



# SHRI JAGDISHPRASAD JHABARMAL TIBREWALA UNIVERSITY, CHUDELA

SYLLABUS

## MSC BOTANY (SEMESTER I TO IV)



## SCHEME OF EXAMINATION

Each theory paper shall carry 100 marks. The duration of examination will be of 3 hours for each theory paper. Laboratory papers will be of six and four hours of durations which involve laboratory experiments/exercises and viva-voce examination.

### SYLLABUS: MSC BOTANY SEMESTER: 1<sup>ST</sup> (FIRST)

S. No.	Subject Code	Course Title	Contact hours per week			Exam Hrs.	Maximum & Minimum Marks		
			L	T	P		Internal/Min. Pass Marks	External/Min. Pass Marks	Total/Min. Pass Marks
1	MBO-101	Algae, Fungi and Bryophyta	4	-	-	3	30/9	70/26	100/36
2	MBO-102	Cell Biology and Evolution	4	-	-	3	30/9	70/26	100/36
3	MBO-103	Plant Pathology & Microbiology	4	-	-	3	30/9	70/26	100/36
4	MBO-104a	Applied Phycology & Mycology (Elective-I)	4	-	-	3	30/9	70/26	100/36
5	MBO-104b	Applied Microbiology (Elective-II)	4	-	-	3	30/9	70/26	100/36
6	MBO-105	Practical Lab (based on MBO-101, MBO-102 & MBO-103)	-	-	9	6	50/15	100/36	150/54
7	MBO-106	Elective Practical Lab (based on MBO-104)	-	-	3	4	15/5	35/13	50/18
<b>Total</b>									
<b>Total Teaching Load</b>									

**L:** Lecture;    **T:** Tutorial;    **P:** Practical

**SYLLABUS: MSC BOTANY**  
**SEMESTER: 2<sup>ND</sup> (SECOND)**

S. No.	Subject Code	Course Title	Contact hours per week			Exam Hrs.	Maximum & Minimum Marks		
			L	T	P		Internal/Min. Pass Marks	External/Min. Pass Marks	Total/Min. Pass Marks
1	MBO-201	Genetics	4	-	-	3	30/9	70/26	100/36
2	MBO-202	Pteridophyta, Gymnosperms & Paleobotany	4	-	-	3	30/9	70/26	100/36
3	MBO-203	Plant Morphology & Developmental Anatomy	4	-	-	3	30/9	70/26	100/36
4	MBO-204a	Bioinformatics & Biostatistics (Elective-I)	4	-	-	3	30/9	70/26	100/36
5	MBO-204b	Principles of Plant Breeding (Elective-II)	4	-	-	3	30/9	70/26	100/36
6	MBO-205	Practical Lab (based on MBO-201, MBO-202 & MBO-203)	-	-	9	6	50/15	100/36	150/54
7	MBO-206	Elective Practical Lab (based on MBO-204)	-	-	3	4	15/5	35/13	50/18
<b>Total</b>									
<b>Total Teaching Load</b>									

**L:** Lecture;    **T:** Tutorial;    **P:** Practical

**SYLLABUS: MSC BOTANY**  
**SEMESTER: 3<sup>RD</sup> (THIRD)**

S. No.	Subject Code	Course Title	Contact hours per week			Exam Hrs.	Maximum & Minimum Marks		
			L	T	P		Internal/Min. Pass Marks	External/Min. Pass Marks	Total/Min. Pass Marks
1	MBO-301	Biosystematics of Angiosperms	4	-	-	3	30/9	70/26	100/36
2	MBO-302	Molecular Biology	4	-	-	3	30/9	70/26	100/36
3	MBO-303	Plant Physiology & Metabolism	4	-	-	3	30/9	70/26	100/36
4	MBO-304a	Genomics & Proteomics (Elective-I)	4	-	-	3	30/9	70/26	100/36
5	MBO-304b	Plant Biochemistry & Metabolism (Elective-II)	4	-	-	3	30/9	70/26	100/36
6	MBO-305	Practical Lab (based on MBO-301, MBO-302 & MBO-303)	-	-	9	6	50/15	100/36	150/54
7	MBO-306	Elective Practical Lab (based on MBO-304)	-	-	3	4	15/5	35/13	50/18
<b>Total</b>									
<b>Total Teaching Load</b>									

**L:** Lecture;    **T:** Tutorial;    **P:** Practical

**SYLLABUS: MSC BOTANY**  
**SEMESTER: 4<sup>TH</sup> (FOUR)**

S. No.	Subject Code	Course Title	Contact hours per week			Exam Hrs.	Maximum & Minimum Marks		
			L	T	P		Internal/Min. Pass Marks	External/Min. Pass Marks	Total/Min. Pass Marks
1	MBO-401	Plant Reproductive Biology	4	-	-	3	30/9	70/26	100/36
2	MBO-402	Plant Tissue Culture & Genetic Transformation	4	-	-	3	30/9	70/26	100/36
3	MBO-403	Plant Ecology	4	-	-	3	30/9	70/26	100/36
4	MBO-404a	Methods in Plant Sciences (Elective-I)	4	-	-	3	30/9	70/26	100/36
5	MBO-404b	Phytochemistry & Herbal Medicine (Elective-II)	4	-	-	3	30/9	70/26	100/36
6	MBO-405	Practical Lab (based on MBO-401, MBO-402 & MBO-403)	-	-	9	6	50/15	100/36	150/54
7	MBO-406	Elective Practical Lab (based on MBO-404)	-	-	3	4	15/5	35/13	50/18
<b>Total</b>									
<b>Total Teaching Load</b>									

**L:** Lecture;    **T:** Tutorial;    **P:** Practical

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 1<sup>st</sup> (FIRST)

Paper: Algae, Fungi & Bryophyta

Course Code: MBO-101

Unit	Contents of Course	Hrs.
I	<b>ALGAE:</b> Algae in diversified habitats (terrestrial, freshwater and marine), thallus organization, cell ultra-structure, reproduction (vegetative asexual and sexual). Classification of algae: based on pigments, cell wall composition, reserved food material and flagellation. Economic importance of algae especially in industry, food, fodder, biofertilizers, Biofuels and algal bloom, isolation and culture of algae.	10
II	<b>ALGAE:</b> Salient features of Cyanophyta, Chlorophyta, Bacillariophyta, Xanthophyta, Pyrrhophyta, Phaeophyta and Rhodophyta with special reference to <i>Spirulina</i> , <i>Scytonema</i> , <i>Dunaliella</i> , <i>Pinnularia</i> , <i>Gonyaulax</i> , <i>Laminaria</i> , <i>Dunaliella</i> , <i>Pinnularia</i> , <i>Gonyaulax</i> , <i>Laminaria</i> , <i>Gelidium</i> and <i>Batrachospermum: Acetabularia</i>	10
III	<b>FUNGI:</b> General characters, substrate relationship thallus organization, cell wall composition, nutrition, reproduction (asexual and sexual). Cell ultra-structure, (saprobic, biotrophic and symbiotic). Heterothallism, Heterokaryosis, Brachymeosis, Parasexuality, sex hormones and recent trends in classification of fungi, phylogeny of fungi	9
IV	<b>FUNGI:</b> General account of Mastigomyotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina with special reference to <i>Rhizopus</i> , <i>Peronospora</i> , <i>Neurospora</i> , <i>Polyporus</i> , <i>Drechslera</i> and <i>Colletotrichum</i> . Economic importance of fungi in industries, medicines and as food, fungi as bio-control agents, poisonous fungi, Mycorrhizae.	11
V	<b>BRYOPHYTES:</b> Distribution, Classification of Morphology, structure and reproduction of bryophytes. General account of Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Funariales and Polytrichales with special reference to <i>Plagiochasma</i> , <i>Notothylus</i> , <i>Sphagnum</i> , <i>Physcomitrella patens</i> and <i>Polytrichum</i> . Fossil Bryophytes, evolutionary trends in Bryophytes. Economic importance of Bryophyta Role of Bryophytes in plant succession	20
	<b>Total</b>	60

### Suggested Laboratory Exercises:

Morphological study of representative members of Algae, fungi and bryophytes present in your locality in their natural habitat with special reference to:

- **ALGAE:** *Microcystis*, *Spirulina*, *Scytonema*, *Rivularia*, *Dunaliella*, *Aulosira*, *Spirogyra*, *Pediastrum*, *Hydrodictyon*, *Ulva*, *Pithophora*, *Stigeoclonium*, *Gelidium* and *Batrachospermum*; Isolation and culture of algae.
- **FUNGI:** *Stemonites*, *Peronospora*, *Pythium*, *Albugo*, *Rhizopus*, *Pilobolus*, *Yeast*, *Emericella*, *Chaetomium*, *Pleospora*, *Morchella*, *Melamsora*, *Phallus*, *Polyporus*, *Drechslera*, *Curvularia*, *Phoma*, *Penicillium*, *Aspergillus*, *Colletotrichum*, *Fusarium* and *Alternaria*
  - Isolation and culture of fungi using moistened blotters, PDA and Sabouraud's Dextrose Agar media
- **BRYOPHYTA:** *Plagiochasma*, *Pogonatum*, *Pellia*, *Notothylus*, *Andreaea* and *Polytrichum*

### Suggested Readings:

1. Alexopoulos CJ, Mims CW, Blackwell M (1996) Introductory Mycology. John Wiley & Sons India
2. Anderson RA (2005) Algal Culturing Techniques. Elsevier Academic Press, USA.
3. Richardson DHS (1981) Biology of Mosses. Blackwell Scientific Publications, Oxford.
4. Ghemawat MS, Kapoor JN, Narayana HS (1976) A text book of Algae. Ramesh Book Depot, Jaipur.
5. Gilbert, Smith M (1985) Cryptogamic Botany, Vol. I & II (2<sup>nd</sup> Edition). Tata McGraw Hill. New Delhi.
6. Puri V (1985) Bryophytes. Atmaram & sons. Delhi, Lucknow.
7. Shanna PD (1996) Introduction to Bryophytes. Ramesh Book Depot, Jaipur.
8. Singh, Pandey, Jain (2019) A Text Book of Botany (Lower Botany). Rastogi Publications.

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 1<sup>st</sup> (FIRST)

Paper: Cell Biology & Evolution

Course Code: MBO-102

Unit	Contents of Course	Hrs.
I	Structural organization and function of organelles (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, structure & function of cytoskeleton and its role in motility). Membrane structure and function: Structure of mode membrane, lipid bilayer and membrane protein) (diffusion, osmosis, ion channels. Active transport and membrane pumps.	10
II	Intracellular compartments and transport: mechanism of protein sorting in peroxisomes, nucleus, chloroplast, mitochondria & ER and regulation of intracellular transport. Cell division and cell cycle (Mitosis and Meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle.	10
III	Cell signaling hormones and their receptors, cell surface receptor, second messengers, signaling through G-protein coupled receptors, signal transduction pathways (Cyclic AMP, phospholipase C, Ca <sup>2+</sup> -Cadmoduline & Receptor Tyrosine Kinase pathway), regulation of signaling pathways. Cellular communication: general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, Integrins. Apoptosis: Apoptosis (Programmed cell death): Mechanism of apoptosis, Apoptosis triggered by internal & external pathways, Apoptosis inducing factors, cancer, oncogenesis.	18
IV	Emergence of evolutionary thoughts Lamarck; Darwin concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations. Origin of cells and unicellular evolution: Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes	10
V	Palaeontology and Evolutionary History: The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals. Population genetics - Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution	12
	<b>Total</b>	<b>60</b>

## Suggested Laboratory Exercises:

- EM study of cell organelles
- Fluorescence staining with FDA for cell viability.
- Cell wall staining with calcefluor white
- Study of stages in cell cycle
- Mitosis and Meiosis
- Histochemical localization of protein, carbohydrate, fats, starch, lignin, nucleic acids
- Isolation of mitochondria and the activity of its marker enzyme, succinate dehydrogenase (SDH).
- Isolation of chloroplast and study of its percentage intactness
- Isolation of chloroplast and study of light reaction system
- Demonstration of SEM and TEM.
- Hardy-Weinberg numerical
- Any other practical based OD theory syllabus.

## Suggested Readings:

1. Lewis, B. 2000. Genes X. Oxford University Press, New York.
2. Alberts, B., Bray, D. Lewis, J., Raff, M., Roberts, K and Watson, J., 1999. Molecular Biology of the Cell. Garland Publishing, Inc., New York.
3. Wolfe, S.L. 1993. Molecular and Cellular Biology. Wadsworth Publishing USA.
4. Rost, T, etal. 1998. Plant Biology. Wadsworth Publishing Co., California USA.
5. Krishnamurthy, K.V. 2000. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida.
6. Buchanan, B.B., Gruissem, W., and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists. Maryland, USA.
7. De, D.N. 2000. Plant Cell Vacuoles: An Introduction. CSIRO Publication Collingwood, Australia.
8. Kleinsmith, L.J. and Kish, V.M. 1995. Principles of Cell and Molecular Biology (2<sup>nd</sup> Edition). Harper Collins College Publishers, New York USA.
9. Lodish, H., Berk, A. Zipursky, S.L. Matsudaira, P., Baltimore D. and Darnell, J. 2000. Molecular Cell Biology (4th Edition) W.H. Freeman and Co., New York, USA.

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

## SYLLABUS: MSC BOTANY

### Semester 1<sup>st</sup> (FIRST)

Paper: Plant Pathology and Microbiology

Course Code: MBO-103

Unit	Contents of Course	Hrs.
I	Plant diseases: Introduction and general account of disease development, History of plant pathology, Nature and concept of plant disease and symptoms of plant diseases caused by plant pathogen. Pathogenesis: Biotic and abiotic factors in pathogenesis, Pathogen factors in disease development. Enzymes and toxin in plant disease -Host specific and non-host specific toxin.	10
II	Disease Development: Modes of infection, Mechanism of penetration of pathogens. Protective and defense mechanism in plants-morphological and biochemical. Plant disease management: Physical, chemical and biological means of disease control. Biotechnological approaches to disease resistance, IPR	15
III	Microbiology: History, scope and developments since 20 <sup>th</sup> century in Microbiology. Diversity of the microbial world - Microbial taxonomy and phylogeny; Microbial nutrition, growth and metabolism; Bergey's manual of systematic bacteriology. Morphology, ultrastructure and cultivation of bacteria: Morphology and ultrastructure of bacteria, cytoplasmic inclusions, plasmids and endospores, growth curve, growth kinetics, batch, continuous culture, growth measurements and pure culture techniques.	17
IV	Introductory virology: Nomenclature and general characteristics of plant viruses, ultrastructure of TMV, TYMV, and Bacteriophage. Life cycle, Economic importance of viruses. Phytoplasma: general characters, morphology and Identification techniques of phytoplasma. Virus-like agents: virions, viroids and prions - concept, structural aspects and evolutionary importance; economic importance of viruses.	8
V	History, symptomology, causal organism, etiology and management of: Fungal diseases: Wheat - Flag smut, Kamal bunt. Rust of Linseed, Tikka disease of Groundnut Bacterial diseases: Crown gall of stone fruits Black rot of Crucifer Viral diseases: Cadang - Cadang-disease of coconut, Sandal spike Nematode disease: Root Knot of Brinjal, Ear Cockle of wheat, Non-Pansitic Diseases: Black heart of potato, Mango necrosis	10
	<b>Total</b>	60

#### Suggested Laboratory Exercises:

- Culture media for microorganisms
- Growth curve of bacteria
- Gram staining
- Virus indexing
- Study of following diseases: Wheat - Flag smut, Kamal bunt. Rust of Linseed
- Tikka disease of Groundnut, Crown gall of stone fruits, Black rot of Crucifer
- Cadang-Cadang disease of Coconut
- Sandal spike
- Root Knot of Brinjal,
- Ear Cockle of Wheat
- Any other practical based on theory

#### Suggested Readings:

1. Alexopoulos, C.J., Minis, C.W. and Blackwell, M. 1996 Introductory Mycology. John Wiley & Sons Inc.
2. Agrios, G.N. 1997. Plant Pathology. Academic Press, London.
3. Albajes, R., Cullino, M.L., Van Lenteren, J.C. and Elad, 2000 Integrated Pest and Disease Management in Greenhouse Crops. Kluwer Academic Publishers.
4. Bridge, P. Moore, D.R. & Scott, P.R. 1998. Information Technology. Plant Pathology and Biodiversity. CAB International, U.K.
5. Clifton, A. 1958. Introduction to the Bacteria. McGraw Book Co., New York.
6. Mandahar, C.I. 1978. Introduction to plant viruses. Chan Co. Ltd. Delhi.
7. Mehrotar R.S. & Agarwal A. 2003 Plant Pathology. Tata McGraw Hill.
8. Rangaswamy, G. & Mahadevan, A. 1999. Diseases of crop plants in India (4th edition) Prentice Hall of India, Pvt. New Delhi.
9. Horsfall, J.G. & A.L. Dimond. Plant Pathology Vols. 1, 2 & 3. Academic Press, New York, USA.
9. Trivedi, P.C. 1998. Nematode Diseases in Plants, CBS Publisher & Distributor, New Delhi.
10. Prescott L, Harley J, Klein D (2005) Microbiology. 6<sup>th</sup> edition, McGraw-Hill.



# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

## SYLLABUS: MSC BOTANY

### Semester 1<sup>st</sup> (FIRST)

Paper: Applied Phycology & Mycology (Elective-I)

Course Code: MBO-104

Unit	Contents of Course	Hrs.
I	<b>Applied Phycology:</b> Use of algae as food, fodder and industrial applications of algae (Alginic acid, Age, Carrageenan), Algal Biofertilizers with special reference to Cyanobacteria. Algal blooms and Water Pollution, toxic Algae, Biofouling and Control. Algal biofuels - algal biodiesel, bio-ethanol (and biological hydrogen production. Algae in global warming - carbon capture by algae.	12
II	Isolation, Purification and Culture of algae; Mass cultivation of microalgae with special reference to <i>Spirulina</i> and <i>Dunaliella</i> and their applications in human welfare, Cryopreservation, aquaculture (micro and macro algae cultivation). Importance of algae in production of algal pigments, important bioactive molecules, role of algae in sustainable environment, role of algae in biofemiation, recent developments and future of algal biotechnology.	12
III	<b>Applied Mycology:</b> Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Fungi in agriculture (biofertilizer) and remediation of contaminated soils. Mycotoxins; Fungal endophytes of plants and their applications: Endophytic fungi, colonization and adaptation of endophytes. Endophytes as latent pathogens and biocontrol agents. Fungi as Biological control agents (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides). Fungi in plant disease control- Selection, production and formulation of fungal biopesticides and commercial use of bio-control agents. Introduction and importance of Keratinophilic fungi.	18
IV	Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition growth and yield. Biology of vesicular arbuscular mycorrhizal (VAM) fungi: signaling, penetration and colonization inside roots, isolation and inoculum production of VAM, and its influence on growth and yield of crop plants and in forestry. Recent advances in the field of mycorrhiza. A general account of Phosphate solubilizing fungi (PSF). Overview of Lichens.	8
V	Mushroom cultivation- General account of Oyster, white button, paddy straw, Morels, Truffles & Poisonous mushrooms. Cultivation of mushrooms ( <i>Agaricusbisporus</i> , <i>Pleurotus</i> and <i>Volvariella</i> ), Medicinal and nutritional value of edible mushrooms, Effect of environmental, nutritional and chemical factors on mushroom cultivation (intensive and extensive cultivation methods)	8
<b>Total</b>		60

#### Suggested Readings:

1. Kumar, H.D. Introductory Phycology , Affiliated East West Pvt. Ltd. , New Delhi
2. Fritsch, F.E (1945). The Structure and Reproduction of Algae Vols. I & II. Cambridge University Press, UK
3. Anderson, R.A. (2005) Algal Culturing Techniques. Physiological Society of America. Elsevier Academic Press, USA.
4. Ghemawat, M.S., Kapoor J.N., and Narayan, ILS. (1976) A text book of Algae. Ramesh book Depot, Jaipur.
5. Alexopoulos, C.J., Mims, C.W. and Blackwel, M. (1996). Introductory Mycology, John Wiley & Sons ind.
6. Agrios, G.N. 1999. Plant Pathology. Academic Press
7. Mehrotra, R.S. 1991. Plant Pathology. Tata McGraw — Hill Publishing Company Ltd

#### Suggested Laboratory Exercises:

1. Isolation and culture of algae.
2. Identification of Algal biofertilizers.
3. Identification of toxic algae.
4. Identification of bloom forming algae.
5. Making an algal bloom.
6. Phytoplankton identification from local water bodies.
7. Isolation, culture and identification of fungi using moistened blotters, PDA and Sabouraud's Dextrose Agar media
8. Cultivation of *Spirulina* and *Dunaliella*.
9. Estimation of pigments in microalgae.
10. Study of Mushroom specimens
11. Mushroom cultivation.
12. Demonstration of antagonistic fungi a) Antibiosis b) Competition c) Mycoparasitism
13. Mycorrhiza: eetomycorrhiza and endomycorrhiza (Photogyaphs)
14. Study of Mycorrhizal colonization in roots of *Parthenium* and *Tageius*.
15. Isolation and identification of AM Fungi and estimation of root colonization,

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

## SYLLABUS: MSC BOTANY

### Semester 1<sup>st</sup> (FIRST)

**Paper:** Applied Microbiology (Elective-II)

**Course Code:** MBO-104

Unit	Contents of Course	Hrs.
I	Food and Dairy Microbiology: Microbial spoilage of food products including cereals, fruits, vegetables, meat, fish, and dairy products, Factors influencing microbial growth foods - extrinsic and intrinsic. Principles of food preservation, Food preservatives and their uses, Fermented food, wine, bakery products, cereals, and milk products, Bacteriocins and their application in food preservative (Nisin, Lactococcuslactis), food additives. Nutritional value of fermented foods, Microbiological examination of milk and milk products, source of their contamination and control.	12
II	Applications of Microbes in Waste Treatment: Solid waste treatment (Landfills, incineration, composting, anaerobic digestion and pyrolysis). Waste water treatment: Pretreatment, primary, secondary (activated sludge, surface aerated basins, fluidized bed reactors, trickling filter, biotower, rotating biological contactors, membrane bioreactors and secondary sedimentation) and tertiary treatment, disinfection and odor control; Application of biofilm in waste water treatment. Microorganisms as indicators of water quality. Role of Microbes in Environment: Biodegradation of recalcitrant compounds — Pesticides, Petroleum, Polychlorinated biphenyls and other organopollutants; Lignin degradation: Lignocellulolytic microorganisms, enzymes and their applications in: Biopulping, Biobleaching, textiles, Biofuels, Animal feed production.	16
III	Bioremediation: <i>In site &amp; Ex situ</i> remediation, Concept of bioremediation technologies, Microbial consortium, Microbial remediation of oil spills, paper and pulp mill effluents and textile effluents; Biostimulation and Bioaugmentation. Bioaccumulation of metals and detoxification. Genetically Modified Organisms released and its environmental impact assessment; Molecular approach to environmental management, Degradative plasmids, Genetic exchange in xenobiotic chemicals.	12
IV	Biodeterioration of buildings and monuments of heritage value, Microbial deterioration of paper, leather, wood, textiles, metal surfaces— mode of deterioration, organisms involved, its disadvantages and methods of prevention. Biobleaching of copper, gold and uranium from ore by microbes. Bio-recovery of petroleum. Microbial plastics, Biodiesel. Biofertilizer for sustainable agriculture- <i>Rhizobium</i> , <i>Azospirillum</i> , <i>Azotobacter</i> , <i>Azolla</i> , BGA -mass production methods - application methods of biofertilizers - significance of biofertilizers.	12
V	Mycorrhizal fungi: Diversity of endo and ecto mycorrhizal fungi, culturing and benefits, role in bioremediation of soil. Fungal endophytes as biocontrol agents. Agriculturally important fungi in sustainable agriculture with special emphasis on Biopesticides, Mycoherbicides and Mycoinsecticides.	8
<b>Total</b>		<b>60</b>

#### Suggested Readings:-

1. Singh, B.D. Biotechnology, Kalyani Publishers, New Delhi
2. Agrios, G.N. 1999. Plant Pathology. Academic Press
3. Kale, V. and Bhusari, K. Applied Microbiology, Him laya Publishing House.
4. S. Aneja K.R., Jain P. and Aneja R., 2008, A textbook of basic and applied microbiology.
5. Madigan, M."T., Martinho, I.M. and Parker, J. Brock biology of microorganisms. Prentice Hall, New Jersey.
6. Evans, G.M. and John, J.C.F. Environmental biotechnology: Theory and applications. John Wiley and Sons, New York.
7. Waste Water Microbiology 2nd Edition by Bitton.
8. Cappucino, J. and Sherman, N. Microbiology: A laboratory manual. Benjamin Cummings Publishing Company, San Francisco.
9. Prescott, L.M. and Harley, J.P. Laboratory exercises in microbiology. McGraw- Hill, New York.

#### Suggested Laboratory Exercises:-

1. Microbiological examination of food.
2. Detection of number of bacteria in milk by standard plate count (SPD).
3. Assay of quality of milk sample using MBRT test.
4. Adulteration tests for milk.
5. Isolation and identification of *Lactobacillus* from fermented dairy products.
6. Isolation and identification of microorganisms from contaminated food and dairy samples.
7. Sampling and analysis of microbial load on food contact surfaces.
8. Micro-organisms degrading oil/ textile dyes/ petrol.
9. Biodeterioration of paper/textiles.
10. Bacteriological examination of water (Potable/hospital waste): Presumptive test; Confirmed Test and Completed Test.
11. Design and operation of multistage reactor for degradation of waste water.
12. Isolation of xenobiotic compound degrading bacteria by enrichment culture technique.

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 2<sup>nd</sup> (SECOND)

Paper: Genetics

Course Code: MBO-201

Unit	Contents of Course	Hrs.
I	Inheritance and allelism: Concept and structure of gene, <i>cis-trans</i> test, Mendelian and non Mendelian inheritance, Co-dominance, incomplete dominance, Gene interactions: Complementary genes, Supplementary genes, Epistasis, Duplicate genes, Polygenic inheritance, Pleiotropy, Multiple alleles and human blood group, Extra nuclear inheritance: Inheritance of mitochondrial and chloroplast genes, cytoplasmic male sterility, Sex determination mechanism, sex linked inheritance, sex limited characters and sex reversal, genomic imprinting.	12
II	Genetic recombination: Homologous and non-homologous recombination, Independent assortment, crossing over; Molecular mechanism of recombination, Holiday junction, site specific recombination, FLP/TRT and Cre/lox recombination, role of Rec-A and Rec-BCD enzymes. Chromosome mapping: Linkage maps, tetrad analysis, mapping with genetic markers, QTL mapping, construction of molecular maps, restriction mapping, Correlation of genetic and physical maps; mapping by using somatic cell hybrids	12
III	Mutations and mutagenesis; Types and nature of mutation: Spontaneous and induced mutations, lethal, conditional, biochemical, loss and gain of function, base substitution, frameshift mutation, germinal versus somatic mutation, physical and chemical mutagens and their effect, Ames test, Mutagenesis: Inspectional mutagenesis by transposons, site directed mutagenesis, in-vitro mutagenesis and deletion technique	12
IV	Structural and numerical alteration in chromosome: Origin, meiosis and breeding behavior of duplication, deficiency, inversion and translocation heterozygote. Origin, occurrence, production and meiosis of Haploids, aneuploids and euploids, Induction and characterization of monosomics and trisomics: Origin, production and meiosis of autopolyploids and allopolyploids; Evolution of major crop plants	12
V	Molecular cytogenetics: Nuclear DNA content, C value paradox, cot curve and its significance, multigene families and their evolution, in situ hybridization - concept and technique, computer assisted chromosome analysis, chromosome micro-dissection and microcloning, flow cytometry and confocal microscopy in karyotype analysis. General account of proteomics, genomics and epigenomics	12
<b>Total</b>		60

## Suggested Laboratory Exercises:

1. Problems related to linkage, crossing over and gene interaction
2. Problems related to gene mapping
3. Construction of restriction map
4. Linear differentiation in chromosome through banding technique
5. Isolation of chlorophyll mutants following irradiation and treatment with chemical mutagen
6. Quantitative estimation of DNA by diphenylamine method
7. Karyotype analysis
8. Induction of polyploidy
9. To study the application of colchicine treatment.
10. Selfing and crossing technique
11. Demonstration of flow cytometry and confocal microscopy
12. Presentation of chart and models related to syllabus
13. Any other exercise based on theory syllabus

## Suggested Reading

1. Benjamin Lenin (2000). Genes X. Oxford university press.
2. Gardner E I, Simmons M I, Snustad D P (1991). Principles of Genetics (III Edn). John Wiley and Sons Inc.
3. William S Klug, Michael R Cummings (1994). Concepts of Genetics. Prentice Hall.
4. Robert J Brooker (2009). Genetics: Analysis and principles (III Edn). McGraw Hill.
5. Daniel L Hartl, Elizabeth W Jones (2009). Genetics: Analysis of genes and genomes (VII Edu). Jones and Bartlett publishers.
6. D Peter Snustad, Michael I Simmons (2010). Principles of genetics (V Edn). John Wiley and Sons.
7. Acquaah G (2007). Principles of Plant Genetics and Breeding, Blackwell Publishing Ltd.USA.
8. Hartl DL and Jones EW (2007). Genetics - Analysis of(Genes and Genomes, 7th edition, Jones and Bartlett publishers.
9. Singh RI (2002). Plant Cytogenetics, 2nd edition, CRC Press.
10. Strickberger MW (2008). Genetics, 3rd Edition, Pearson (Prentice Hall).

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

## SYLLABUS: MSC BOTANY

### Semester 2<sup>nd</sup> (SECOND)

**Paper:** Pteridophyta, Gymnosperms & Paleobotany

**Course Code:** MBO-202

Unit	Contents of Course	Hrs.
I	<b>Pteridophytes:</b> Distribution, origin and evolution, telome theory, classification by International Committee of Botanical Nomenclature (ICBR), Economic importance of Pteridophytes. Origin and evolution of stele, heterospory and seed habit	10
II	General account of fossil Pteridophytes, Psilopsida, Lycopsida, Sphenopsida and Pteropsida classes. Morphology, anatomy, reproduction, classification, life history of: <i>Tmesipteris</i> , <i>Lycopodium</i> , <i>Gleichenia</i> , <i>Isoetes</i> , <i>Ophioglossum</i> and <i>Azolla</i> .	14
III	<b>Gymnosperms:</b> Distribution, morphology, anatomy, reproduction; classification, life history and evolution. Cycadales ( <i>Zamia</i> ), Ginkgoales ( <i>Ginkgo</i> ), Coniferales ( <i>Pinus</i> , <i>Taxus</i> , <i>Araucaria</i> and <i>Biota</i> ), Welwitschiales ( <i>Welwitschia</i> ), Gnetales ( <i>Gnetum</i> ).	14
IV	Paleobotany: History of paleobotany, formation and types of fossils, techniques of Study of fossils, Geological time scale. Paleobotany and the evolution of vascular plants. Applied aspects of paleobotany, use in coal and petroleum exploration.	10
V	Brief account of Pteridospermales ( <i>Lygenopteris</i> , <i>Medullosa</i> , <i>Caytonia</i> and <i>Glossopteris</i> ). Brief account of Cycadeoidales ( <i>Cycadeoidea</i> ), Cordaitales ( <i>Cordaites</i> ).	12
	<b>Total</b>	60

#### Suggested Laboratory Exercises:

Morphological and anatomical study of representative members of Pteridophytes and Gymnosperms in their natural habitat found in your locality with special reference to,

- *Lycopodium*, *Isoetes*, *Gleichenia*, *Ophioglossum* and *Amelia* in Pteridophytes.
- *Zamia*, *Ginkgo*, *Pinus*, *Taxus*, *Araucaria*, *Biota* and *Gnetum* in Gymnosperms.
- Collection and study of fossils.

#### Suggested Readings:

1. Parihar, N.S. 1996. Biology & Morphology of Pteridophytes. Central Book Depot, Allahabad.
2. Sporne, K.K. 1991. The Morphology of Pteridophytes. B.I. Publishing Pvt. Ltd., Bombay.
3. Stewart, W.N. and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press, UK.
4. Bhaniagar, S.P. and Moitm, A. 1996. Gymnosperms. New Age International Pvt. Ltd., New Delhi.
5. Singh, H. 1978. Embryology of Gymnosperms, Encyclopedia of Plant Anatomy Gebruder Borntraeger, Berlin, Germany.
6. Smith, G.M. 1955. Cryptogamic Botany Vol II Tata 1 McGraw Hill Book Co, NY.
7. Pandey, B.P. 1993. College Botany. Vol. II. S. Chant and Company Ltd., New Delhi.
8. Arnold, Chester, A. 2000. An Introduction to Paleobotany. Agrobios, (India).
9. Rashid, A. 2001. An introduction to Pteridophyta (II edition). Vikas publishing house, Pvt. Ltd., New Delhi.
10. Sunderrajan, S. (2007), Introduction to Pteridophyta, New Age International Publishers, New Delhi.

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 2<sup>nd</sup> (SECOND)

PAPER: Plant Morphology & Developmental Anatomy

COURSE CODE: MBO-203

Unit	Contents of Course	Hrs.
I	Introduction: Unique features of plant development, differences between animal and plant development. Seed germination and seedling growth: Metabolism of proteins and mobilization of food reserves, tropisms during seed germination and seedling growth, hormonal control of seedling growth, gene expression, use of mutants in understanding seedling development.	19
II	Shoot development: Organization of the shoot apical meristem (SAM), cytological and molecular analysis of SAM, control of cell division and cell to cell communication, Stem cell in plants, Primary and Secondary tissue differentiation, control of tissue differentiation, especially xylem and phloem, secretory ducts and laticifers, wood development in relation to environmental factors.	15
III	Leaf growth and differentiation: Inception, phyllotaxy, control of leaf form (leaf meristems and other factors), differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll, Kranz anatomy, Leaf traces and leaf gaps, transfer cells.	14
IV	Root development: Organization of root apical meristem (RAM), vascular tissue differentiation, lateral roots, root hairs, root-microbe interactions.	6
V	Seed coat development: External and internal morphology of seed, seed appendages, ontogeny of seed coat in various families, mature structure, spermoderm patterns.	6
<b>Total</b>		60

## Suggested Laboratory/Field Exercises

1. Study of living shoot apices by dissections using plants such as *Tabernaemontana*, *Albizia*
2. Study of cyto-histological zonation in the shoot apical meristem (SAM) in sectioned and double-stained permanent slides of a suitable plant. Examination of shoot apices in a monocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordia.
3. Study of alternate and distichous, alternate and superposed, opposite and superposed, opposite and decussate leaf arrangement. Examination of rosette plants (*Launaea*, *Mollugo*, *Raphanus*, *Hyoscyamus* etc.) and induction of bolting under natural conditions as well as by GA treatment.
4. Microscopic examination of vertical sections of leaves such as *Eucalyptus*, *Ficus*, Mango, *Nerium*, maize, grass and wheat to understand the internal structure of leaf tissues and trichomes, glands etc. Also study the leaf anatomy C<sub>3</sub> and C<sub>4</sub> of plants.
5. Study of epidermal peels of leaves such as *Coccinia*, *Tradescantia* etc. to study the development and final structure of stomata and prepare stomatal index.
6. Study of types of stomata in plants belonging to different families.
7. Study of whole roots in monocots and dicots.
8. Examination of L.S. of root from a permanent preparation to understand the organization of root apical meristem and its derivatives (use maize, aerial roots of banyan etc.).
9. Study of lateral root development.
10. Study of leguminous roots with different types of nodules.
11. Study of primary and secondary tissue differentiation in roots and shoots.
12. Study of seed coat types- *Pisum*, *Cucurbita*, wheat.
13. Study of vascular tissues by clearing technique.

## Suggested Readings:

- Atwill, B.J. Kriedermann, P.E. and Jumbull, C.G.N. (eds). 1999. Plants in Action : Adaption in Nature Performance, in Cultivation, MacMillan Education, Sydney, Australia.
- Bewley. I.D. and Black, M. 1994. Seeds: Physiology of Development and Germination, Plenum Press. New York.
- Burguess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
- Fahn, A. 1982. Plant Anatomy. (3rd edition). Pergamon Press, Oxford, New York.
- Raven. P.H., Evert. R.F. and Eichhom, S. 1992. Biology of Plants (5th edition). Worth, New York.
- Salisbury, P.B. and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing, Belmont, California.
- Steeves, T.A. and Sussex, I.M., 1989. Patterns in Plant Development (2<sup>nd</sup> edition). Cambridge University Press, Cambridge.
- Waisel, Y., Eshel, A. and Kafkaki, U. (eds.). 1996. Plant Roots: The Hidden Hall (2nd edition). Marcel Dekker, New York.

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 2<sup>nd</sup> (SECOND)

PAPER: Bioinformatics & Biostatistics (Elective-I)

COURSE CODE: MBO-204

Unit	Contents of Course	Hrs.
I	Concepts of Bioinformatics: Introduction and future prospects; Applications in genomics and proteomics; Public databases; Gene bank; Database searches: sequence retrieval systems; Similarity searching: BLAST, FASTA, Multiple sequence alignment: CLUSTALW; Detecting functional sites in DNA; Motifs and domain prediction and analysis; Identification of open reading frames (ORB): Gene annotation technology.	11
II	Databases and online tools: Biological Databases: - Types and applications; Sequence databases: - GenBank, EMBL, DDB, PIR-PSD, SWISS-PROT; Structure Databases-PDB, SCOP, NDB; Derived Databases:- PROSITE, PRINTS, TIGR; Online tools:- Genetool; STRING; I-TASSER; Bioedit; BioGRID; MEGA; Sequin, Bankit	9
III	Applications of Bioinformatics: Computational methods for sequence analysis: Dot blot and dynamic programming methods; Phylogenetic analysis; Virtual and electronic cell; Internet tools for DNA sequence translation; Restriction enzyme mapping; Prediction of secondary structure of proteins; Application tools- primer designing, molecular mapping and concept and tools of computer aided drug designing	10
IV	Fundamentals of statistics: Arithmetic mean, median, mode: theory and simple numerical problem; Measures of variation: standard deviation, variance, coefficient of variation; Correlation, types and methods: simple, multiple, linear and nonlinear correlation, Spearman's correlation, rank correlation; Regression: linear and curvilinear regression (for two variable X and Y only), Regression lines by least square method; regression equations of X on Y and, Y on X only; Sample size; Power of study	13
V	Tests of significance: Null hypothesis; Standard error; Level of significance; Degrees of freedom; Significance of mean for large samples; Significance in means for small samples (students t-test); Significance in ratio of two samples; F test (for difference between variance of two samples); Chi square test. Analysis of variance test (ANOVA) for one and two way classification; Calculation of an unknown variable using regression equation. Laws of probability, theorem of total probability	17
	<b>Total</b>	60

## Suggested Laboratory/Field Exercises

1. Introduction to bioinformatics databases (any three): NCBI/PDP/DDBJ, Uniprot, PDB etc.
2. Sequence retrieval using BLAST
3. Sequence alignment
4. Phylogenetic analysis using Clustal-W
5. Protein structure prediction
6. Picking out a given gene from genomes using Genscan or other softwares (promoter region identification, repeat in genome, ORF prediction).
7. Prediction of different features of a functional gene
8. Determination of statistical averages/ central tendencies
  - a) Arithmetic mean
  - b) Median
  - c) Mode
9. Determination of measures of Dispersion
  - a) Mean deviation
  - b) Standard deviation and coefficient of variation
  - c) Quartile deviation
10. Tests of significance- Application of following
  - a) Chi-Square test
  - b) t- test
  - c) Standard error to learn graphical representations of statistical data with the help of computers (e.g. MS Excel).

## Suggested Readings

1. Introduction to Bioinformatics, Attwood, Pearson Education.
2. Bioinformatics: Sequence and Genome Analysis, David W. Mount (2001), Cold Spring Harbor (CSH) Laboratory Press.
3. Coruzzi, G.M. (2009). Plant System Biology, Wiley Publishing House.
4. Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins. 2nd Edition by Baxevanis.
5. Bioinformatics: Sequence, structure and Data Bank: A Practical Approach by Higgins.
6. Introduction to Bioinformatics by Altwood.
7. Protein Biotechnology. Edited by Felix Franks. Humana Press, Totowa, New Jersey.
8. Statistical Methods in Biology - 2000 by Bailey, N.T. J, English Univ. Press. 17,
9. Fundamental or Biostatistics by Khan IS.
10. Introduction to Biostatistics, Le and Chap (2009), Wiley and Sons.
11. Fundamentals of Biostatistics. B. Rosner (2005), Duxbliry Press.

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 2<sup>nd</sup> (SECOND)

PAPER: Principles of Plant Breeding (Elective-II)

COURSE CODE: MBO-204

Unit	Contents of Course	Hrs.
I	Overview & Historical perspectives: history of plant breeding-the pioneers, their theories and plant breeding techniques. Population and quantitative genetic principles: concept of population, gene pool, gene frequency and inbreeding and its implications in breeding, qualitative genetics versus quantitative genetics, the concept of population improvement. Reproductive systems: Importance of mode of reproduction , Types of reproduction, autogamy, haploids and double haploids: their application in plant breeding, allogamy, inbreeding depression, hybrid vigour, hybridization, wide crosses, clonal propagation and <i>In vitro</i> culture	17
II	Germplasm for Breeding: variation-types, origin and scale, plant domestication- centers & models, plant genetic resources- importance & sources of germplasm, concept of gene pools, crop vulnerability, germplasm conservation: <i>in situ</i> & <i>ex situ</i> , types of germplasm collection, germplasm storage technologies, plant explorations & introductions & their impact on agriculture.	10
III	Breeding objectives: yield and morphological trait- yield potential, harvest index, breeding for lodging resistance, shattering resistance, plant stature & early maturity; quality traits- breeding for improved protein content, improved fatty acid content, seedlessness in fruits, delayed ripening & novel traits, breeding for resistance to disease & insect pests - resistance breeding strategies; abiotic stresses -breeding for drought resistance, cold tolerance, salt tolerance, heat stress, aluminum toxicity, oxidative stress, resistance to water jogging	13
IV	Selection Methods: Breeding -self-pollinated species- mass selection, pure line selection, pedigree selection & bulk population; cross pollinated species - hybrid cultivars and clonally propagated species. Molecular Breeding: Molecular markers- classification, mapping of genes- gene maps & QTL mapping, marker assisted selection, mutagenesis and polyploidy in plant breeding	14
V	Marketing and societal issues breeding: performance and evaluation for crop cultivar release, seed certification and commercial seed release, regulatory and legal issues, value driven concepts and social concerns, international plant breeding efforts. Plant cultivar protection, legislation, patenting and transgenics.	6
	<b>Total</b>	60

## Suggested Laboratory/Field Exercises

1. Vegetative propagation methods of important crops of the locality.
2. Emasculation, selfing and crossing techniques.
3. Floral biology in self-pollinated species
4. Floral biology in cross pollinated species
5. Floral biology in self-pollinated species
6. Selection methods in segregating populations and evaluation of breeding material
7. Germplasm conservation methods- *In situ*- & *Ex situ*- methods
8. Haploid production.
9. *In situ* & *Ex situ* conservation methods
10. Analysis of variance (ANOVA).
11. Maintenance of experimental records
12. Field inspection at different growth stages to study various breeding objectives.

## Suggested Readings:

1. George Acquaah. 2012 Principles of Plant Genetics and Breeding. Wiley- Blackwell.
2. B.D. Singh. 2015. Plant Breeding principles & Methods .Kalyani Publishers.
3. Jack Brown , Peter Caligari and Hugo campos. 2014. An Introduction to Plant Breeding. Wiley.
4. Brown and Caligari. 2008. An Introduction to Plant Breeding. Blackwell Publishing.
5. Chepra VL. 2004. Plant Breeding. Oxford & IBH.
6. Gupta SK. 2005. Practical Plant Breeding. Agribios, odhpur
7. Simmonds NW. 1990. Principles of Crop Improvement. English Language Book Society.
8. Dana, Sukumar. 2001. Plant Breeding. Naya Udyog, Lolcutta. 700 006
9. Kuctu, Kobabe and Wenzel (1995). Fundamentals of Plant Breeding, Narosa Publishing House.
10. Singh BD, 2006. Plant Breeding. Kalyani.
11. Singh P. 2006. Essentials of P1ant Breeding. Kalyani.
12. Singh: S & Pawar IS. 2006. Genetic Bases and Methods of Plant Breeding. CBS.

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 3<sup>rd</sup> (THIRD)

PAPER: Biosystematics of Angiosperms

COURSE CODE: MBO-301

Unit	Contents of Course	Hrs.
I	Biosystemic studies: Population concept, methods of biosystematics, biosystematics categories - Ecads, Ecotypes, coenospecies, evolution and differentiation of species - various models. International code of botanical nomenclature: principles, rules and recommendations, Taxonomic concept: Hierarchy, species, genus, family and other categories, Taxonomic literature: Flora, Monograph, Icones, Library, Manuals, Journals, Periodicals, Index.	18
II	Taxonomic tools and techniques: Herbarium: preparation, maintenance, utility, important national, international and digital herbaria, serological, molecular technique, GIS and Mapping biodiversity. Taxonomic evidences: morphology, anatomy, palynology, embryology, cytology, phytochemistry and genome analysis. Classification: phenetic system; phylogenetic- Cronquist, Dahlgren, Thorne and APG system with merits and demerits of these systems.	24
III	Salient features of the groups: Polypetalae, Gamopetalae, Monochlamydae and Monocotyledons. Study of the following families - Ranunculaceae, Caryophyllaceae, Sterculiaceae, Rhamnaceae, Leguminosae, Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae, Asclepiadaceae, Apocynaceae, Convulvulaceae, Solanaceae, Acanthaceae, Lamiaceae, Polygonaceae, Chenopodiaceae, Amaranthaceae, Euphorbiaceae, Cyperaceae and Poaceae	8
IV	Phylogeny of Angiosperm: Ancestors of angiosperms with special reference to <i>Amborella</i> , time and place of origin of Angiosperms, Habit of Angiosperm, primitive living angiosperm, inter relationship among the major groups of Angiosperm.	6
V	Ethnobotany: Scope, Interdisciplinary approaches, ethnic groups of India, conservation practices of biodiversity, role of ethnobotany in national priorities, health care in India	5
	<b>Total</b>	60

## Suggested Laboratory Exercises:

- Description of a specimen from representative, locally available families.
  - List of locally available families  
Ranunculaceae, Capparidaceae, Portulacaceae, Caryophyllaceae, Malvaceae, Tiliaceae, Sterculiaceae, Zygophyllaceae, Rhamnaceae, Sapindaceae, Leguminosae, Combretaceae, Myrtaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae, Primulaceae, Plumbaginaceae, Asclepiadaceae, Convulvulaceae, Solanaceae, Boraginaceae, Polemoniaceae, Acanthaceae, Pedaliaceae, Martyniaceae, Bignoniaceae, Lamiaceae, Nyctaginaceae, Polygonaceae, Chenopodiaceae, Amaranthaceae, Aizoaceae, Molluginaceae, Euphorbiaceae, Commelinaceae, Cyperaceae and Poaceae
- Description of a species based on various specimens to study intraspecific variation: a collective exercise.
- Description of various species of a genus, location of key characters and preparation of keys at generic level.
- Location of key characters and use of keys at family level.
- Field trips within and around the campus, compilation of field notes and preparation of herbarium sheets of such plants, wild or cultivated, as are abundant.
- Training in using floras and herbaria for identification of specimens described in the class.
- Demonstration of the utility of secondary metabolites in the taxonomy of some appropriate genera.
- Comparison of different species of a genus and different genera of a family to calculate similarity coefficients and preparation of dendrograms.

## Suggested Readings:

- Grant, V. 1971, Plant Specimen, Columbia University Press London.
- Grant, W".E. 1984, Plant Biosystematics. Academic press London.
- Heslop- Harrison, J. 1967. Plant Taxonomy, English Language Book Soc. Edward Arnold Pub. Ltd. U.K.
- Jones, S.B, Jr. and Luchsinger, A.E. 1986. Plant Systematic (2<sup>nd</sup> Edition), Mc.Graw-Hill Book Co., New York,
- Nordenstam, B., El Gazi, G. and Kassas, M, 2010 Plant Systematic For 21<sup>st</sup> Century. Portland Press Ltd., London
- Radford, A.E. 1986. Fundamentals of Plant Systematics. Harper & Row Pub., USA.
- Singh, H. 1978, Embryology of Gymnosperms. Encyclopedia of Plant Anatomy X. GebruderBortraeger, Berlin.
- Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.



# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 3<sup>rd</sup> (THIRD)

PAPER: Molecular Biology

COURSE CODE: MBO-302

Unit	Contents of Course	Hrs.
I	Genes and DNA: Genome, gene, evidences of DNA and RNA as the genetic material for bacteria, virus and eukaryotes, Double helical structure of DNA, Denaturation & Renaturation of DNA; DNA supercoiling, Coding DNA, ORF, Gene structure, Non-coding DNA & RNA. DNA replication: Mechanisms or prokaryotic DNA replication: Initiation, Elongation and Termination; Replicons-linear, circular and D-loops; DNA polymerases, helicase, other enzymes and accessory proteins involved in DNA replication. Fidelity of replication and coordinating synthesis of the leading and lagging strand, Okazaki fragments. DNA damage and repair: Causes of DNA damage and molecular mechanisms of repair - excision repair system in bacteria and eukaryotes, base excision, recombination repair systems and SOS repair.	15
II	Transcription and post transcriptional change: Types of RNA, mRNA structure, prokaryotic and eukaryotic RNA polymerases, Transcriptional factors, promoter sequences, binding sites for RNA polymerase, transcription initiation, promoter clearance and elongation, termination, attenuation and anti-termination. Role of enhancers, repressors, mediators, silencers & inhibitors in transcription regulation. RNA splicing and processing: Capping, poly-adenylation, splicing, splicesome, mRNA stability, group I intron, trans-esterification, ribozyme and RNA editing.	13
III	Translation & protein targeting: Code, Translation-formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, aminoacylation of tRNA, aminoacyl tRNA synthetase and termination in prokaryotes and eukaryotes, translational inhibitors, Co and post translational modification of proteins. Protein sorting, and targeting of proteins into chloroplast, mitochondria, vacuoles, and peroxisomes. Protein trafficking.	10
IV	Gene regulation in prokaryotes: Basic models: Lac, arabinose and Tryp operons. Positive and negative controls. Regulation in viruses: Lytic and lysogenic cycle. Regulation of gene expression in eukaryotes: Differential gene expression, Regulation of chromatin structure (Histone modification, DNA methylation, epigenetic inheritance), Regulation of Transcription Initiation (Role of transcription factors, enhancers), Post transcriptional regulation, gene silencing (RNA interference: effect of miRNA and siRNA). Epigenome & epigenetics.	12
V	Techniques of gene expression analysis: Electrophoresis, blotting techniques (Southern, Northern and Western), gene sequencing methods (Sanger's methods, Maxam Gilbert's method, Automated and Pyrosequencing), nick translation, DNA finger printing, RNase protection assay, PCR (semi and quantitative) and Reverse Transcription-PCR, DNA microarrays, DNA- protein interaction (DNA footprinting), Protein-protein interaction (yeast two-hybrid system).	10
	<b>Total</b>	60

## Suggested laboratory Exercises

1. Building of a model of B-DNA
2. Demonstration of linking number in supercoiled B-DNA.
3. Isolation of nuclei and identification of histones by SDS-PAGE.
4. Isolation of plant DNA and its quantitation by a spectrophotometric method.
5. Isolation of DNA, and preparation of cot curve.
6. Separation and visualization of DNA fragments by Agarose gel electrophoresis.
7. Determination of size of DNA by comparison with DNA ladder electrophoretically.
8. Determination of denaturation and denaturation of DBA double helix.
9. Isolation of RNA and quantitation by a spectrophotometric method,
10. Polymerase Chain reaction.
11. Southern blot analysis using a gene specific probe.
12. Immunological techniques: Ouchterlony method, ELISA and western blotting.

## Suggested Readings:

1. Alberts, B., Bray, D., Lewis, et al. Molecular Biology of the Cell. Garland Publishing, Inc., New York,
2. Wolfe, S.L. 1993. Molecular and Cellular Biology. Wadsworth Publishing Co., California, USA.
3. Rost, T. et al. 1998. Plant Biology. Wadsworth publishing Co., California, USA.
4. Buchanan, B.B., Gruissem, W., and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants,
5. Lodish, H., Berk, A., Zipursky, S.L., et al. 2000. Molecular Cell Biology (4<sup>th</sup> Edition). W.H. Freeman and Co., New York, USA.
6. Glick B.R. and Thompson, J.E. 1993. Methods in Plant Molecular, Biology and Biotechnology. CRC Press, Boca Raton, Florida.
7. Glover, D.M. and Hames, B.D, 1995. DNA Cloning 1: A Practical Approach, Core Techniques. Oxford University Press Oxford.
8. Shaw, C.H. (Ed.), 1988. Plant Molecular Biology: A Practical Approach. IRL Press Oxford.

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 3<sup>rd</sup> (THIRD)

PAPER: Plant Physiology & Metabolism

COURSE CODE: MBO-303

Unit	Contents of Course	Hrs.
I	Water relations to plants: Properties of water, properties of solutions, chemical potential, water potential, Soil- plant-atmosphere continuum, Transpiration, Stomatal regulation of transpiration, Anti-transpirants. Translocation of water and solute, mechanism of water transport Cohesion- Tension theory, Pressure flow model. Membrane transport: Passive non-mediated transport, Nernst equation, passive mediated transport, ATP- drive active transport, ion channels. Mineral nutrition: macro and micro nutrients and their role in plants	15
II	Biomolecules: General structure, classification, properties, distribution and functions of primary metabolites (carbohydrates, proteins, amino acids, lipids) and secondary metabolites (flavonoids, alkaloids, steroids) Enzymes- Discovery and nomenclature, characteristics of enzymes. Concept of holzymes, apozymes, coenzyme, ribozyme, abzyme and artificial enzyme. Regulation of enzyme activity, mechanism of action. Michaelis-Menten equation	15
III	Carbohydrate metabolism: Synthesis of carbohydrates: Photosynthetic pigments, absorption and transformation of radiant energy, (light harvest complex-LHC) photooxidation, Red drop effect, Emerson enhancement effect, Photosynthetic quantum yield, Photorespiration, CAM, impact of changing environment effect, Photosynthetic, Industrial photosynthesis, Allocation, translocation and partitioning of photo-assimilate.	9
IV	Degradation of Carbohydrate. Glycolysis, Krebs cycle, Electron Transport System (ETS) and its evolution, Pentose phosphate pathway, Hexose monophosphate shunt, glyoxylate pathway, Glycogenesis, gluconeogenesis, Respiratory inhibitors, High energy compounds, their synthesis and utilization. Nitrogen metabolism: N <sub>2</sub> fixation symbiotic and asymbiotic. Nodule development Amino Acid Metabolism. Fat metabolism: Synthesis of long chain fatty acids, lipid biosynthesis, & oxidation.	12
V	Plant growth regulators: Chemical nature, bioassay, physiological effects and mode of action of Auxins, Gibberelins, cytokinines, abscisic acid and ethylene, Salicylic acid, Strigolactones, Jasmonic acid.	9
<b>Total</b>		60

## Suggested Practical exercises

1. Effect of temperature and different solvents on membrane permeability of beet root.
2. Study of stomatal regulation.
3. Estimation of lipids
4. Separation of chlorophyll by paper chromatography.
5. Separation of amino acids by paper chromatography.
6. Separation of chlorophyll by liquid-liquid chromatography.
7. Test of phenols, steroids alkaloids and terpenoids.
8. Isolation of VAM fungi.
9. Determination of amylase activity.
10. Separation of aliphatic wax components by thin layer chromatography (TLC).
11. Isolation of root nodule bacteria from roots of legume plant.
12. Quantification of protein in given plant sample.
13. Demonstration of Physiological effects of growth regulator.
14. Quantification of carbohydrates in given sample.
15. Demonstration of plasmolysis in *Rheo discolor* leaf peel.
16. The effect of temperature on enzyme activity.
17. The effect of pH on enzyme action.
18. To determine total soluble carbohydrates in given plant material.
19. To determine proline in given plant material.

## Suggested Readings

1. Taiz L and Zeiger E. (2006) Plant Physiology, 4th Edition, Sinauer Associates Inc. Publishers, Massachusetts, USA.
2. Salisbury, F.B. and Ross, C.W. 1992. Plant Physiology. Asia Ltd. Singapore.
3. Devlin, R.M. and Witham, F.H. 1986. Plant Physiology, 4th Ed. CBS Pub. DelN.
4. Verma, S K. A Textbook of Plant Physiology, Biochemistry & Biotechnology. S. Chand & Co.
5. Hopkins WG & Huner NFA. 2004. Introduction to Plant Physiology. John Wiley & Sons
6. Voet, D and Voet J.G. 1995. Plant Biochemistry, John Wiley, New York.
7. Lehninger, A.L. 1982. Principles of Biochemistry, CBS Publication

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 3<sup>rd</sup> (THIRD)

PAPER: Genomics & Proteomics (Elective-I)

COURSE CODE: MBO-304

Unit	Contents of Course	Hrs.
I	<b>Genomic analysis:</b> Introduction to genome and genomics, Structural & functional genomics, Structure & organization of prokaryotic ( <i>E. coli</i> ) & eukaryotic genome (Yeast), Genome and gene databases, Brief Outlook of Various Plant Genome Projects and their Outcome ( <i>Arabidopsis</i> , Tomato, Potato, Rice)	8
II	Human Genome Project. Genome sequencing strategies, new technologies for high throughput sequencing, Various Approaches in sequencing genome; shotgun, directed short gun & Clone Contig Approach, Primer Walking, Chromosome Walking, Chromosome Jumping, Contig assembly, Methods for sequence alignment and gene annotation.	8
III	Approaches to analyze differential expression of genes - ESTs, SAGE, microarrays and their applications, gene tagging, gene and promoter trapping; knockout and knock-down mutants. Transcriptome, Transcriptomics, RNA interference and gene silencing, genome imprinting, small RNAs-biogenesis and functions, role of small RNAs in heterochromatin formation and gene silencing, tools to study methylome and histone modifications.	15
IV	Proteomics: Introduction to Proteome, Sequence & Structural Proteomics, Interaction Functional Proteomics. Tools and techniques of proteome analysis: 1-D and 2 D gel electrophoresis, DIGE (Differential In Gel Electrophoresis), Image analysis of 2D and DIGE gels: spot detection & quantitation, gel matching, data analysis and presentation, Liquid Chromatography and Multidimensional Chromatography; Protein Identification by Mass Spectroscopy (MALDI/TOF), LC/MS-MS for identification of proteins, Peptide Mass Fingerprinting, Protein <i>de novo</i> sequencing.	15
V	Analysis of proteins by different biochemical and biophysical procedures: CD (Circular Dichroism), NMR, Analysis of post-translational modifications and protein- protein interactions; protein chips and arrays, Proteome Databases: Protein Sequence Database. SWISS-PROT, PROSITE, PDB etc. other pi'otein related bioinformatics tools (ERASE, PRAM). Applications of proteornics in medicine, toxicology and Pharmaceuticals.	14
	<b>Total</b>	60

## Suggested Practical Exercises:

1. Demonstration and listing of sequence retrieval online tools.
2. Demonstration and listing of sequence submission online tools.
3. Listing and demonstration of Protein and DNA Sequence Databases and their utilities.
4. Demonstration of DBA and Protein Array Technology and applications.
5. Reverse transcription-PCR to examine gene expression.
6. Real-time PCR to quantify gene expression.
7. Northern and Western Blotting analysis.
8. Demonstration of Instrumentation (MALDI/TOF, LC-MS-MS, 2DGE) by visit or audio-visual medium.
9. Protein separation techniques (Chromatography-Ion-Exchange, Gel Filtration, Affinity; Ultrafiltration, Recombinant protein separation techniques)
10. Comparison of Next-generation sequencing methods (by Chart/ poster preparation).
11. Any other exercises designed by course teacher as per the syllabus.

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 3<sup>rd</sup> (THIRD)

PAPER: Plant Biochemistry & Metabolism (Elective-II)

COURSE CODE: MBO-304

Unit	Contents of Course	Hrs.
I	<b>Energy:</b> Principles of thermodynamics, free energy, Concept of energy rich compounds and intermediates, Structure and function of ATP, ATP synthesis and chemo-osmotic hypothesis of ATP generation, Redox reaction, Types and mechanisms of Phosphorylation. <b>Nucleotides metabolism:</b> Biosynthesis of ribo-nucleotides and of deoxy- ribonucleotides- salvage and denovo pathways, nucleotide degradation	15
II	<b>Enzymes:</b> Enzyme kinetics. Michalis- Menten equation and significance of Km value, negative and positive co-operativity, enzyme nomenclature and EC number, Catalytic mechanisms: Acid-Base catalysis, covalent catalysis. Metal-ion catalysis, electrostatic state bonding, Lysozyme as model enzyme for catalytic mechanism, Regulation of enzyme activity: feedback and allosteric regulation, active sites, isozymes, activators and inhibitors.	15
III	<b>Proteins:</b> Structure, Ramchandran Plot, techniques of protein purification. Protein sequencing and proteomics, Dynamics of protein structure, Protein structure prediction tools, Protein Folding, protein stability, globular proteins and maintenance of specific confirmation, structural evolution. Molecular Chaperons, Protein Data Banks.	15
IV	<b>Secondary Metabolites:</b> Detailed account of Coumarins, Lignins, Insecticides (pyrethrins and rotenoides), Tannins, Flavonoids. Alkaloids and Steroid and their role in plant defense.	8
V	<b>Vitamins:</b> Water and fat soluble vitamins , biochemical functions of thiamine, riboflavin, nicotinic acid, pantothenic acid, pyridoxine, biotin, folic acid, vitamin B12, ascorbic acid, Vitamin A and Vitamin D.	7
	<b>Total</b>	60

## Suggested Laboratory Exercises:

1. Estimation of lipids
2. Separation of chlorophyll by paper chromatography.
3. Separation of amino acids by paper chromatography.
4. Separation of chlorophyll by liquid-liquid chromatography.
5. Test of phenols, steroids, alkaloids and terpenoids.
6. Isolation of VAM fungi
7. Quantification of protein in given plant sample.
8. Separation of aliphatic wax components by thin layer chromatography (TLC)
9. Quantification of carbohydrates in given sample.
10. Study of stomatal regulation.
11. Demonstration of physiological effects of growth regulator.
12. Effect of temperature and different solvents on membrane permeability of beet
13. To determine proline in given plant material.
14. The effect of temperature on enzyme activity.
15. The effect of pH on enzyme action.
16. Determination of amylase activity
17. Demonstration of plasmolysis in *Rheo discolor* leaf peel.
18. Isolation of root nodule bacteria from roots of legume plant.

## Suggested Readings

1. Lehninger AL, Nelson DL, Cox MM: Principles of Biochemistry. 3rd edition. Macmillan Publishers, Worth New York. 2000.
2. Jain JL: Fundamental of Biochemistry. 2nd ed., S. Chand & Co. Ltd., New Delhi. 1990.
3. Voet D, Voet JG: Biochemistry. 2nd edition. Wiley, New York. 1995.
4. William G. Hopkins and Norman P. Huner. (2009), Introduction to Plant Physiology, Published by John Wiley & sons, Inc, USA
5. Lincoln Taiz (2014). Plant Physiology and Development, Published by Oxford University Press.
6. Bob B Buchanan, W. Gruissem, and RL Jones (2015) Biochemistry and Molecular Biology of Plants, 2nd Edition, Published by Wiley-Blackwell.

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 4<sup>th</sup> (FOUR)

PAPER: Plant Reproductive Biology

COURSE CODE: MBO-401

Unit	Contents of Course	Hrs.
I	<b>Flower development and differentiation:</b> Flower development, genetics of floral organ differentiation, homeotic mutants in <i>Arabidopsis</i> and <i>Antirrhinum</i> , sex determination. <b>Female gametophyte:</b> Ovule development, megasporogenesis, ultrastructural aspects of embryo sac development.	13
II	<b>Male gametophyte :</b> Structure of anthers, microsporogenesis, role of tapetum, pollen development and gene expression, male sterility, sperm dimorphism and hybrid seed production, pollen germination, pollen tube growth and guidance, pollen storage, pollen allergy, pollen embryos	13
III	<b>Pollination,</b> pollen-pistil interaction and fertilization: Floral characteristics in relation to pollination, structure of the pistil, pollen-pistil interactions, sporophytic and gametophytic self-incompatibility (cyological, biochemical and molecular aspects), double fertilization, in vitro fertilization.	13
IV	<b>Endosperm and Embryo development:</b> Endosperm development, embryogenesis storage proteins of endosperm and embryo, Polyembryony, apomixis, dynamics of fruit growth, biochemistry and molecular biology of fruit maturation. Embryo rescue in wide hybridization, Introduction to embryo culture, endosperm and ovary culture.	10
V	Latent life - Dormancy: importance and types of dormancy, seed dormancy, overcoming seed dormancy, bud dormancy. Senescence and Programmed Cell Death (PCD) : Basic concepts, types of cell death, PCD in the life cycle of plants. metabolic changes associated with senescence and its regulation, influence of hormones and environmental factors on senescence	11
<b>Total</b>		<b>60</b>

### Suggested Practical/Field Exercises:-

1. Study of microsporogenesis and gametogenesis in sections of anthers of different ages.
2. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (maize, grasses, *Cannabis sativa*, *Crotolaria*, *Tradescantia*, *Brassica*, *Petunia*, *Solanum melongena*, etc.)
3. Study of wall layers of anther.
4. Tests for pollen viability using stains and in vitro germination.
5. Pollen germination using hanging drop and sitting drop cultures, suspension culture and surface culture.
6. Estimating percentage and average pollen tube length in vitro.
7. Study of ovules in cleared preparations, study of monosporic, bisporic and tetrasporic types of embryo sac development through examination of permanent, stained serial sections.
8. Field study of several types of flower with different pollination mechanisms.
9. Emasculation, bagging and hand pollination to study pollen germination.
10. Study of nuclear and cellular endosperm through dissections and staining.
11. Isolation of zygotic globular, heart-shaped, torpedo stage and mature embryos from suitable seeds.
12. Polyembryony in citrus, jamun (*Syzygium cumini*) etc. by dissections.
13. Endosperm, ovary and embryo culture.
14. Biochemical estimation (qualitative and quantitative) of metabolites of seeds

### Suggested Readings

1. Atwill, B.J. Kriedermann, P.E, and Turnbull, C.G.N. (eds). 1999. Plants in Action: Adaption in Nature Performance, in Cultivation, MacMillan Education, Sydney, Australia.
2. Bewley, J.D. and Black, M. 1994. Seeds: Physiology of Development and Germination, Plenum Press, New York.
3. Bhojwani, S.S. and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4 revised and enlarged edition). Vikas Publishing House, New Deih.
4. Burgess, I. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
5. Fageri, K. and Van der Pijl, L. 1979, The Principle of Pollination Ecology. Pergamon Press, Oxford.
6. Fahh, A. 1982. Plant Anatomy. (3rd edition). Pergamon Press, Oxford.
7. Fosker, D.E. 1994. Plant Growth and Development. A Molecular Approach. Academic Press, San Diego.
8. Howell, S.H. 1998. Molecular Genetics of Plant Developmem. Cambridge University press, Cambridge.
9. Leins, P., TucKer, S.C. and Endress, P.K. 1988. Aspects of Floral Development, J. Cramer, Gemiany.
10. Lyndon, R.F. 1990. Plant Development. The Cellular Basis, UnninByman, London.
11. Murphy, T.M. and Thompson, W.E, 1988. Molecular Plant Development. Prentice Hall, New Jersey.
12. Raghavan, V. 1997. Molecular Embryology of Flower ing Plants. Cambridge University Press, Cambridge.
13. Raven, P.H., Evert, R.F. and Eichhom, S. 1992. Biology of Plants (5th edition). Worth, New York.

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 4<sup>th</sup> (FOUR)

PAPER: Plant Tissue Culture & Genetic Transformation

COURSE CODE: MBO-402

Unit	Contents of Course	Hrs.
I	<p><b>Historical perspectives:</b> Concept of cell culture, development of tissue culture, Root tip culture, Embryo culture, Stem tip culture, Role of auxin, Discovery of cytokinin, hormonal control of organ formation, improvement of media, Preparation and cloning of single cell culture, Contribution of various scientists, Recent advances.</p> <p><b>Laboratory facilities, Operation &amp; Management:</b> Organization of laboratory, Equipments commonly used, media composition, preparation and handling, aseptic manipulation and preparation of explants</p> <p><b>Cellular totipotency:</b> Process and mechanism, concept of differentiation, dedifferentiation &amp; redifferentiation</p>	12
II	<p><b>Cell culture and cell cloning:</b> Isolation of single cells, growth &amp; subculture of suspension cultures, Types &amp; culture medium for cell suspensions, synchronization &amp; measurement of growth in suspensions, Viability of cultured cells, culture techniques and applications such as isolation and characterization of mutant plant cell cultures.</p> <p><b>Virus free plants:</b> Shoot tip culture, thermotherapy &amp; meristem culture, cryotherapy, Chemotherapy, Virus Indexing, Micropropagation: Proliferation of axillary buds, steps and advantages, Embryo culture and Embryo rescue for wide cross hybrids</p> <p><b>Somatic embryogenesis:</b> requirements, protocol in dicots &amp; monocots, Induction and controlling factors, Practical applications, Artificial Seeds: synthesis method &amp; Applications.</p> <p><b>Organogenesis:</b> Direct and from &amp; callus &amp; suspension cultures, Process and controlling factors.</p>	12
III	<p><b>Anther culture for Double Haploid Production:</b> Androgenic and gynogenesis: Technique, Factors influencing anther culture, Pathways for development of Androgenic Haploids, Isolated Pollen culture method, genetic stability and variability of pollen-derived plants, Diplodisation of haploid plants. Application of haploids in Plant Breeding,</p> <p><b>Ovary and Endosperm culture.</b></p> <p><b>Somatic hybridization:</b> Isolation, Viability and culture of Protoplast, culture techniques, Protoplast fusion; types, methods, selection of somatic hybrids &amp; cybrids by various methods, Somaclonal and gametoclonal variation and their selection: Causes of Variation, Induction of variation, detection and Isolation of variant, Application in Plant breeding.</p>	12
IV	<p><b>Methods of plant transformation:</b> Direct gene transfer methods, <i>Agrobacterium</i>- mediated gene transfer, Biology of <i>Agrobacterium</i>, mechanisms of T-DNA transfer and integration, Chloroplast transformation and clean gene technology.</p> <p><b>Secondary metabolites-</b>Why do Plants Produce Secondary Metabolites? Process, methods and applications of Secondary Metabolites, Medium Composition and Effect of Nutrients, Elicitor-Induced Production of Secondary Metabolites, Effect of Environmental Factors, Biotransformation Using Plant Cell Cultures.</p> <p>Micro-techniques and analytical procedures used for plant cultures: Histological techniques, TEM and SEM, Staining procedures for chromosome analysis, ELISA to certify pathogen free plants.</p>	12
V	<p>Role of plant tissue culture in Biodiversity conservation and economic development. <i>In vitro</i> conservation method, conservation of endangered plant species, Cryopreservation for germplasm collection, Pollen and spore gene banks.</p> <p>Floriculture: APEDA, Status in India, Economics, and Case studies: <i>Dianthus</i></p> <p>Tissue culture studies in medicinal plants, for rapid propagation of trees, for biomass energy production, forestry, for fruit trees and for improvement in cereal production. Agencies funding projects on Tissue culture: CSIR, DBT, UGC, ICT, DST &amp; MoEF. Low cost options for tissue culture technology in developing countries- Integration of technology from lab to land, Green House features.</p>	12
<b>Total</b>		60

### Suggested Laboratory Exercises:

1. Preparation of media for PTC.
2. Surface sterilization technique for preparation of explants.
3. Micro propagation technique
4. Organ culture
5. Callus propagation, organogenesis, transfer of plants to soil.
6. Anther culture, production of Haploids.
7. Preparation of synthetic seeds
8. Cytological examination of regenerated plants.
9. Isolation of protoplasts from various plant tissues and testing their viability.
10. Single cell culture techniques: Bergmann plating technique, hanging drop & nurse cell culture
11. Hairy root cultures
12. Elicitation and precursor feeding
13. Extraction of alkaloids and flavonoids from plant material and their separation using TLC.

### Suggested Readings:

1. M.K. Razdan 2003. An Introduction to Plant Tissue Culture. Oxford & IBH Publishing Co. Pvt. Ltd.
2. Bhojwani, Sant Saran, Dantu, Poem Kumar. Plant Tissue Culture: An Introductory Text.
3. Robert N. Trigiano, Dennis J. Gray. Plant Tissue culture, Development, and Biotechnology. CRC Press.
4. Roberta Smith 2012. Plant Tissue Culture. Academic Press. . 3<sup>rd</sup> Edition.

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 4<sup>th</sup> (FOUR)

PAPER: Plant Ecology

COURSE CODE: MBO-403

Unit	Contents of Course	Hrs.
I	<b>Science of Ecology:</b> Introduction to ecology, evolutionary ecology, ecological model <b>Population:</b> Characteristics of population, population size and exponential growth, limits of population growth, population dynamics, life history pattern, fertility rate and age structure, population growth. Competition and coexistence, intra-specific interactions, interspecific interactions, scramble and contest competition model, mutualism, communalism and allelopathy, prey-predator interactions.	15
II	<b>Vegetation organization:</b> Concepts of community and continuum, community coefficients, interspecific associations, ordination, species diversity and pattern diversity in community, concept of habitat and ecotone, ecological niche. <b>Vegetation development:</b> Temporal changes (cyclic and non-cyclic), mechanism of ecological succession (relay floristic and initial floristic composition), succession models (facilitation, tolerance and inhibition models), Changes in ecosystem properties during succession, concept of climax.	15
III	<b>Ecosystems:</b> Nature and size of ecosystem, components of an ecosystem (producers, consumers and decomposers), Grazing (grassland) and Detritus food chain in freshwater ecosystems, food webs, Ecological energetic: Solar radiation and energy intakes at the earth's surface, energy flow models, Productivity of various ecosystems of the world and global biogeochemical cycles of carbon and nitrogen, <b>Ecosystem Management:</b> Homeostasis and cybernetics of ecosystem, Resilience of ecosystem, Restoration of degraded ecosystems, ecology of plant invasion. Ecosystem services,	15
IV	Biomes, Biodiversity & Conservation: Major biomes of the world and Impact of changing climate on biomes, Biodiversity assessment (local, national and global), loss of diversity, conservation (ex-situ and in situ) and management, International Conservational organizations, biodiversity act of India and related international Conventions.	8
V	Diversity indices, sustainable development, natural resource management in changing environment, molecular ecology, genetic analysis of single and multiple population, molecular approach to behavioral ecology, conservation genetics.	7
<b>Total</b>		60

### Suggested Laboratory Exercises

- To determine minimum size and number of quadrat required for reliable estimate of biomass in grasslands.
- To compare protected and unprotected grassland stands using community coefficients (similarity indices).
- To estimate IVI of the species in a grassland/woodland using quadrat method.
- To determine gross and net phytoplankton productivity by light and dark bottle
- To determine soil moisture content, porosity and bulk density of soils collected from varying depths at different locations.
- To determine the Water holding capacity of soils collected from different locations.
- To determine percent organic carbon and organic matter in the soils of cropland, grassland and forest.
- To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples by azide modification of Wrinkler's method.
- To estimate chlorophyll content in SO<sub>2</sub> fumigated and un-fumigated plants leaves.
- To estimate rate of carbon dioxide evolution from different soils using soda lime or alkali absorption method.
- To study environmental impact of a given developmental activity using checklist as a EIA method

### Suggested Readings

- Smith, R.L. 1996. Ecology and Field Biology, Harper- Collins, New York.
- Muller-Dombois, D. and Ellenberg, H., 1974. Aims and Methods of Vegetation Ecology, Wiley, New York.
- Begon, M. Harper, J.L. and Townsend, C.I.C 1996. Geology; Blackwell Science, Cambridge, U.S.A.
- Ludwig, I. and Reynolds, J.F. 1988. Statistical Ecology. John Wiley & Sons.
- Odum, E.P. 2005. Fundamentals of Ecology, Saunders, Philadelphia.
- Odum, E.P. 2005. Basic Ecology, Saunders, Philadelphia.
- Barbour, M.c., Burt, J.H. and Pitts, W.D. 1987. Terrestrial Plant Ecology, Benjamin/Cummings Publication Company, California.
- Kormondy, E.J., 1996. Concepts of ecology. Prentice-Hall of India Pvt. Ltd., New Delhi.
- Chapman, T.L. and Reiss, M.J. 1988. Ecology, Principles and Applications. Cambridge University Press, Cambridge, U.K.
- Molan, B. and Billharz, S. 1997. Sustainability Indicators, John Wily Sons, New York.
- Heywood, V.H. and Watson, R.T. 1985. Global Biodiversity Assessment. Cambridge University Press.
- N.S. Subrahmanyam and A.V.S.S. Sambarn 2000. Ecology. Narosa Publishing House, Delhi
- S.K. Maiti. 2004. Handbook of Methods in Environmental Studies Vol. 1 &2. ABD Publisher, Jaipur.
- J. L. Chapman and M. J. Reiss. 1995. Ecology principles and applications. Cambridge University Press.
- G.T. Miller Jr. 2005. Essentials of Ecology. 1st Edition, Thomson, Brooks/Cole

# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 4<sup>th</sup> (FOUR)

PAPER: Methods in Plant Sciences (Elective-I)

COURSE CODE: MBO-404

Unit	Contents of Course	Hrs.
I	<b>Centrifugation:</b> Plant Extraction and isolation of cell organelles, Basic principle. RCM, classification, Ultracentrifuge, Precautions and applications. <b>Spectroscopy:</b> Ultraviolet and visible: principle, Instrumentation, Sampling, application in Biology- DNA, RNA quantification and purity check. Fluorescence & Phosphorescence spectrophotometry: instrumentation & application. Quantification of Biomolecules. Calorimetry and Visible Spectrophotometry	13
II	<b>Immuno techniques:</b> Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, <i>in situ</i> localization by techniques such as FISH and GISH. <b>Biophysical Method:</b> Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, Molecular structure determination using X- ray diffraction and NMR, Molecular analysis using light scattering, different types of mass spectrometry .	15
III	<b>Radiolabeling techniques:</b> Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, Autoradiography- Principle, method, use in gene probe molecules, safety guidelines	6
IV	<b>Microscopic techniques:</b> Visualization of cells and sub cellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.	8
V	<b>Statistical Methods:</b> Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; F-test; Analysis of variance; <i>Chi-square</i> test. <b>Bioinformatics</b> (Definition, history, applications & scope): Biological databases and Sequence analysis. BLAST and FASTA, Multiple sequence alignment, phylogenetic analysis and Bioinformatics in drug discovery.	18
<b>Total</b>		60

### Suggested Laboratory Exercises:

1. Instrumentation in Lab.
2. Microscopy- SEM, TEM, Fluorescence, Staining & fixation procedures
3. Centrifugation technique for isolation of cell organelles
4. Separation of biomolecules by Column/TLC/partition chromatography.
5. Measurement of cell size using stage micrometer and ocular micrometer.
6. Quantification of DNA by UV-Visible spectrophotometer.
7. Quantification of RNA by UV-Visible spectrophotometer
8. NMR spectroscopy technique.
9. IR spectroscopy technique.
10. Numericals related to biostatistics
11. ELISA, RIA, Flow cytometry
12. BLAST and FASTA
13. Phylogenetic analysis
14. Any other Exercise within scope of the syllabus

### Suggested Readings:

1. Keith Wilson and John Walker, (2005). Principles and Techniques of Biochemistry and Molecular Biology, 6th edition, Cambridge University Press.
2. K. L. Ghatak, 2011. Techniques and Methods in Biology. PHL learning Private Limited, New Delhi.
3. Upadhyay, Upadhyay and Nath, (2014). Biophysical Chemistry-Principles and Techniques, 4<sup>th</sup> Edition, Himalaya Publishing House Pvt. Ltd.
4. Hammes GD (2005) Spectroscopy for the Biological Sciences: Wiley Interscience, USA,
5. Vinay Sharma, (2008). Text Book of Bioinformatics. Rastogi Publications.
6. Pranav Kumar (2016). Fundamentals and Techniques of Biophysics and Molecular Biology Paperback. Pathfinder Publication.
7. Rosener (2010). Fundamentals of Biostatistics. Cengage Learning, Inc.



# SHRI JJT UNIVERSITY, JHUNJHUNU, RAJASTHAN

SYLLABUS: MSC BOTANY

Semester 4<sup>th</sup> (FOUR)

PAPER: Phytochemistry & Herbal Medicine (Elective-II)

COURSE CODE: MBO-404

Unit	Contents of Course	Hrs.
I	<b>Historical background &amp; Present status-</b> Scope of Medicinal Botany, Indigenous medical system, Bioprospecting, Indigenous Knowledge system, Ayurveda, Siddha, Unani, Homeopathy, Tibetan and Folklore system of medicine. Need to Preserve Knowledge system.	10
II	<b>Phytochemical screening of crude drugs:</b> Crude Drugs: Scope & Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Cultivation, Collection & Processing of Crude Drugs.	8
III	<b>Extraction and Characterization of Phytochemicals:</b> Extraction, isolation, purification, characterization of following phyto-constituents such as Carbohydrates & Derived Products; Glycosides- Digoxin, Sennosides ( <i>Digitalis</i> , <i>Aloe</i> , <i>Dioscorea</i> - Extraction Methods); Tannins (Hydrolysable & Condensed Types); Volatile Oils (Clove, Mentha- Extraction Methods); Alkaloids: Caffeine, Atropine, Ergometrine, Morphine; Flavonoids- Rutin, Quercetin; Terpenoids- Taxol, Pyrethrin; Saponins- Glycyrrhizinic acid, Diosgenin.	15
IV	<b>Analysis of Phytochemicals:</b> Standardization of phyto-pharmaceuticals by: UV, IR, HPLC, and HPTLC, GCMS techniques. Preliminary screening, Assay of Drugs- Biological Evaluation/Assays, Microbiological Methods; Methods of Drug Evaluation (Morphological, Microscopic, Physical & Chemical); Processing, equipment and analytical profiles; Sterility, stability and preservation of extracts; Drug Adulteration: Types of Adulterants.	15
V	<b>Indian Trade in Medicinal and Aromatic plants:</b> Export potential of Indian medicinal herbs. Indian medicinal plants used in cosmetics and aromatherapy. Spices and their exports, Classification of medicinal plant based industry, Production and utilization of medicinal plants and their products in India, List of medicinal plants cultivated in India. <b>Global regulatory status of herbal medicines:</b> Patents: Indian and international patent laws, Recent amendments as applicable to herbal natural products and processes.	12
<b>Total</b>		60

## Suggested Laboratory Exercises:

- Crude drug preparation methods.
- Demonstration of Soxhlet extraction method.
- Solvent Screening for various phytochemical extractions.
- Extraction methods of Phytochemicals (alkaloids, tannins, glycosides, Flavonoids)
- Reagent test of alkaloids determination in plants (Dragendorff's reagent, Meyer's reagent, Hager's reagent, Wagner's Test).
- Phytochemical screening and detection of carbohydrates (Molisch's Test, Benedict's test, Fehling's Test)
- Phytochemical screening and detection of glycosides-, saponins, phytosterols, flavonoids, and tannins extracted from plant samples (at least one assay for each type of phytochemical)
- Demonstration of counter current extraction, microwave-assisted extraction, ultrasound extraction (sonication), supercritical fluid extraction, and distillation techniques (water distillation, steam distillation, phytonic extraction (with hydro fluorocarbon solvents).

## Text /References Books:

- Craig, C R. and Stitzel, B.E.; Modem Pharmacology, Little Brown and Co, Boston
- S. Drill, V.A.; Pharmacology in Medicine, McGraw Hill, New York
- Goodman and Gilman; Pharmacological Basis of Therapeutics, McGraw Hill
- Trease and Evans, Pharmacogroscopy, Saunders Company, London.
- Wallis T. E., Text Book of Phannacognosy, CBS publishers & distribution, Delhi.
- Textbook of Industrial Pharmacognosy, by A. N, Kalia, CBS Publishers and Distributors. New Delhi
- Chaudhari R D, Herbal Drug Industry, Eastern publication,
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