MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY SEMESTER –IV (2018-19)

Core course 11: *M4BOT01-CT11*

Paper I: *Genetic Engineering of plants*

Unit-I Credit hours: 12

Recombinant DNA Technology: – Gene cloning principles and techniques (Plasmid, phage, cosmid, construction of genomics/ cDNA libraries, choice of vectors. Restriction enzymes. Restriction mapping- concept and techniques. DNA sequencing, PCR, Northern and Southern blotting, RFLP, RAPD, AFLP based DNA finger printing, microarrays. Integration and expression of foreign genes in pro- and eukaryotes. Site-directed mutagenesis.

Unit-II Credit hours: 12

The Genetics of RNA: Catalytic diversity of RNAs, RNA silencing in plants, Cross talk between RNA metabolic pathways- an RNomics approach. Alternative splicing. Ribozyme, siRNA libraries. Non-coding RNA and gene silencing, Epigenetics Prions of yeast as epigenetic phenomena.

Unit-III Credit hours: 12

Genetic Engineering of Plants: Methods of direct and *Agrobacterium* mediated gene transfer, electroporation, microinjection, particle-gun technology. Chloroplast transformation and its utility. Transgenic plants: performance and fortification of agricultural products–Bt cotton, Bt brinjal. Herbicide resistance, viral resistance, bacterial resistance, fungal resistance, stress tolerance, Golden rice and transgenic sweet potato. Current status of transgenic plants in India and other countries, ecological ad ethical issues associated with GM crops and GM food. Labeling of GM plants and products.

Unit-IV Credit hours: 12

Applications: Gene therapy: Principles and different strategies, Gene therapy for inherited diseases, stem cell based therapy and tissue engineering, Ethical and social considerations, genome projects, Basics of protein engineering and design. Production of Industrial enzymes, biodegradable plastics, therapeutic proteins.

Unit-V Credit hours: 12

Applications: Molecular mechanisms and differentiation of T4-DNA, Seed and Cell bank, Biosensors, Biochips, Hybridoma technology, production of edible vaccines and antibiotics using transgenic technology, Nucleic acid probes, Brief idea of Animal vaccines, Cryopreservation, germplasm collection and conservation, Brief idea of plant tissue culture certification. Terminator gene technology. Environmental impact of herbicide resistance crops and super weeds.

Practicals:

1. Isolation of plant genomic DNA, its purification and visualization.
2. Isolation of plasmid DNA and genetic transformation of bacterial cells using competent *E. coli*.
3. Preparation of master-mix and setting of PCR reaction.
4. RAPD and ISSR markers.
5. Demonstration of particle gun technology and model.
6. SDS-PAGE and its use in protein profiling and analysis.
7. Culture of *Agrobacterium tumefaciens* on agar-plate and broth.
8. Co-culture of *Agrobacterium* with plant explants.
9. Gus assay for genetic transformation.
10. Restriction Digestion of genomic DNA by use of Restriction enzymes e.g. Eco RI, Hind III, Bam H I and Gel Electrophoresis.

Reference Books:

1. Glick and Pasternick, J.J. Molecular Biotechnology, Principles and Applications of Recombinant DNA. Ason Press Washington.
2. Thieman,W.J. and Palladino, M.A. Introduction to biotechnology (II Edn). Pearson Publishing House.
3. Jeremy W Dale, Malcolm von Schantz . From genes to genomes. John Wiley and Sons Ltd.
4. Higgs, Paul,G. and Attwood, Teressa,K. Bioinformatics and molecular evolution. Blackwell Publishing.
5. Singh, B.D. Biotechnology- An Expanding Horizon. Kalyani Publishers.
6. Sandhya Mitra. Genetic engineering- principles and practice. Macmillan India Limited
7. Satyanarayana, U. Biotechnology. Books and Allied Publishers.
8. Primrose, S and Twyman R, Principles of Gene Manipulation and Genomics. Blackwell publishing.
9. Sambrook, J. and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL.
10. Brown, TA, Gene Cloning and DNA Analysis: An Introduction. Blackwell publishing.
11. Dale and Schantz. From genes to genome. Blackwell publishers.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY SEMESTER –IV (2018-19)

Core course 12: *M4BOT02-CT12*

Paper II: *Techniques in Plant Sciences*

Unit-I Credit hours: 12

Microscopy: Optical, phase contrast, Fluorescence and electron microscopy (TEM and Scanning); Centrifugation-Principle; Ultra centrifugation.
Electrophoretic techniques:Principle, types of instruments, resolution, separation and application, isoelectric focusing.

Unit-II Credit hours: 12

Chromatography:Principle and methodology of chromatographic techniques: (a) Paper (b) Thin Layer (c) Column (d) Gel (e) Gas and (f) HPLC.
Spectrophotometry-Principle, and applications, Atomic Absorption Spectrometer, NMR.

Unit-III Credit hours: 12

Bioinformatics: Introduction, Biological Sequence Databases; Various nucleic acid and protein databases, Applications of Bioinformatics. Introduction to phylogenetics

Unit-IV Credit hours: 12

Biostatistics: Concept of treatment, replicates, sample and experimental design, Measures of central tendency – Mean (arithmetic), Median and Mode. Standard deviation and standard errors; skewness and kurtosis.

Unit-V Credit hours: 12

Biostatistics: Basics of Correlation and Regression. Analysis of variance (single factor analysis), chi-square test, Duncans multiple range test (DMRT).

Practicals:

1. Principle, construction, operation and application of the following instruments and technologies:
    (i) Various types of chromatography and TLC, column chromatography, gas and HPLC.
    (ii) Electrophoresis system
    (iii) Various types of microscopes.
    (iv) Centrifugation
    (v) Spectrophotometers
    (vi) Fluorimeters.
2. Computation of mean, mode, median, standard deviation, chi square, analysis of variance, correlation coefficient, regression analysis, post hoc analysis.
3. Multiple Sequence alignment and Construction of phylogenetic tree.

Reference Books:

1. Instrumental methods of chemical analysis: Chatwal and Anand, Himalaya Publishing House.
2. Instrumental Methods of Chemical Analysis: B.K. Sharma, Goel Publishing House.
3. S. C. Gupta. Fundamentals of Statistics. Himalaya Pub. House.
4. J. Medhi. Statistical Methods an introductory text. New Age International (P) Ltd. Publishers.
5. P. S. S. Sudar Rao & J. Richard. An introduction to biostatistics. Prentice Hall of India. N. Delhi.
6. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
7. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY SEMESTER –III (2018-19)

Discipline Specific Electives

M3BOT01-ET01A
Applied Plant Sciences

Unit-I Credit hours: 12

Biofertilizers: General account about the microbes used as biofertilizer – *Rhizobium, Azospirillum, Azotobacter,* Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, Mycorrhizal association; colonization of VAM. Organic farming – Green manuring and organic fertilizers.

Unit-II Credit hours: 12

Nursery development: objectives and scope. Planning and seasonal activities - Planting - direct seeding and transplants. Vegetative propagation: air-layering, cutting, treatment of cutting, rooting medium and planting of cuttings. Hydroponics

Unit-III Credit hours: 12

Floriculture: Importance and scope of floriculture and landscape gardening. Ornamental Plants: Flowering annuals; Herbaceous perennials. Bonsai. Commercial Floriculture: Factors affecting flower production. Hardening of plants – green house - mist chamber, shed root, shade house and glass house.

Unit-IV Credit hours: 12

Plant disease management: Symptoms of plant diseases. Control methods. Integrated pest management. Study of etiology and management of following important plant diseases; Downy mildew and Green ear of bajra, Blight of maize, Tikka disease of groundnut, Leaf blight of rice, Grassy shoots of sugarcane, Sandal spike, Rice tungro, Bunchy top of banana. Diseases and Pests of Ornamental Plants.

Unit-V Credit hours: 12

Intellectual Property Rights: Introduction to Intellectual Property. Historical Perspective, Different Types of IP, Importance of protecting IP. Copyrights, Trade Marks, Patents, Geographical Indications, Trade Secrets, Different International agreements; Word Trade Organization (WTO), General Agreement on Tariffs & Trade (GATT), Trade Related Intellectual Property Rights (TRIPS).

Practicals:

1. Effect of mycorrhizal inoculation on plant growth.
2. Study of root nodule development
3. Effect of Blue Green algae on plant growth

4. Various nursery and gardening practices
5. IPR issues-case studies
6. Study of important plant diseases

Reference Books

1. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic _Farming Akta Prakashan, Nadiad
2. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
3. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
4. N.K. Acharya: *Textbook on intellectual property rights*, Asia Law House (2001).
5. Manjula Guru & *M.B.* Rao, *Understanding Trips: Managing Knowledge in Developing Countries*, Sage Publications (2003).
6. P. Ganguli, Intellectual Property Rights: *Unleashing the Knowledge Economy*, Tata McGraw-Hill (2001).
7. Nelson, P.U. 1991. Greenhouse operation and management. Prentice-Hall, NJ, USA.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY SEMESTER –III (2018-19)

Discipline Specific Electives

M3BOT01-ET01B

Bioinformatics

Unit-I Credit hours: 12

Introduction of computers: Components and their functions, hardware and software, Input-Output devices. Basic concepts about data and information, Representation of data in computers in binary, bits and bytes.

Unit-II Credit hours: 12

Programming languages: Computer words coding (ASCII and EBCDIC), Numeric data. Introduction to Programming languages, C^{++} Perl. Conceptual understanding of assemblers, Compilers, Operating System.

Unit-III Credit hours: 12

Information Retrieval: LAN, WAN, Introduction to Internet, WWW, NICNET, ERNET, VSNL, ISDN, E-mail, Publication on worldwide web, on-line publishing ventures eg. Biomed, online international database access.

Unit-IV Credit hours: 12

Biological Databases: Primary Sequence databases (Protein and DNA databases), Secondary databases, Composite databases.
Sequence Alignment and Databases searching: Evolutionary basis of sequence alignment. Optimal Alignment methods, Substitution Scores and Gap penalties.

Unit-V Credit hours: 12

Sequence Alignment: Statistical significance of alignment, Databases similarity searching: FASTA, BLAST.
Pairwise database searching: EMBOSS, Multiple Sequence alignment: CLUSTAL W. BLIS Network in India.

Practicals:

Practicals will be based on theory course contents.

Reference Books:

1. Fundamental of Computer: P.K. Sinha
2. Introduction to Bioinformatics: Parrysmith and Attwood.
3. Introduction to Bioinformatics: Baxevenis and Oulette.
4. Internet for Molecular Biologist: Swindell.
5. Molecular databases for protein sequences and structure studies – An Introduction Silence: J., Sillince M., Springerberlagd, Berlin 1972.
6. Leaping from Basic to C^{++}: Robert J. Traister, A.P. Professional Cambridge.
7. Perl 5 Unleashed: Kamran Husain & Robert F. Breedlore SAMS Publishing.
8. Bioinformatics-Methods and Applications. Rastogi, Mendratta, Rastogi Prentice Hall, New Delhi.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY SEMESTER –III (2018-19)

Discipline Specific Electives

M3BOT01-ET01C

Plant Tissue Culture

Unit-I Credit hours: 12

History: Scope and applications, Historical account of development of plant tissue culture; Contributions of P. R. White, R. J. Gauthret, J. Reinert, F. C. Steward, G. Morel, E. C. Cocking, P. Maheshwari, B. M. Johri, I. K. Vasil, Vimla Vasil, S. C. Maheshwari, Sipra-Guha Mukherjee. Concept of cell totipotency, cellular differentiation and morphogenesis, molecular basis of *in vitro* differentiation.

Unit-II Credit hours: 12

Tools and techniques: Concept of asepsis and methods of sterilization-physical and chemical methods of sterilization, Principle, construction and operation of instruments used in plant tissue culture- pH meter, ovens, Laminar Flow Clean Air Bench, Glassbead sterilizer, Lux meter, Magnetic stirrer etc. Explant selection, preparation and initiation of cultures, callus and suspension cultures, single cell culture, measurement of growth characteristics (cell size, types, number, viability, fresh and dry weight, PCV etc.)

Unit-III Credit hours: 12

In vitro regeneration of plants: Different pathways of micropropagation (Enhanced axillary branching, *de novo* shoot bud differentiation, somatic embryogenesis and callus organogenesis) and their applications. Stages of micropropagation. Micropropagation in forestry and horticulture.

Unit-IV Credit hours: 12

Protoplast technology: Protoplast isolation, culture, regeneration and maintenance, Viability tests for protoplast generation, Regeneration from protoplasts, Methodology adopted in protoplast fusion and their application in plant research. Somatic hybridization. Somaclonal variation-its causes and consequences. Role of plant tissue culture in crop improvement. Virus elimination and culture of obligate parasites.

Unit-V Credit hours: 12

Secondary plant metabolites: Production by use of cell culture technology. Bioreactors, types and uses. Hairy root culture, cell immobilization. General methods of phytochemical analysis, methods of extraction, isolation, separation, identification and analysis. Production , function and uses of Alkaloids, phenols, tannins and antibiotics in culture

Practicals:

1. TLC of plant pigment/ colored food additives (Anthocyanin/ curcuma).
2. TLC of alkaloid/ guggulsterone, use of TLC documentation system.
3. HPLC separation of secondary products, preparation of sample for HPLC (dilutions, filtration by membrane, loading and calculation of data).
4. Determination of UV lambda max by spectrophotometer.
5. Organized culture subculture in liquid medium: root/ shoot/hair roots.
6. Hairy root culture: co-culture method.
7. Somatic embryogenesis.
8. Column chromatography procedure for separation of secondary metabolites.
9. Anther culture for haploids.
10. Observation of cells under visible/ fluorescence microscope.
11. Explant preparation.
12. Medium preparation.
13. Shoot culture technique and regeneration.
14. Separation of shoots in organized culture.
15. Hybridization techniques - Emasculation, Bagging (For demonstration only).
16. Induction of polyploidy conditions in plants (For demonstration only).
17. Dissertation

Reference Books:

1. Bhojwani S.S. and Razdan M.K. (1983). Plant Tissue Culture: Theory and Practice. Elsevier, Amsterdam.
2. Razdan M.K., 2002. Introduction to Plant Tissue Culture. Oxford & IBH.
3. Reinert J. and Bajaj Y.P.S.1977. Plant Cell Tissue and Organ Culture. Springer Verlag.

4. Bhojwani S.S. 1990. Plant Tissue Culture: Application and Limitations. Elseiver.

5. Narayanswamy. 1994. Plant Cell and Tissue Culture. East-West Press.

6. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.

7. Purohit, S.D. 2013. An Introduction to Plant Cell, Tissue and Organ culture. Prentice Hall, India.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY SEMESTER –III (2018-19)

Discipline Specific Electives

M3BOT01-ET01D
Biosystematics

Unit-I Credit hours: 12

Experimental Taxonomy: Classical vis-à-vis experimental taxonomy, scope and significance of experimental taxonomy, principles and procedures of biosystematics, experimental taxonomic categories, Deme terminology. Concept of species, origin and evolution of species, speciation in vegetatively reproducing plants, speciation in relation to breeding systems. Concept of character, adaptive significance of major taxonomic characters and morphological trends in angiosperms, a general account of numerical taxonomy.

Unit-II Credit hours: 12

Population and Speciation: Population concept, variation within population, causes of variation in populations; polymorphism and gene flow within population. Population and the environment: phenotypic plasticity and range of tolerance, ecotypes, transplant experiments. Hybridization: recognition of hybrids, isolation mechanisms, hybrid swarms and introgression, taxonomic treatment of hybrids.

Unit-III Credit hours: 12

Biosystematics and conservation: Endangered taxa and their conservation with special reference to India, Hot spots; Biosystematics and conservation. Evolution and migration of flora, taxonomy of cultivated plants; Plant explorations, invasions and introductions; Local plant diversity and its socio-economic importance

Unit-IV Credit hours: 12

Taxonomic tools: Herbarium, flora, histological, cytological, phytochemical, serological, biochemical and molecular techniques; Computer and GIS. Role of the following disciplines in modern taxonomy: Morphology, Anatomy, Embryology, Phytochemistry, Cytology, Palynology, Genome analysis, Nucleic acid hybridization

Unit-V Credit hours: 12

Case studies: Taxonomic and morphological characteristics of the following : *Paeonia, Exocarpus, Trapa, Sphenoclea, Nyctanthes, Funaria, Calycanthus, Polygala, Aristolochia, Casuarina, Passiflora, Centella, Dischidia, Ultricularia, Tillandsia, Butomus, Butomopsis, Alisma.*

Practical:

1. Descriptions, sketching, classification and identification of wild and cultivated plants represented in local flora.
2. Methods of preparation of herbarium
3. Methods of preparation of digital herbarium
4. Exercises on nomenclature problems: Author citation, Principle of Priority, transfer of taxa, effective and valid publication etc
5. Describing new taxon, deposition of type, Latin diagnosis and abbreviations used in citations.
6. Preparation and use of Botanical keys
7. Practical based on numerical taxonomy
8. Study of Exotic plants found in the region
9. Study of Endemic plants of India in light of IUCN Red List Categories.
10. Semipermanent pollen preparations by acetolysis method and study of different pollen morphotypes.
11. Study of chomosomes, chromosome banding and Karyotype analysis
12. Interpretation of phytochemical data for taxonomy

Reference Books:

1. Bhojwani, S. S. and Bhatnagar, S. P. 1984. Embryology of Angiosperms. Vikas Publ. House, New Delhi.
2. Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
3. Cronquist, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.
4. Davis, P. H. and V. H. Heywood 1991. Principles of Angiosperm Taxonomy. Today and Tommorow Publications, New Delhi.
5. Erdtman, G. 1952. Pollen Morphology and Plant Taxonomy. Angiosperms. Almquist and Wiksell. Stockholm.
6. Fahn. 1979. Plant Anatomy.
7. Hutchinson, J. 1959. Families of Flowering plants.
8. Johri, B. M. 1984. Comparative embryology of Angiosperms. Ind. Nat. Sc. Acad. New Delhi.
9. Judd Walter S., Cmpbell C. S., Kollogg, E. A., Stevens P.F. and M. J. Donoghue 2008. Plant Systematics. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts,USA.
10. Lawrence George H. M. 1951. Taxonomy of Vascular Plants. Oxford and IBH Publ.Co. Pvt. Ltd. New Delhi .
11. Maheshwari, P. 1985. An Introduction to Embryology of Angiosperms. Tata McGraw Hill. New Delhi.

12. Nair, P. K. K. 1966. Pollen morphology of Angiosperms. Periodical Expert Book Agency, New Delhi.

13. Manilal, K. S. and M. S. Muktesh Kumar [ed.] 1998. A Handbook of Taxonomic Training. DST, New Delhi.

14. Quicke, Donald, L. J. 1993. Principles and Techniques of Contemporary Taxonomy. Blakie Academic & Professional, London.

15. Shivanna, K. R. and N. S. Rangaswamy. 1992. Pollen Biology- A Laboratory Manual. Springer-Verlag

16. Sharma Arunkumar and Archana Sharma. 1980. Chromosome Technique: Theory and Practices (3rd ed.) Butterworths, London.

17. Taylor, D. V. and L. J. Hickey 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.

18. Takhtajan, A. 1962. Flowering plants- Origin and Dispersal.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY SEMESTER –III (2018-19)

Discipline Specific Electives

M3BOT02-ET02A

Applied Phycology

Unit –I Credit hours: 12

Methods of algal study; collection of algae, preservation, types of culture media, preparation of culture media, isolation, types of cultures, commercial cultivation of algae.

Algal taxonomy, morphological identification keys, molecular systematics, role of DNA barcoding genes, evolution of algal groups and phylogenetics. Fossil algae.

Unit –II Credit hours: 12

Application of algae for nanoparticles synthesis, characterization techniques of nanoparticles, current market for phyconanotechnology. Nanoecotoxicology; effect of nanoparticles on algal physiology.

Unit –III Credit hours: 12

Algae for bioenergy; use of algae for biodiesel production, bio-ethanol and biological hydrogen production, technique of isolation of algal oil, characteristics of algal oil, fuel extraction, current status, economic viability and future prospect. Diatom based solar panels.

Unit –IV Credit hours: 12

Optimization of production of useful high value compounds from algae, Case study of algae producing high value compounds like astaxanthin, omega-3 and -6, fucoxanthin, eicosapenenoic acid (EPA), dicosahexaenoic acid (DHA), alpha-linolenic acid (ALA), carrageenan, Agar, proteins, vitamins. Market value of high value compounds.

Unit –V Credit hours: 12

Application of algae for bioremediation of waste water containing heavy metals and organic pollutants, absorption and adsorption kinetics. Algae as biofertilizers. Algae in global warming – carbon capture by algae. Algal blooms and Toxic algae. Commercialization of algal strains for education purpose.

Practicals

1. Preparation of algal culture media
2. Collection, isolation and axenic culture establishment
3. Measurement of growth rate of algal culture
4. Isolation of genomic DNA from algae
5. Amplification of DNA barcoding gene for molecular systematics
6. Separation of algal pigments using TLC

Suggested Readings:

1. Andersen RA (2005). Algal Culturing Techniques. Physiological Society of America. Elsevier Academic Press, USA.
2. Cole KM and Sheath RG (1990). Biology of the Red Algae. Cambridge Univ. Press, Cambridge.
3. Fritsch FE (1945). The Structure and Reproduction of Algae. Vol. II. Cambridge Univ. Press. Cambridge, London.
4. Isabella A. Abbott, George J and Hollenberg (1993). Marine Algae of California. Stanford University Press. USA.
5. Lee RE (1989). Phycology. Vol. II. Cambridge Univ. Press. Cambridge, USA.
6. Sahoo D & Qasim SZ (Eds), (2002). "Sustainable Aquaculture". APH Publishing Corporation, New Delhi, India.
7. South GR and Whittick A. (1987). Introduction to Phycology. Blackwell Scientific Publications. London.
8. Journals: Journal of Applied Phycology, Journal of Phycology, European Journal of Phycology, Phycologia, Botanica Marina.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY SEMESTER –III (2018-19)

Discipline Specific Electives

M3BOT02-ET02B

Biology and Evolution in Bryophytes

Unit-I Credit hours: 12

Introduction, characteristics and classification, Evolution of gametophyte and sporophyte of bryophytes. Reproduction : asexual and sexual

Unit –II Credit hours: 12

A comparative study of the various orders of : Hepaticopsida, Anthocerotopsida, Bryopsida, Regeneration studies, Ecology

Unit –III Credit hours: 12

Bryophytic flora of Rajasthan, Contribution of Indian Bryologists : SR Kashyap, SK Pande, Ram Udar , PN Mehra, Cytology and cytogenetics.Spore morphology, germination and interrelationships in mosses.

Unit –IV Credit hours: 12

Morphogenetic studies with special reference to : Protonema and mechanism of bud formation, Physiology of rhizoid formation, Physiology of reproduction

Unit –V Credit hours: 12

Origin of Bryophytes, Economic importance, Microtechniques in bryological studies

Practicals:

Practicals will be based on theory course contents.

Reference Books:

1. Introduction to Bryology. Vol.I and II. W.B. Schofield, University of British Columbia.
2. Bryophyte Development: Physiology and Biochemistry. Chopra R.N., Satish C. Bhatia. CRC Press.
3. An introduction to Bryophyta. A. Rashid. Vikas Publications. New Delhi.
4. British Mosses and Liverworts. Cambridge Watson. E.V.
5. Cryptogrmic Botany. Vol. II. Smith G.M.
6. Liverworts of the Western Himalayas and the Punjab Palm Part I. University of Punjab, Lahore.
7. Biology of Bryophytes. R.N. Chopra & S.C. Bhatia.
8. Taxonomy of Indian Mosses. R.S. Chopra.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY SEMESTER –III (2018-19)

Discipline Specific Electives

M3BOT02-ET02C
Agrostology

UNIT – I Credit hours: 12

Gramineae: Distribution, Habit, Root, Stem, Leaf, Inflorescence, fruit, seed and Embryo. Relationship of the Gramineae. Evolution in Gramineae: Evolution of spikelets Floral evolution, structure and evolution of Gynoecium. Grass Systematics: Sub families, tribes and sub-tribes.Anatomy of Grass leaf and stem

UNIT – II Credit hours: 12

Grasslands: Grassland Environment including Micrometeorological Parameters: Humidity, Absolute humidity, Specific humidity, Relative humidity, Vapour pressure and Measurement of humidity.Soil and soil forming process operating in Grasslands.Root system of plants of grasslands. Ecological amplitude of various constituent species of grasslands. Chemical composition and fodder value of Indian Grasses.

UNIT – III Credit hours: 12

Grassland research: Institutions of Grassland research in India: Their aims, objectives and achievements. Grasslands and National Economy: Grassland as supplier of fodder, Role of grasses in checking soil erosion, stabilization of sand dunes, Thatching, Oil, Khas khas; Grassland and defence, wildlife management, food for human consumption.
Socio-economic importance of Grasses in the life of indigenous people of Rajasthan. Threats to the grasslands of Indian desert.

UNIT – IV Credit hours: 12

Pastures: Importance, status and research needs of pastures; pasture establishment, improvement and renovation of natural pastures, cultivated pastures and common pasture grasses; Scope of grassland ecology; grassland climate, Basis of grassland classification, phytogeography of grasslands, major grassland types, grasslands in India with special reference to Rajasthan. Ecological status of grasslands in India.

UNIT – V Credit hours: 12

Grassland as an ecosystem; Dynamics of grassland ecosystem, nutrition of grasslands, Grass-legume association; Ecology of fire in grasslands; Grasses and grasslands in relation to soil conservation; management of grasslands.

Practicals:

1. Study of Morphological and Anatomical Characters of Grass Stem, Root and Leaf.
2. Study of types of inflorescence of family Poaceae.
3. Study of Spikelet of Grasses.
4. Mechanical analysis of Grassland soil.
5. Determination of the pH of Grassland soil.
6. Study of Grassland vegetation by Quadrat method.
7. Study of Grassland vegetation by line transect method.
8. Study of Grassland vegetation by point frame.
9. Study of Grassland vegetation by the point – centered quarter method.
10. Comparison of grassland communities under various stresses of biotic impacts.
11. Determination of total biomass in a Grassland community.
12. Study of primary productivity of a Grassland vegetation.
13. Determination of organic matter of Grassland soil.
14. Determination of chlorophyll content of Grassland species.
15. Determination of Forbes and grass ratio of Grassland by random count method.
16. Determination of Inter and Intraspecific relations of the Grassland species.
17. Study of Reproductive capacity of Grassland species.
18. Study of seed Germination of grass species.
19. Determination of leaf area index.
20. Study of microflora of Grassland soil.

Reference Books:

1. Grass Systematics by Frank W. Gould.
2. Grassland and Fodder Resources of India by R.O. Whyte.
3. Forage Crops of India by Dabadghao and Shankarnarayan.
4. Grass cover of India by Shankarnarayan.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY SEMESTER –III (2018-19)

Discipline Specific Electives

M3BOT02-ET02D

Industrial Biotechnology and Bioprocess engineering

Unit-I Credit hours: 12

Industrial Biotechnology: Principles of fermentation technology, Fermenters and Bioreactors; types, construction, design. Operation processes; aeration, agitation, temperature regulation and filtration method. Control of bioprocess parameters; physical, chemical and mechanical.

Unit-II Credit hours: 12

Fermentation processes: batch culture, fed-batch culture and continuous culture. Solid state fermentation. Air and Media sterilization. Microbial growth kinetics and measurement of growth. Factors affecting growth. Isolation, preservation and improvement of industrially important microbes. Media for industrial fermentation. Inoculum development.

Unit-III Credit hours: 12

Downstream Processing: introduction, removal of microbial cells and solid matter, foam preparation, precipitation, filtration, centrifugation, cell disruptions, liquid-liquid extraction, chromatography, membrane process, drying and crystallization.
Industrial production of microbial biomass, enzymes, primary and secondary metabolites. Enzyme and cell immobilization and their industrial applications.

Unit-IV Credit hours: 12

Applications: Industrial application of recombinant DNA technology using microbes. Microbial polysaccharides and polyesters. Production of Single Cell Proteins (SCP). Microbial transformation of steroids and sterols. Use of microbes in bioprospecting, oil recovery, bioremediation, biomining. Effluent treatment and disposal of effluents.

Unit-V Credit hours: 12

Microbial Food Technology: Concept, Microbiology of food products. Principles of Food preservation: Contamination, spoilage and preservation of different kinds of foods. Sterilization and Pasteurization. Fermented foods. Probiotics. Elementary idea of canning and packing. Food sanitation, control and inspection.

Practicals:

1. Study of principle and working of important instruments used in industrial and bioprocess engineering.
2. Designing of a simple Lab fermenter.
3. Study of growth kinetics of bacteria.
4. Study of effect of physical factors on growth of production strain.
5. Study of effect of chemical factors on growth of production strain.
6. Study of effect of inoculum size on growth.
7. Study of effect of UV radiation on microbial growth.
8. Study of effect of chemical disinfectants on microbial growth.
9. Isolation and purification of microbial metabolites
10. Improvement of production strains.
11. Study of production of organic acids from bacterial strains.
12. Study of immobilization of enzymes.
13. Isolation of antibiotic producing microbes from soil.
14. Antibiotic sensitivity test.
15. Isolation of industrially important microorganisms for microbial processes.
16. To test the production of enzymes: Amylase, proteinases, lipases and celluloses by microorganisms.
17. Demonstration of citric acid production by *Aspergillus niger*.
18. Methylene blue reductase test to determine the quality of milk sample.
19. Study of food-spoilage microorganisms in fresh, canned, fermented food and meat.
20. Production and analysis of SCP: *Spirulina*, yeast, *Chlorella*, mushroom.
21. Production of yoghurt using specific starter cultures.
22. Preparation of alcohol from fruit juices.
23. Removal of microbial cells from a solution by membrane filtration method.
24. Determination of phenol coefficient.
25. Dissertation

Reference books:

1. Microbiology: Concepts and Applications; Michael Joseph Pelczar, E. C. S. Chan, Noel R. Krieg, McGraw-Hill Companies; 6th edition (February 1993).

2. Food Microbiology; William C Frazier and Dennis C. Westhoff. Tata Mgraw Hill. 2008.
3. General Microbiology; R.C. Dube and D. K. Maheswari. S Chand , New Delhi. 2000.
4. Microbiology; M.J., Prescott, J.P Harley and D.A. Klein.. 5th Edition, WCB Mc GrawHill, New York. 2002.
5. General Microbiology; R.Y. Stanier, E.A. Adelberg and J.L. Ingram. 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi. 1991.
6. Introduction to Microbiology; A.S. Rao. Prentice-Hall of India Pvt Ltd., Nerw Delhi. 1997.
7. Microbiology: Principles and Explorations, J.G. Black, John Wiley, USA.2005.
8. A Text Book of Microbiology: R. C. Dubey and Maheshwari. S Chand & Company Ltd. 2009.
9. Principles of Fermentation Technology; P F Stanbury , S. Hall , A. Whitaker. Butterworth-Heinemann; 2 edition. 1999.
10. Microbiology: an Introduction, G.J. Tortora. R.F. Burdell and C.L. Case. Benjamin-Cummings Publishing Company. 1989.
11. Industrial Microbiology: An Introduction; M.J. Waites, N. L. Morgan, N. L. and G. Higton, Wiley-Blackwell. 2001.
12. Experiments in Microbiology, Plant pathology and Biotechnology, K. R. Aneja. New Age international Publishers, 2004.
13. Manual of Microbiology: Tools and Techniques; Kanika Sharma. Ane books. New Delhi. 2007.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR
M. Sc. BOTANY SEMESTER –IV (2018-19)

Discipline Specific Electives

M4BOT03-ET03A
Advanced Plant Pathology

Unit-I Credit hours: 12

Disease: History and significance, General definitions and terminology. Concept of disease: Parasites, parasitism, pathogen, pathogenicity, Fundamental concepts of plant pathology. Inoculum; Source: primary and secondary, Inoculum potential. Epidemiology: epidemic and sporadic diseases. Epiphytotics. Disease forecasting, Factors affecting plant diseases: abiotic; soil, climatic, other physical factors, Methods of studying, plant pathogens, Koch's Postulates, Isolation and identification of pathogens

Unit-II Credit hours: 12

Pathogenesis: Penetration of host, Plant disease development and symptoms, Transmission of disease. Resistance to plant pathogens: Types of resistance; horizontal vertical resistance. Deranged physiology with special reference to phenolics, carbohydrates, enzymes, plant growth regulators and other metabolites, Molecular basis of pathogen virulence and host resistance, gene-for-gene concept. Role of toxins and phytoalexins in disease development.

Unit-III Credit hours: 12

Pathogens: Study of symptoms, etiology, perpetuation and control measures of common fungal, bacterial, viral and phytoplasma induced disease with special reference to Wheat, Maize, Bajra, Sesame, Groundnut, Sugarcane, Cowpea, Gram, Tomato, Potato, Chillies, Lemon etc. diseases specially with respect to regional crops and vegetables. Plant galls: insect and mite induced galls, types, classification, structure, effect on host physiology. Nematodes as plant-parasites or pathogens of plants, Host response and symptoms, Important plant- parasitic nematodes and diseases, Control of plant-parasitic nematodes.

Unit-IV Credit hours: 12

Plant disease management: Concept: Principles and practice, Prophylactic approach, Eradication, Prevention. Quarantine, some examples of Agri-quarantine measures. Chemical control; classification and types of formulations, additives, application, equipment, and calibrations transportation, handling, storage and disposals.Chemical

groups, structure, formulation and methods of application. Bioassay tests and formulation stability.

Unit-V Credit hours: 12

Biological control: Definition, Concept, biological control agents (BCA), natural control and natural balance.Types of interactions contributing to biological control. Mechanisms of biological control. Biocontrol agents, Commercial products and application

Practicals:

1. Preparation of culture media; PDA, Czapeks Dox Agar and Fries' medium for fungal culture.
2. Measurement of fungal dimensions (Measurement of spore size, Mycelium width etc.)
3. Proving of Koch's postulates for at least one fungal disease and one bacterial disease.
4. Study of the effect of fungicides on the germination and growth of plant pathogenic fungi.
5. Isolation of nematode from soil & study of their histology.
6. Study of diseases with respect to host, casual organism, symptoms.
7. Isolation and pure culture development of plant pathogenic fungi and bacteria.
8. Identification of plant pathogenic fungi and bacteria.

Reference Books:

1. Principles of Plant Pathology, R.S. Singh, 3 rd Ed., Oxford & IBH Co., New Delhi. 1988.
2. Plant Pathology, R.S. Mehrotra,. Tata McGraw Hill Publishing Company, New Delhi. 1989.
3. Diseases of Crop Plants in India, G. Rangaswami and A. Mahadevan, Printice Hall of India Publications. 1999.
4. Essential Plant Pathology, Gail L. Schumann and Cleora J. D'Arcy C H Dickinson , J A Lucas, 2006.
5. A Text books of Modern Plant Pathology, K. S. Bilgrami and H. C. Dube, Vikas Publishing House Pvt. Ltd., 1996.
6. Plant Tumors, Arun Mishra, Today and Tomorrow's Printer and Publishers, India, 1985.
7. Plant Disease: An Advance Treatise, James G. Horsfall and Ellis B. Cowling, Second Edition, Academic Press, London, 1977

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY SEMESTER –IV (2018-19)

Discipline Specific Electives

M4BOT03-ET03B

Stress Physiology

Unit-I Credit hours: 12

Stress: Introduction and General Concepts, Environmental conditions that cause stress. Osmotic Stress: Causes of water deficit and its physiological consequences, physiological responses of plants to salinity stress, *osmoregulants, ROS and antioxidative defence system.*

Unit-II Credit hours: 12

Heat stress: Conditions that cause heat stress, physiological consequences of heat stress,Heat avoidance and tolerance, Heat shock proteins and their role in stress resistance.

Freezing stress: Effect of low temperature on plant metabolism, Acclimatization to low temperature, molecular basis of freezing injury and tolerance.

Unit-III Credit hours: 12

Photoprotection and photoinhibition: Influence of high light intensity on photosynthesis, Concept of photoprotection and photoinhibition; *Non-photochemical quenching;* Mechanism of photoprotection in plants- *water-water cycle,* xanthophyll cycle, anthocyanin mediated photoprotection.

Unit-IV Credit hours: 12

Biotic stress: Role of secondary metabolites, NO, Benzoic acid and salicylic acid, ROS, Jasmonic acid and Pathogenesis-related (PR) proteins, Plant defensins, Pytoalexins, Systemic plant defence responses, Systemic acquired resistance (SAR), Induced systemic resistance (ISR).

Unit-V Credit hours: 12

Bioenergetics and genetic engineering for abiotic and biotic stress tolerance: Chlorophyll fluorescence: General concept, *Kautsky effect*- Polyphasic fluorescence transients, JIP-test,, *Genetically altered crops for drought, salinity, temperature tolerance.* Bt cotton, Bt brinjal. Herbicide resistance, viral resistance, bacterial resistance, fungal resistance in plants.

Practicals:

1. Determination of water potential of plant.
2. Measurement of relative water content and osmotic potential.
3. Determination of chlorophyll stability index.
4. Study of free proline accumulation in plants under stress.
5. Study of seed germination under stress condition.
6. Determination of water potential by gravimetric method.
7. Effect of temperature on membrane permeability.
8. Study of rate of transpiration under different environmental factors.
9. Study of rate of photosynthesis under different light intensities.

Reference Books:

1. Singhal *et al*. 1999. Concepts in Photobiology, Photosynthesis and Phytomorphognesis, Narosa Pub. House, New Delhi.
2. Plant Physiology Taiz and Zeiger, Sinauer Associates Inc., Publishers, Sunderland.

   1998.
3. Devlin and Witham, 1986. Plant Physiology. CBS Publishers and Distributors, New Delhi.
4. Buchanan, B.B., Gruissem, W. and Jones, R.L. 2000. Biochemistry and molecular Biology of plants. American Society of Plant Physiologists
5. Physiological Plant Ecology : Ecophysiology and Stress Physiology of Functional Groups. Springer-Verlag. Larcher, W. 2004.
6. Plant Physiological Ecology. Lambers, H, Chapin III, F.S. and Pons, T.L. Springer. 1998
7. Introduction to plant physiology. Hopkins, W.G and Huner, 2004..
8. Fitter AH and Hay, R.K.M. 2001. Wiley. Environmental Physiology of Plants 2nd Edition.Academic Press.
9. The Physiology of Plants Under Stress, Soil and Biotic Factors. D.M. Orcutt and E.T. Nilsen. John Wiley and Sons, Inc., 605 3rd Avenue, New York, NY
10. Physiological Plant Ecology: ecophysiology and stress physiology. Walter Larcher. Springer, New York. 2003.
11. Plant response to abiotic stress. Heribert Hirt, Kazuo Shinozaki. Springer-Verlag Berlin Heidelberg, Germany. 2004.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY SEMESTER –IV (2018-19)

Discipline Specific Electives

M4BOT03-ET03C

Commercialization of Micropropagation Technologies

Unit-I Credit hours: 12

Micropropagation technology: Global opportunities, growth of tissue culture industry in India. Scope of commercialization of tissue culture based technologies. Planning and design of tissue culture facility for mass propagation of plants. Concept of clean area. Mass media preparation and dispensation, and storage. Autoclaving and contamination control. Hatcheries, transfer area, control of physical environment in growth room, air – handling and conditioning, culture room lightning, air exchange, humidity control.

Unit-II Credit hours: 12

Commercialization: Economizing micropropagation through reduction in labor cost, space utilization, cost reduction in media constituents and innovative approaches e.g. CO_2 enrichment, automation in plant tissue culture-use of bioreactors and robotics. Culture vessel ventilation. *Ex Vitro* rooting. Natural light in culture rooms. Liquid culture and temporary immersion.

Unit-III Credit hours: 12

Green house technology: Greenhouse location design, glazing materials, greenhouse cooling and heating, evaporative cooling, axial flow fans and humidity control. Monitoring water quality-water softening, ion exchange, reverse osmosis and distillation. Control of insects pests and microbial infection. Fogging facility, misting systems, light control in greenhouse, General nursery practices, maintenance of plants under nursery shade.

Unit-IV Credit hours: 12

Applications: Available technologies for micropropagation of ornamentals, fruit plants plantation crops, spices and condiments, oil seeds and legumes. Costing of tissue culture raised plants, quality control, packaging, transport and shipment. Ex-agar and agar-gel transportation. Virus indexing, quarantine and health.

Unit-V Credit hours: 12

Entrepreneurship: Setting-up of a micropropagation based industry- SWOT analysis, capital and operational cost, market survey and product acceptance, technology

demonstration , preparation of project report, financial institutions and supports, marketing strategies, Export potential.

Practicals:

1. Basic concepts of laboratory planning: concept of clean area, Hatch windows, environmental control in growth rooms, transfer area, culture room lighting, air-exchange, humidity control.
2. Scale-up production of identified plant species involving – culture establishment, shoot multiplication, rooting and hardening and acclimatization.
3. Learning Innovations in micropropagation:
   (a) Liquid culture system
   (b) Support matrices
   (c) CO_2 enrichment
   (d) Temporary immersion
   (e) Culture vessal ventilation
4. Greenhouse design, operation and management:
   (a) Glazing materials
   (b) Forgging, Misting, Light Control
   (c) Greenhouse cooling
   (d) Greenhouse heating
5. Cost analysis exercises for tissue culture plants.
6. Project development, planning and execution – case studies

Reference Books:

1. Pierik, RLM (1987) *In vitro* culture of Higher Plants, Martinus Nijhoff Publishers, Dordrecht, The Netherlands.
2. Prakash, J. and Pierik, RLM (Eds.) 1992 "Plant Biotechnology: Commercial Prospects and Problems" Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Hartmann, HT, Kestar, DE, Davis, FT and Geneve RL 1997. Plant Propagation – Principles and Practices. Sixth Edition, Pretice Hall Inc. New Jersey, USA.
4. Jitendra Prakash 1995. Biotechnology Research and Industry Survey. Vadamalai Services, Pichanur, Coimbatore.
5. Vasil, IK (Ed.) 1991. Scale-up and Automation in Plant Propagatuion In "Cell Culture and Somatic Cell Genetics of Plant Vol. 8, Academic Press, N. York, USA.
6. Nelson, PV 1991. Greenhouse operation and Management (Fourth Edition), Prentice Hall Inc. New Jersey, USA.
7. Purohit, S.D. 2013. An Introduction to Plant Cell, Tissue and Organ culture. Prentice-Hall, India

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY SEMESTER –IV (2018-19)

Discipline Specific Electives

M4BOT03-ET03D

Secondary Metabolite Production

Unit-I Credit hours: 12

Secondary metabolites: Primary and secondary metabolites. Principal classes of secondary metabolites with their occurrence and classification: Alkaloids, Terpenes and Phenolics. Shikimic acid and mevalonate pathways. Bioactive molecules from fungi (Fungal metabolites, Mycotoxins, colorant, enzymes) and Microorganisms.

Unit-II Credit hours: 12

Production of secondary metabolites: Basic concept of Callus and cell suspension cultures. Nutrients and media, approaches and factors affecting the production of secondary metabolites (optimization, effects of auxin, selection, hairy roots, elicitation, precursors, concept of growth and production media).

Unit-III Credit hours: 12

Production of pharmaceutically important drugs in culture: alkaloids (*Catharanthus*, *Nicotiana*, *Papaver*), anti-tumour agents (taxol, podophyllotoxins, camptothecine), saponins and sterols (diosgenin, guggul, ginseng), food additives (sweetners, flavours and colours). Basic concepts of Biotransformations and Cell Immobilization.

Unit-IV Credit hours: 12

Molecular farming: Production of drugs and recombinant protein by genetic engineering technology, metabolic engineering for the production of useful metabolites (Pathway manipulation of Tropane and Indole alkaloids), Edible vaccines, products on market, Production of Artemisinin in *Artemisia annua*. Basic concepts of functional foods. Nutraceuticals (Classification of Nutraceuticals, Phytochemicals as nutraceuticals).

Unit-V Credit hours: 12

Bioreactors: Types of bioreactors (stirred tank, air lift, membrane type, immobilized cell and wave bioreactors), process and operation for small and large bioreactors. Bioreactor for production of biomass (secondary metabolites and for micropropagation), scope of commercialization of bioreactor based technologies. Plant tissue culture industry in India.

Practicals:

1. Extraction and preparation of crude extract for value addition.
2. TLC and/or Paper Chromatography of various compounds – alkaloids, food additives.
3. Handling of spectrophotometer and _λ_max determination.
4. HPLC profile of selected material.
5. Column chromatography for isolation of pure compound.
6. Identification of 10 local medicinal plants and their usage.
7. Quantitative tests for alkaloids, steroids, terpens, phenolics etc.
8. Visit to pharmaceutical/drug producing industry.
9. Media preparation for callus and Cell Suspension culture.
10. Initiation of callus and cell suspension culture.
11. Media preparation for fungal cultures.
12. Isolation, culture and Identification of some important fungi for metabolite production.
13. Market survey for availability of various functional food and nutraceuticals

Reference Books:

1. Plant Secondary Metabolites by A. Crozier et al., Blackwell Publishers.
2. Biotechnology – Secondary Metabolites by K.G. Ramawat & J.M. Merillon, Science Publishers Inc.
3. Natural Products from Plant II Edition by L.J. Cseke et. al., Taylor and Francis.
4. Bioactive Molecules and Medicinal Plants by K.G. Ramawat and J.M. Merillon, Springer, Germany.

5. Plant-derived Natural Products by A.E. Osbourn & V. Lonzotti, Springer, Germany.
6. Handbook of Secondary Fungal Metabolites by Richard J. Cole, Bruce B. Jarvis and Milbra A. Schweikert. 2003 Elsevier Inc.
7. Fungal Metabolite by Merillon JM, Ramawat KG.2017.. Springer, Switzerland.
8. Protective Cultures, Antimicrobial Metabolites and Bacteriophages for Food and Beverage Biopreservation (Woodhead Publishing Series in Food Science, Technology and Nutrition) Hardcover – Import, 29 Nov 2010 by C. Lacroix MD. Publisher: Woodhead Publishing (29 November 2010) ISBN-10: 1845696697
9. Market Overview of Nutraceuticals in India : The complete report of Functional Foods, Probiotics and Dietary Supplements in India Kindle Edition by Atharva Lifesciences Consulting. Publisher: Atharva Lifesciences Consulting Pvt. Ltd. (19 August 2013) ASIN: B00EOLOQTC
10. Handbook of Nutraceuticals: Volume I, Ingredients, Formulations And Applications (Special Indian Edition) Hardcover – 2016 by Yashwant Pathak. Publisher: T&F India (2016). ISBN-10: 1498770886

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY (2018-19)

Skill Course Elective

BOT-SP01A	Skill Course Elective 1	ENGLISH COMMUNICATION

Unit-I Credit hours: 6

Introduction: Theory of Communication, Types and modes of Communication

Unit-II Credit hours: 6

Language of Communication: Verbal and Non-verbal (Spoken and Written) Personal, Social and Business Barriers and Strategies Intra-personal, Inter-personal and Group communication

Unit-III Credit hours: 6

Speaking Skills: Monologue Dialogue Group Discussion Effective Communication/ Mis-Communication Interview Public Speech

Unit-IV Credit hours: 6

Reading and Understanding Close Reading Comprehension Summary Paraphrasing Analysis and Interpretation Translation(from Indian language to English and vice-versa) Literary/Knowledge Texts

Unit-V Credit hours: 6

Writing Skills Documenting Report Writing Making notes Letter writing

Recommended Readings:

1. Fluency in English - Part II, Oxford University Press, 2006.
2. Business English, Pearson, 2008.
3. Language, Literature and Creativity, Orient Blackswan, 2013.
4. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brati Biswas

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY (2018-19)

Skill Course Elective

BOT-SP02A	Skill Course Elective 1	COLLECTION, PROCESSING, PRESERVATION & SALE OF PLANT MATERIALS

Unit-I **Credit hours: 6**

Collection of specimens, storing in fixatives, type of fixatives, Stains and dyes; type of stains, natural dyes, coal tar dyes. Theory of staining, types of staining, differentiation, mordants, bleaching, staining, temporary preparation of free hand section, permanent preparation of free hand section, permanent preparation of microtome section.

Unit-II **Credit hours: 6**

Paraffin course; washing, dehydration, infiltration, embedding, sectioning, cutting wood cube, cutting paraffin block, cutting paraffin ribbons, mounting of ribbon, staining of sections.Whole mount preparation, bacteria, fungi, algae, bryophytes, pteridophytes, gymnosperms & angiosperms, study of stomata. Smear or squash procedure; anther, root tip.

Unit-III **Credit hours: 6**

Herbarium technique; collection process, equipments for collection, plant press, field book, blotting materials, pressing of plants, keeping wet materials, drying of specimens, mounting of specimens, labeling of specimen, storing of herbarium sheets, preservation of type specimen, important herbarium of the world and india.

Unit-IV **Credit hours: 6**

Culture technique; conditions, plugging, agar-agar, pouring of medium, marking of glassware, sterilization, autoclave, pouring of sterilized media, inoculation of hood and room, inoculation tools, transfer of culture, preparation of agar slant, maintenance of culture, fungi, algae, angiosperms

Unit-V **Credit hours: 6**

Solutions, true solution, suspension, concentration of solutions, acid, base and salt, dilute solution of acids, salts, measurement of pH, pH meter, glass electrode, buffer solution, phosphate buffer. Glasswares, graduated glassware, ungraduated glassware, cleaning of glassware. Strategy for sale of the classwork material and scope.

Suggested Readings

Dwivedi, J.N., Singh, R.B. 1985. Essential of Plant techniques. Scientific Publishers, Jodhpur.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY (2018-19)

Skill Course Elective

BOT-SP03A	Skill Course Elective 1	BIOFERTILIZERS

Unit I Credit hours: 6

General account about the microbes used as biofertilizer – *Rhizobium* – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.

Unit II Credit hours: 6

Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. *Azotobacter*: classification, characteristics – crop response to *Azotobacter* inoculum, maintenance and mass multiplication.

Unit III Credit hours: 6

Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation.

Unit IV Credit hours: 6

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

Unit V Credit hours: 6

Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods,
types and method of vermicomposting – field Application.

Suggested Readings

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

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY (2018-19)

Skill Course Elective

BOT-SP04A	Skill Course Elective 1	BIOINFORMATICS

Unit-I Credit hours: 6

Introduction of computers: Components and their functions, hardware and software, Input-Output devices. Basic concepts about data and information, Representation of data in computers in binary, bits and bytes.

Unit-II Credit hours: 6

Programming languages: Computer words coding (ASCII and EBCDIC), Numeric data. Introduction to Programming languages, C^{++} Perl. Conceptual understanding of assemblers, Compilers, Operating System.

Unit-III Credit hours: 6

Biological Databases: Primary Sequence databases (Protein and DNA databases), Secondary databases, Composite databases.

Unit-IV Credit hours: 6

Sequence Alignment and Databases searching: Evolutionary basis of sequence alignment. Optimal Alignment methods, Substitution Scores and Gap penalties.

Unit-V Credit hours: 6

Sequence Alignment: Statistical significance of alignment, Databases similarity searching: FASTA, BLAST.
Pairwise database searching: EMBOSS, Multiple Sequence alignment: CLUSTAL W. BLIS Network in India.

Practicals:

Practicals will be based on theory course contents.
Primer Design
BLAST
Multiple Sequence Alignment

Reference Books:

1. Fundamental of Computer: P.K. Sinha
2. Introduction to Bioinformatics: Parrysmith and Attwood.
3. Introduction to Bioinformatics: Baxevenis and Oulette.
4. Internet for Molecular Biologist: Swindell.
5. Molecular databases for protein sequences and structure studies – An Introduction Silence: J., Sillince M., Springerberlagd, Berlin 1972.
6. Leaping from Basic to C^{++}: Robert J. Traister, A.P. Professional Cambridge.
7. Perl 5 Unleashed: Kamran Husain & Robert F. Breedlore SAMS Publishing.
8. Bioinformatics-Methods and Applications. Rastogi, Mendratta, Rastogi Prentice Hall, New Delhi.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

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Skill Course Elective

BOT-SP05A	Skill Course Elective 2	INTELLECTUAL PROPERTY RIGHT

Unit I Credit hours: 6

Introduction to Intellectual Property: Historical Perspective, Different Types of IP, Importance of protecting IP. Copyrights Introduction, How to obtain, Differences from Patents. Trade Marks Introduction, How to obtain, Different types of marks – Collective marks, certification marks, service marks, Trade names, etc. Differences from Designs.

Unit II Credit hours: 6

Patents Historical Perspective, Basic and associated right, WIPO, PCT system, Traditional Knowledge, Patents and Healthcare – balancing promoting innovation with public health, Software patents and their importance for India. Geographical Indications Definition, rules for registration, prevention of illegal exploitation, importance to India.

Unit III Credit hours: 6

Industrial Designs Definition, How to obtain, features, International design registration. Layout design of integrated circuits Circuit Boards, Integrated Chips, Importance for electronic industry. Trade Secrets Introduction and Historical Perspectives, Scope of Protection, Risks involved and legal aspects of Trade Secret Protection.

Unit IV Credit hours: 6

Different International agreements (a) Word Trade Organization (WTO): (i) General Agreement on Tariffs & Trade (GATT), Trade Related Intellectual Property Rights (TRIPS) agreement (ii) General Agreement on Trade related Services (GATS) (iii) Madrid Protocol (iv) Berne Convention (v) Budapest Treaty (b) Paris Convention WIPO and TRIPS, IPR and Plant Breeders Rights, IPR and Biodiversity

Unit V Credit hours: 6

IP Infringement issue and enforcement – Role of Judiciary, Role of law enforcement agencies – Police, Customs etc. Economic Value of Intellectual Property – Intangible assets and their valuation, Intellectual Property in the Indian Context – Various laws in India Licensing and technology transfer.

Reference Books:

N.K. Acharya: *Textbook on intellectual property rights*, Asia Law House (2001)
 Manjula Guru *&M.B.* Rao, *Understanding Trips: Managing Knowledge in*

Developing Countries, Sage Publications (2003).
P. Ganguli, Intellectual Property Rights: *Unleashing the Knowledge Economy,* Tata McGraw-Hill (2001).
Arthur Raphael Miller, Micheal H.Davis; *Intellectual Property: Patents, Trademarks and Copyright in a Nutshell,* West Group Publishers (2000).
Jayashree Watal, *Intellectual property rights in the WTO and developing countries,* Oxford University Press, Oxford.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY (2018-19)

Skill Course Elective

BOT-SP06A	Skill Course Elective 2	NURSERY, GARDENINING & GREEN HOUSE PRACTICES

Unit-I Credit hours: 6

Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants. Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion – Seed production technology - seed testing and certification.

Unit-II Credit hours: 6

Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants – green house - mist chamber, shed root, shade house and glass house.

Unit-III Credit hours: 6

Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.

Unit-IV Credit hours: 6

Cultivation of Vegetables: Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.

Unit –V Credit hours: 6

Green house: Fundamentals of greenhouse structures and greenhouse design, heating and cooling, benching, lighting, irrigation, and fertigation systems, and greenhouse maintenance. Greenhouse pest control. Different kinds of plants grown in a greenhouse

such as foliage plants, bedding plants, flowering plants, vegetables and cut flowers. Soilless media; Vermiculite, Soilrite, Coeopeat. Water treatment plants.

Suggested Readings

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National _Seed Corporation Ltd., New Delhi.
6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.
7. Nelson, P.V. 1991. Greenhouse Operation and Management. Prentice Hall, New Jersey, USA.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY (2018-19)

Skill Course Elective

BOT-SP07A	Skill Course Elective 2	ENVIRONMENTAL MONITORING, MANAGEMENT AND RESTORATION

Unit-I Credit hours: 6

Environmental pollution: Types (Air, Water, Soil, Radioactive, Noise, Thermal), effects on plants, animals and buildings; control of pollution; indoor air pollution.
Green house effect and global warming; ozone depletion; UV- B radiations; acid rain.
Environmental monitoring; Biomonitoring; Bioindicators.

Unit-II Credit hours: 6

Biological diversity: Threats to biodiversity, major causes of extinction, vulnerability of species to extinction, IUCN threat categories, Red data book. Strategies for biodiversity conservation,

Unit -III Credit hours: 6

principles of biodiversity conservation *in-situ* and *ex-situ* conservation strategies, theory of reserve design; Biosphere reserves. Megadiversity zones and Hot spots, concepts, distribution and importance.Threatened plants of India.

Unit -IV Credit hours: 6

Waste management: Solid Waste; Sources and management; Composting and methane production; Hazardous waste; Disposal and management of radioactive waste. Industrial ecology and recycling industry.

Unit -V Credit hours: 6

Environmental Biotechnology – Scope and applications; Concept of cleaner technology.

Practicals:

1. Determination of phenol contents of the given plant samples growing in polluted and seemingly non-polluted environments.

2. Determination of chlorophyll ‘a’, ‘b’ and total chlorophyll contents of the given plant samples growing in polluted and seemingly non-polluted environments.
3. Determination of soluble protein contents of the given plant samples growing in polluted and seemingly non-polluted environments.
4. Determination of carbohydrate contents of the given plant samples growing in polluted and seemingly non-polluted environment.
5. Determination of the proline contents of plants growing in polluted and seemingly non-polluted environments.
6. Determination of the activity of acid phosphatase enzyme in the given plant samples growing in polluted and seemingly non-polluted environments.
7. Determination of the activity of peroxidase enzyme in the given plant samples growing in polluted and seemingly non-polluted environments.
8. Determination of the activity of polyphenol oxidase enzyme in the given plant samples growing in polluted and seemingly non-polluted environments.
9. Determination of the activity of nitrate reductase enzyme in the given plant samples growing in polluted and seemingly non-polluted environments.
10. Calculate the dust capturing capacity of the leaves provided to you.
11. Calculate the percentage of the injured area in the leaves provided to you.
12. Study the effect of different lead and cadmium concentrations on the germination of seeds
13. Determination of the Dissolved Oxygen content of the given water samples.
14. Determination of the hardness of the given water samples.
15. Determination of the alkalinity of the given water samples.
16. Determination of the acidity of the given water samples.
17. Determination of the residual chlorine in the given water samples.
18. Determination of the organic carbon contents in the given soil sample.
19. Determination of the contents of calcium carbonate in the given soil sample.
20. Measurement of alpha and beta counts in soil samples
21. Field survey of important plants of the region for biodiversity.
22. Study of IUCN Red list categories.

Reference Books:

1. Bradshaw, A.D. and Chadwick, M.J. 1980. The Restoration of Land. Blackwell Scientific Publications, Oxford.

2. Singh A and Ward O.P. (Eds.). Applied Bioremediation and Phytoremediation. Springer. 2004.
3. Abrol I.P. and Dhruva Narayan V.V. (Eds.). Technologies for Wasteland Development. ICAR, New Delhi. 1998.
4. K.V.S.G. Murlikrishan. Air pollution and control.
5. Bell & Bell. Industrial noise control.
6. Peary. Environmental engineering.
7. Gilbert Masters. Introduction to environmental engineering and science.
8. Owen and Chiras. Natural Resource Conservation.
9. K.D. Saxena. Environmental planning, policies and programs in India.
10. G.W.Cox. Conservation Ecology.
11. W.R. L. IUCN. Global Biodiversity. Aery N.C. 2010. Manual of Environmental Analysis. Ane Books. New Delhi.

MOHANLAL SUKHADIA UNIVERSITY, UDAIPUR

M. Sc. BOTANY (2018-19)

Skill Course Elective

BOT-SP08A	Skill Course Elective 2	SCIENTIFIC WRITING

Unit I **Credit hours: 6**

Choosing the right word, using a dictionary and thesaurus, basic elements of a sentence, clauses, true sentence, tenses, active and passive verbs, punctuation and parallelism, Paragraphs, logic, and organization. Organizational strategies, art of precise writing.

Unit II **Credit hours: 6**

Using web based search engines, authenticating the information, editing in MS office, style analysis programs, data entry and working knowledge of excel, creating tables, figures, graphs, photographs and other documentary illustrations, explanatory artwork, An introductory idea about use of abode, photoshop and coral making powerpoint presentation, making and refining presentations using advanced presentation features, making a poster, using a library, indexing systems available for various science streams, e-resources, e-journals, INFLIBNET and Sodhganga.

Unit III **Credit hours: 6**

Introduction-Overview of science writing, how is scientific writing different from general writing, know your audience, writing for general public, science reporting, Science news, explanatory writing, lengthy magazine article, popular articles and popular lectures. Reading material: Popular science magazine articles.

Unit IV **Credit hours: 6**

Writing for scientific community, types of paper (short communication, original research article, review), the various components for each type and the content of each

components (title, author affiliation, abstract , key words, introduction, material and methods, results and discussion, conclusion, references and bibliography, citation. Ethics in writing, plagiarism, plagiarism checker on line.

Unit V Credit hours: 6

Publishing work: selection of journal, impact factors, h index, following author guidelines, on line submission, proof reading of a manuscript, understanding the symbols, reviewing of a manuscript, making corrections and answering reviewers query, galey proof reading. Writing research grant proposal, Book review, write up mini profiles of prominent scientists, letters to editor, opinion writing, interview of a scientist, career in scientific writing

Practical/Assignments:

1. Take a science article and reduce it to 1/10 th length and make a brief abstract.
2. Make a press release for the general masses about a scientific event in your city.
3. Make a Review of an instrument, technique or Technology
4. Make a Powerpoint presentation on topic of your choice.
5. Make a poster on selected topic.
6. Convert the assignment 3 for general public
7. Collect few science news, science magazine article, popular articles on science and read them in class and critically discuss them.
8. Make a report of a practical exercise or a field visit.
9. Write a short communication on the given selected practical exercise in the given selected journal.
10. Peer review the article written by your class mates with proof reading symbols and on line review tool.
11. Frame questions for interview of a well known scientist/or on campus scientists
12. Make a small research grant proposal.
13. Write a mini profile of a prominent scientist.

Annexure I

1. In the 4th semester students one in-house minor research project within the department or in sister departments of this University in lieu of one DSE. Such students will also have to submit a dissertation report as per the prescribed format for the training. (Annexure 1)
2. The total credits and marks for minor research project will be the same as for any other DSE and Evaluation of the minor research project will be done as per the prescribed scheme. (Annexure 2)
3. The total contact hrs. for minor research project will be 8 hrs./week. The student who opts for industrial training will have submit a duly signed and sealed certificate from the mentor and competent authority in the prescribed format (Annexure 3)
4. Students can choose skill courses from the list provided in the syllabi of M.Sc. Biotechnology, M. Sc. Botany, M. Sc. Microbiology or any other subject from the faculty of Science. The student also has the choice of choosing any general skill courses offered by College of Science
5. Students can also earn extra credits by taking addition skill courses during entire program period.

General Guidelines for Preparation of Project Report

(For specific details the students are advised to consult their respective supervisors)

1. Strictly follow the format given to write the manuscript of the project.
2. On the front page include title of the project (font size 21, centered). The title should not contain abbreviation and scientific names of organisms should be in *italics*. This page should not be numbered.
3. Starting from second page, the pages must be numbered consecutively, including figures and table.
4. Text should be 1.5 point spaced type written using Times New Roman Font, Font Size 12, on one side of A 4 Size paper, with 1.5 inch margins throughout. Scientific names of the organisms should be in *italics*. Main headings (Summary, Introduction, Chapter details, Conclusions and References) should be bold type, justified and separated from the text.
5. The full text of project should not exceed 20-25 one side typed pages.
6. Literature citation in the text should be cited in alphabetic order. The form and style of references should be as indicated below.

(a) Journal article

Carvalho, L.C., Goulao, L., Oliveira, C., Goncalves, C.J. and Amancio, S. 2004. Rapid assessment for identification of clonal identity and genetic stability of *in vitro* propagated chestnut hybrids. Plant Cell Tiss. Org. Cult. 77:23-27.

Chae, W.B., Choi, G.W. and Chung, I.S. 2004. Plant regeneration depending on explant type in *Chrysanthemum coronarium* L. J. Plant Biotech. 6:253-258.

(b) Book reference

Salisbury, F. B., Ross, C. W. 1992. Plant Physiology. 4th edn. Wadsworth Publishing Company. Belmount.

(c) Edited books

Constantine, D.R. 1986. Micropropagation in the commercial environment. In : "Plant Tissue Culture and its Agricultural Applications". L.A. Withers and P.G. Alderson (Eds.) pp. 175-186. Butterworths, London, UK.

(d) Paper presented at a conference

Chaturvedi, H.C. 1992. Hardening of *in vitro* raised plants for transplant success. A state of art report. Paper presented in DBT Project Monitoring Committee Meeting held on 6^{th}-7^{th} July, 1992 in DBT, New Delhi, India.

(e) Proceeding of a symposium

Rajsekharan, P. E., Ganeshan, S. 2005. Designing *exsitu* conservation strategies for threatened medicinal plant species of South India. In: " Proc. Natl. Symp. and 27^{th} Annual Meeting of PTCA(I)." A.K. Kukreja *et al* (Eds). Pp.159-164. CIMAP, Lucknow, India.

(f) Thesis/ Dissertation

Dave, N. 2004. Factors influencing micropropagation of two varieties of *Achras sapota* and their rootstock *Mimusops hexandra*. Ph.D. Thesis, Mohanlal Sukhadia University, Udaipur, India.

(g) Patent

Trepaginer, J.H. 2000. New surface finishings and coatings. US Pat 1276323 (to DuPont Inc, USA). 27 June, 2000. Chem Abstr, 49 (2000) 27689.

(h) Reports

Anonymous, 1976. The Wealth of India. Raw Meterials. Vo. X. pp. 44-48. CSIR, New Delhi, India.

TITLE MUST BE IN CAPITAL LETTERS, SIZE 21 AND CENTERED, WITH *Scientific names* IN ITALICS

A Project Report submitted

for the partial fulfillment of the Degree of Master of Science

By

(**Name of student**)

[M.Sc. (BOTANY), IV Semester]

DEPARTMENT OF BOTANY

MOHANLAL SUKHADIA UNIVERSITY

UDAIPUR

201__-1__

INSTITUTE NAME AND LOGO

Ref no.-…….. Date……

CERTIFICATE

This is to certify that the dissertation/project report entitled "**……**" submitted towards the partial fulfillment for the award of the degree of Master of Science in Biotechnology, from Mohanlal Sukhadia University, Udaipur (Rajasthan) India is the result of bonafide work compiled by **Mr./Ms. ……** carried outunder the guidance of **Dr. ……** at **……** under my supervision in the academic year of …….. It has no part the dissertation has been submitted for the award of any degree, diploma, fellowship or other similar titles or prizes and that the work has not been published in part or full in any scientific or popular journals or magazines.

Date

Name & Signature of the supervisor

Seal of the supervisor

Declaration

I, **……..** Roll No. **_____**student of M. Sc. IV Semester Biotechnology (Session 2010-11) hereby declare that the project entitled "……..." is my own compilation. I have strictly adhered to the guidelines provided by the department for the preparation of the project report.

Dated: Signature of the Student

TABLE OF CONTENTS

Annexure II

MARKING SCHEME FOR MINOR RESEARCH PROJECT

M. Sc. BOTANY semester IV

S. No.		Maximum Marks	Marks Obtained
1	**Dissertation Report** a. Review of Literature b. Methodology c. Outcome	 15 10 15	
2	Seminar	25	
3	Viva – voce	15	
4	Continuous Assessment	20	
	TOTAL MARKS	**100**	

Annexure III

CONTINUOUS ASSESSMENT SHEET

M. Sc. BOTANY: Minor Research Project

Name of Student's :

Technical Competence	Maximum Marks	Minimum Marks
• Review of Literature	5	
• Experimental Design & Skills	5	
• Data Interpretation/ Result Analysis	5	
• Attendance	5	
GRAND TOTAL	**20**	

Remark on professional competence (or deficiency) of the trainee and overall performance.

Name :

Designation : E-mail…….

Ph. No.

Organization:

Date: Signature with seal

Annexure IV

Internal Assessment of Practical

Practical Examination Question Paper Pattern (Internal)

DEPARTMENT OF BOTANY

UNIVERSITY COLLEGE OF SCIENCE, M.L. SUKHADIA UNIVERSITY

UDAIPUR

M.SC. (SEMESTER -) BOTANY – 20 -

PRACTICAL – I/II

PAPER: _____

PAPER: _____

(BASED ON THEORY PAPER – &)

TIME : 2 HOURS **MAX. MARKS: 20**

1.	Major Question (from Paper one mentioned above)	**5**
2.	Major Question (from Paper two mentioned above)	**5**
3.	Identify and comment upon the Spots (1-4) (Two from each paper)	**4**
4.	Record	**3**
5.	Viva – Voce.	**3**
	Total	**20**

External Assessment of Practicals

Practical Examination Question Paper Pattern (End Semester)

DEPARTMENT OF BOTANY

UNIVERSITY COLLEGE OF SCIENCE, M.L. SUKHADIA UNIVERSITY

UDAIPUR

M.SC. (SEMESTER -) BOTANY – 20 -

PRACTICAL – I/II

PAPER: _____

PAPER: _____

(BASED ON THEORY PAPER – &)

TIME : 6 HOURS **MAX. MARKS: 80**

1.	Major Question (from Paper one mentioned above)	**16**
2.	Minor Question (from Paper one mentioned above)	**08**
3.	Major Question (from Paper two mentioned above)	**16**
4.	Minor Question (from Paper two mentioned above)	**08**
5.	Identify and comment upon the Spots (1-6) (Two from each paper)	**12**
6.	Record	**10**
7.	Viva – Voce.	**10**
	Total	**80**

Internal Assessment of Theory Papers

DEPARTMENT OF BOTANY

UNIVERSITY COLLEGE OF SCIENCE, M.L. SUKHADIA UNIVERSITY

UDAIPUR

M.SC. (SEMESTER -) BOTANY – 20 -

1. Assignment: 5 marks
2. Seminar: 5 marks
3. Internal test: 10 marks

Internal test question paper pattern: 10 marks

Part A: Five questions compulsory, each of one mark

Part B: Attempt two questions, with internal choice, each of 2.5 marks.