approaches to conservation; Biodiversity awareness programmes; Sustainable development.

Unit IV **10h**

Role of plants in relation to human welfare: Importance of forestry, their utilization and commercial aspects, avenue trees; Ornamental plants of India; Important tuber crops and their commercial importance.

Suggested Readings

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

DMB05: Dissertation [**Credit: 06 (written report -04; presentation of the work -02)**; Maximum Marks: 100]

Excursion (Credits 02; maximum marks -50)

The Excursion tour to different parts of the country for phyto-geographical study and observation/collection of plant materials will be undertaken any time in between III & IV Semesters. However, the study report will be evaluated during III semester.

The syllabi of following programs are hereby approved in a meeting of the Board of Studies for Botany, Department of Botany, IGNTU, Amarkantak (M.P.) on this date of August 16th, 2017, Wednesday.

1. Syllabi for MSc (Botany) & PhD (Botany) entrance examinations
2. Syllabi for PhD Course work
3. Syllabi for MSc (Botany)
3. Syllabi for BSc (Hon's) in Botany

Prof. S. P. Adhikary
(Member, External Expert)

Prof. R. P. Sinha
(Member, External Expert)

Prof. A.K. Shukla
(Member)

Dr. V.K. Mishra
(Member)

Dr. T.Srinivasan
(Member)

Dr. Prashant K. Singh
(Member)

Dr. Ravindra Shukla
(Member)

Prof. N. K. Sharma
(Chairman & Convener)