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Department of Botany

Illustrative Credit Distribution Structure for One/Two Year Post Graduate Degree Programme in Botany

Illustrative Credit distribution structure for Two Years/ One Year PG (M.A./M.Sc./M.Com.) and Ph. D. Programme

Year (2 Yr PG)	Level	Sem. (2 Yr)	Major		RM	OJT / FP	RP	Cum. Cr.	Degree
			Mandatory	Electives					
I	6.0	Sem I	12-14 (2*4 +2*2 or 3*4+2)	4	4			20-22	PG Diploma (after 3 Yr Degree)
		Sem II	12-14 (2*4 +2*2 or 3*4+2)	4		4		20-22	
Cum. Cr. For PG Diploma			24-28	8	4	4	-	40-44	
Exit option: PG Diploma (40-44 Credits) after Three Year UG Degree									
II	6.5	Sem III	12-14 (2*4 +2*2 or 3*4+2)	4			4	20-22	PG Degree After 3- Yr UG Or PG Degree after 4- Yr UG
		Sem IV	10-12 (2*4 +2 or 3*4)	4			6	20-22	
Cum. Cr. for 1 Yr PG Degree			22-26	8			10	40-44	
Cum. Cr. for 2 Yr PG Degree			46-54	16	4	4	10	80-88	
2 Years-4 Sem. PG Degree (80-88 credits) after Three Year UG Degree or 1 Year-2 Sem PG Degree (40-44 credits) after Four Year UG Degree									
	8.0		Course Work Min. 12 (3*4)		Training in Teaching / Education/ Pedagogy: 4		16 + Ph. D. Work		Ph.D. in Subject

Abbreviations: Yr.: Year; Sem.: Semester; OJT: On Job Training; Internship/ Apprenticeship; FP: Field projects; RM: Research Methodology; Research Project: RP; Cumulative Credits: Cum. Cr.

SEMESTER WISE COURSE STRUCTURE OF M.SC. BOTANY

M.Sc. Part I (Level 6.0) SEMESTER- I

Sr. No.	Course Type	Course Code		Title of the Course	Total Credit	Hours/ Semester	Teaching Scheme (hrs/week)		Continuous Evaluation Scheme		
							Theory	Practical	Internal Evaluation (CIE) (CA)	End Semester Evaluation (ESE) (UA)	Duration of Examination (Hrs)
							T	P			
1	DSC Major	DSC-25 [T]	BOT-MJ-501	Plant Systematics- I (Algae, Fungi and Bryophytes)	4	60	60	-	40	60	3.00
		DSC-26 [T]	BOT-MJ-502	Taxonomy of Angiosperms	2	30	30	-	20	30	2.00
		DSC-27 [T]	BOT-MJ-503	Applied Plant Biotechnology	4	60	60	-	40	60	3.00
		DSC-28 [P]	BOT-MJP-505	Practical Based on BOT-MJ-501, BOT-MJ-502, BOT-MJ-503	4	120	-	120	40	60	3.00
2	DSE Major	DSE-5 [T] (Any One)	BOT-EC-521	Plant Pathology	4	60	60	-	40	60	3.00
			BOT-EC-522	Anatomy and Histochemistry	4	60	60	-	40	60	3.00
3	Research	RM [T]	BOT-RM-541	Research Methodology	4	60	60	-	40	60	3.00
Total					22	390	210	120	220	330	---

M.Sc. Part I (Level 6.0) SEMESTER- II

Sr. No.	Course Type	Course Code		Title of the Course	Total Credit	Hours/ Semester	Teaching Scheme (hrs/week)		Continuous Evaluation Scheme		
							Theory	Practical	Internal Evaluation (CIE) (CA)	End Semester Evaluation (ESE) (UA)	Duration of Examination (Hrs)
							T	P			
1	DSC Major	DSC-29 [T]	BOT-MJ-551	Plant Systematics- II (Pteridophytes, Gymnosperms & Paleobotany)	4	60	60	-	40	60	3.00
		DSC-30 [T]	BOT-MJ-552	Plant Physiology and Metabolism	2	30	30	-	20	30	2.00
		DSC-31 [T]	BOT-MJ-553	Cytogenetics and Molecular Biology	4	60	60	-	40	60	3.00
		DSC-32 [P]	BOT-MJP-504	Practical Based on BOT-MJ-551, BOT-MJ-552 & BOT-MJ-553	4	120	-	120	40	60	3.00
2	DSE Major	DSE-6 [T] (Any One)	BOT-EC-571	Plant Breeding & Seed Technology	4	60	60	-	40	60	3.00
			BOT-EC-572	Plant Ecology and Phytogeography	4	60	60	-	40	60	3.00
3	FP/OJT/ RP	OJT/INT	BOT-OJT-591	On Job Training/Internship/Apprenticeship	4	60	-	60	40	60	3.00
Total					22	390	210	180	240	330	---

Department of Botany Pratap College, Amalner (Autonomous)



M.SC. BOTANY PROGRAMME OUTCOMES (PO'S)

- ❖ Students are expected to learn about the basics of lower plants and their importance.
- ❖ Important aspects of plant pathology such as diseases caused by fungi, bacteria and viruses and defence mechanisms will be dealt with suitable details for the benefit of the students.
- ❖ Students will learn about the diversity of flowering plants, families and their different systems of classifications.
- ❖ To inspire students to understand the anatomy, embryology and palynology of angiosperms.
- ❖ Will gain knowledge about some important aspects of biochemistry, biosynthetic and metabolic pathways, plant metabolism, factors affecting plant growths etc.
- ❖ Different aspects of cell biology/cytology including plant cell structure, components and functions; different aspects of genetics and plant breeding, seed science will be learnt by the students.
- ❖ Different biological processes at molecular level and different modern techniques in the field of biotechnology with reference to plants with hands on training will be provided.
- ❖ On completion of the course students will have the expertise in Bioprospecting, test various physico-chemical properties of water and soil, qualitative and quantitative mapping of resources which would help in creating employability in various institutes/centres related in the field of Environment and Forest, Government and NGO's dealing with Biodiversity and Sustainable livelihood. It will also help encourage Bio- entrepreneurship.
- ❖ Introduction to Research Methodology, basic statistical tools for biological research and data analysis.
- ❖ The students will also learn about phylogenetic tree and phenetic approach to classification along with scope and concept of biosystematics.

M.SC. BOTANY PROGRAMME SPECIFIC OUTCOMES (PSO'S)

- ❖ Students will be able to handle equipment's for analytical techniques with regards separation of biomolecule like Chromatography techniques such as Spectrophotometry, Digital herbarium.
- ❖ Students will learn techniques of fungal and bacterial isolation and its culture. Students can identify the pathogen and its associated plant diseases.
- ❖ Students will be capable to perform various experiments related to 'Plant Tissue Culture, Molecular characterization, Phytochemical analysis, Molecular biology, Biotechnology and other Applied Plant Science' as they will be trained to handle different equipment's like Electrophoresis Systems, Biosafety Cabinet, Laminar Flow Cabinet, Different types of Autoclaves, Distillation unit, Centrifuge, Muffle Furnace and other modern equipment's necessary for modern days research.
- ❖ Student will undertake a small research topic as a part of M Sc. Dissertation and will execute in two semesters. The purpose of the assignment is to ignite the analytic approach of the students and mentally prepare as a potential future researcher. Further, students will be allowed for 'Industrial Visit, Academic Study Tour, ON Job Training of their choice for a short duration.

Department of Botany
Pratap College, Amalner (Autonomous)



SYLLABUS FOR
ONE/TWO YEAR POST GRADUATE PROGRAMME IN BOTANY

AS PER

NATIONAL EDUCATION POLICY- 2020

BASED ON CBCS

M.Sc. Part I Botany
(Level 6.0) SEMESTER- I

Discipline Specific Core Courses (Major)

BOT-MJ-501 Plant Systematics I (Algae, Fungi and Bryophytes)

BOT-MJ-502 Taxonomy of Angiosperms

BOT-MJ-503 Applied Plant Biotechnology

BOT-MJP-504 Practical Based on BOT-MJ-501, BOT-MJ-502 & BOT-MJ-503

Discipline Specific Elective Courses (Major-Any One)

BOT-EC-521 Plant Pathology

BOT-EC-522 Anatomy and Histochemistry

Research Methodology

BOT-RM-521 Research Methodology

DSC 25 {T}	BOT-MJ-501 Plant Systematics-I (Algae, Fungi and Bryophytes)	Credits 4 Lecture 60
<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To study salient features of Algae, Fungi and Bryophytes 2. To know the diversity of Cryptogamic plants in nature. 3. To study the life cycle patterns in cryptogams. <p>Course Outcomes:</p> <ol style="list-style-type: none"> 1. Able to differentiate cryptogamic plants 2. Able to describe life cycle patterns in cryptogams 3. Higher cognitive skills will develop 		
Unit 1	<p>Introduction to Algae</p> <ol style="list-style-type: none"> 1. Introduction: Definition, Occurrence and Habitat General characters, and similarities and differences with Fungi and Bryophyte 2. Reproduction; Life cycle and Alternation of generation 3. Algae in human welfare 	03 L
Unit 2	<p>Classification of algae</p> <ol style="list-style-type: none"> 1. Basis of algal classification and nomenclature; Classification of algae According to F. E. Fritsch (1945) and Parker (1982) up to class and subclass: 2. Comparative account of the algal classes, with respect to pigments, reserve food, cell wall, chloroplast and eyespot, flagella 	03 L
Unit 3	<p>Study of importance classes of algae</p> <p>A. Cyanophyceae</p> <ol style="list-style-type: none"> i) Introduction, Ecology of Blue Green Alga, ii) Thallus organization, Ultra cell structure & Heterocyst, Heterocyst function iii) Reproduction and Economic role <p>B. Chlorophyceae</p> <ol style="list-style-type: none"> i) General characters, Range of thallus structure, Structure of Cell ii) Method of reproduction. <p>C. Phaeophyceae</p> <ol style="list-style-type: none"> i) General characters, Range of thallus structure ii) Method of reproduction <p>D. Rhodophyceae</p> <ol style="list-style-type: none"> i) General characters, Range of thallus structure ii) Method of reproduction <p>E. Introduction and General Characters of following Class</p> <ol style="list-style-type: none"> i. Bacillariophyceae ii. Euglenophyceae 	14 L

	iii. Xanthophyceae	
Unit 4	Fungi – Introduction: <ol style="list-style-type: none"> 1. Distinguishing characters, Thallus structure, Hyphal modifications 2. Nutrition 3. Classification of fungi up to classes as per- Ainsworth et al., system (1973). 4. Economic importance- Fungi in biotechnology, fungi as food 	03 L
Unit 5	A) Myxomycota: <ol style="list-style-type: none"> i) Distinguishing characters ii) Structure of thallus and reproductive bodies iii) Life cycle pattern with reference to Pysarum. B) Mastigomycotina: <ol style="list-style-type: none"> i) Distinguishing characters ii) Thallus structure and reproduction (Asexual and sexual) iii) Life cycle pattern with reference to Plasmopara. C) Zygomycotina: <ol style="list-style-type: none"> i) Distinguishing characters ii) Thallus structure, Heterothallism and reproduction iii) Life cycle pattern with reference to Mucor 	09 L
Unit 6	A) Ascomycotina: <ol style="list-style-type: none"> i) Distinguishing characters ii) Thallus structure, structure of asci, Types of ascocarps iii) Life cycle pattern with reference to Eurotium B) Basidiomycotina: <ol style="list-style-type: none"> i) Distinguishing characters ii) Thallus structure, Types and Structure of basidia and basidiocarps iii) Life cycle pattern with reference to Teliomycetes D) Deuteromycotina: <ol style="list-style-type: none"> i) Distinguishing characters ii) Thallus structure, fructifications, Types of conidia 	08 L
Unit 7	Introduction to Bryophytes <ol style="list-style-type: none"> A) Introduction: - General characteristics, habitat, reproduction, structure of gametophyte & sporophyte B) Classification: - Classification of Bryophytes up to orders by G.M. Smith (1955) C) Economic importance of Bryophytes D) Evolution of gametophytes & sporophytes in Bryophytes 	05 L
Unit 8	Distinguishing features, phylogeny & evolutionary tendencies of the following orders with their affinities	15 L

Hepaticae :(Marchantiales, Jungermannias, Metzerales and Calobryales

Anthocerotae: Anthocerotales

Musci: Polytrichales

Suggested readings:

1. Bold, H and Wynne M.J. (1978) Algal structure and reproduction. Prentice Hall of India Pri.Ltd.New Delhi, India.
2. Bony, A.D. (1978) Phytoplankton.Edward Arnold Pub.Ltd. London, U.K.
3. Chapman, V.J. and Chapman D.J. (1979) The Algae. English Language Book Society and Mc.millan,Co, London, U.K.
4. C.van den Hoek; D.G.Mann; H.M.Jahns (1988) Algae An introduction to Phycology. Cambridge University Press, UK.
5. Daws, C. J. (1981) Marine Botany. Wiley Publication Com. New York, USA.
6. F.E.Fritsh (1965) The Structure and reproduction of Algae Vol. I and II. The syndics of the Cambridge University press,London.
7. Gupta J.S (1981) A Text Book of Algae, Oxford & IBH Publishing Co. Mumbai, India.
8. Khan M. (1970) Fundamentals of Phycology Bishan Singh Mahendra Pal Singh, Dehra Dun, India.
9. Lee, R.E. (1989) Phycology. Cambridge University Press, Cambridge, U.K
10. Mahendra Perumal G and N. Anand(2009) Mannual of Freshwater Algae of Tamil Nadu, Bishen Singh Mahendr Pal Singh, Dehra Dun, India
11. Morris, I (1967) An Introduction To The Algae, Hutchinson University Press, U.K.
12. Prescott, G.W. (1969). The Algae.Thomas Nelson and Sons Ltd, Nashville, USA
13. Robin G.South and Alan Whittick (1996).Phycology .Blackwell science. Oxford London Edinburg, U.K.
14. Round, F.E. (1973)The Biology of the Algae. Edward Arnold, London, U.K.
15. Sharma, O.P.(1950)A text book of Algae.TataMcGraw Hill, New Delhi, India.
16. Smith, G.M. (1950). Fresh water Algae of United States.McGrawHill Book Company, New York, USA.
17. Sambamurty A.V.S.S. (2005) A Text Book of Algae. I.K.International Mumbai, India.
18. Vashishta B.R. (2010) Botany Part- I Algae S.Chand& Company Ltd.New Delhi, India.
19. Vijayaraghavan M.R. and Sunita kumara (1995) Chlorophyta Structure Ultrastructure & Reproduction, Bishen Singh Mahendr Pal Singh, Dehra Dun, India
20. O. P.Sharma (2011) Algae. Tata Mc Graw Hill Education Private Limited, New Delhi.
21. Vashishta B.R. (2010) Botany Pa rt- I Algae S.Chand& Company Ltd.New Delhi, India.
22. Ainsworth, Sussman and Sparrow (1973) The fungi. Vol IV A & IV B. Academic Press. London, U.K. 21.
23. Alexopolous C.J., Minms C.W. and Blackwell M. (1999) (4th edn) Introductory Mycology. Willey, New York, USA.
24. Deacon J.W. (2006) Fungal Biology (4th Ed.) Blackwell Publishing, Oxford, U.K.

25. Dube H.C. (2004) An Introduction To Fungi. Vikas Publishers. New Delhi, India.
26. Kendrick B. (1994) The Fifth Kingdom (paperback), North America, New York Publisher:
27. Kirk et al. (2001) Dictionary of fungi, 9th edn, Wallingford: CABI.
28. Mehrotra R.S. and Aneja K.R. (1990) An Introduction To Mycology. New Age Publishers, New Delhi, India
29. Miguel U., Richard H., and Samuel A. (2000) Illustrated Dictionary of the Mycology. Elvira Aguirre Acosta, Publisher: St. Paul, Minn: APS press.
30. Sharma O.P. (2010) A Text Book of Fungi. S.Chand's Publication, New Delhi, India
31. Sharma, P.D. (1998) The Fungi. Rastogi Publications, Merrut, India.
32. Vashista, B.R. and Sinha A.K. (2008) Botany for Degree Students –Fungi. S.Chand and company Ltd., New Delhi, India.
33. Webster J. and Rpland W. (2007) Introduction To Fungi (3rd Edn) Cambridge University, Press, U.K.
34. Cavers F. (1976) Interrelationships of Bryophytes S.R. Technic, Ashok Rajpath, Patana.
35. Chopra R.N. & Kumar P.K. (1988) Biology of Bryophytes John Wiley & Sons, New York
36. Kashyap S.R. (1929) Liverworts of the Western Himalayas and the Punjab Plains Part 1, Chronica Botanica, New Delhi.
37. Kashyap S.R. (1932) Liverworts of the Western Himalayas and the Punjab Plains (Illustrated) Part 2, Chronica Botanica, New Delhi.
38. Pandey B.P. (2014) College Botany: 1 S. Chand Publications 20th Edition.
39. Parihar N.S. (1980). Bryophytes : An Introduction to Embryophyta Vol-I, Central Book Depot, Allahabad.
40. Prem Puri (1981) Bryophytes: Morphology, Growth and Differentiation. Atma Ram and Sons , New Delhi
41. Rashid A. (1996) An Introduction to Bryophytes Vikas Publication House Pvt. Ltd. New Delhi
42. Sambamurty A.V.S.S. (2020) A textbook of Bryophytes, pteridophytes gymnosperms & paleobotany, Dreamtech Press.
43. Smith G.M. (2019) Cryptogamic Botany, Bryophytes & Pteridophytes Vol-II 2nd Edition, Surjeet Publications
44. Udar R. (1975) Bryology in India. Chronica Botanica, New Delhi
45. Udar R. (1970) Introduction to Bryophytes, Shashidhar Malaviya Prakashan, Lucknow
46. Watson E.V. (1971) Structure and life of Bryophytes 3rd Edn. Hutchinson University Library London.
47. Vashishta B.R., Sinha A.K., Kumar A. (2008) Botany for degree students Bryophyta, S.Chands Publication



DSC 26 {T}	BOT-MJ-502 Taxonomy of Angiosperms	Credit 2 Lecture 30
<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To study aims, principles and methods in taxonomy. 2. To study taxonomic structure of Angiosperms. 3. To study Cronquist system of classification. 4. To study recent APG system of classification and evolutionary trends. 5. To study morphological peculiarities and biological importance of plants <p>Course outcomes:</p> <ol style="list-style-type: none"> 1. Student provide with importance of classification in Angiosperms. 2. They will get the knowledge of recent system of classification in Angiosperms. 3. This course helps to make them aware of wild plants their habit and habitat from field tour. 4. Student will know biological adaption and evolutionary trends of angiosperm. 		
Unit 1	<p>Taxonomy</p> <ol style="list-style-type: none"> 1. Aim, principles and methods in taxonomy. 2. Basic Concepts of Biosystematics and Taxonomy, Trends in biosystematics-Chemotaxonomy, Cytotaxonomy. 3. Taxonomic Tools – Floras, monographs, Herbaria, Important Websites for Taxonomy, Botanical survey of India(Regional & zonal centre, activity) 	06 L
Unit 2	<p>System of classification.</p> <ol style="list-style-type: none"> 1. Review of Pre- Darwinian and Post Darwinian classification 2. Cronquist system of classification: Introduction, principles, Outline, Merits and demerits. 	06 L
Unit 3	<p>Angiosperm phylogeny group.</p> <ol style="list-style-type: none"> 1. Principles of APG – I (1998), APG- II (2003), APG- III (2009) and APG-IV (2016) system of classification. 2. APG-III (2003) system of classification: Introduction, APG III vs Bentham and Hookers classification, Outline classification. 	06 L
Unit 4	<p>Families of Angiosperm.</p> <p>With respect to characteristic features, interrelationships, classification (APG) and economic importance of families: ANITA grade: Nymphaeaceae, MAGNOLIIDS: Magnoliaceae, MONOCOTS: Araceae, COMMELINOIDS: Arecaceae, EUDICOTS: Papaveraceae, CORE EUDICOTS: Amaranthaceae, EUROSIDS-I: Malpighiaceae, EUROSID- II: Malvaceae, ASTERIDS: Sapotaceae, EUASTERIDS-I: Gentianaceae EUASTERID-II: Apiaceae, Asteraceae.</p>	06 L
Unit 5	<p>Biological importance and morphological peculiarities of the families.</p> <p>a) Nepenthaceae, Orobanchaceae, Rafflesiaceae, Orchidaceae</p> <p>b) Study of evolutionary trends in taxonomy</p> <ol style="list-style-type: none"> i) Evolution of Inflorescence ii) Evolution of floral nectaries iii) Evolution of Androecium iv) Evolution of Gynoecium 	06 L

Suggested readings:

1. Agashe SN (1995) *Paleobotany*, Oxford and IBH Publ. Co. Pvt. Ltd, New Delhi.
2. **Briggs David 2009.** *Plant microevolution and Conservation in Human-influenced Ecosystems*. Cambridge University Press.
3. **Cook T (1903).** *The Flora of Presidency of Bombay, Vol. I (Indian Reprint)* Bishen Singh, Mahendra Pal Singh, Dehradun
4. **Cronquist, A. 1981.** *An Integrated System of Classification of Flowering Plants* Columbia University Press, New York.
5. **Cronquist, A. 1988.** *The Evolution and Classification of Flowering Plants (2nded.)* Allen Press, U.S.A.
6. **Davis, P. H. and V. H. Heywood 1991.** *Principles of Angiosperm Taxonomy*. Today and Tomorrow Publications, New Delhi.
7. **Eames A J (1961).** *Morphology of Angiosperms*, McGraw Hill Book Co.
8. **Erdtman G (1966).** *Pollen Morphology and Plant Taxonomy of Angiosperms (An introduction to Palynology I)*, Hafner Pub. Co. London.
9. **Hickey M and King C (2000).** *The Cambridge Illustrated Glossary of Botanical Terms*. Cambridge University Press, UK.
10. **Jain S. K. and Rao R. R.** *Handbook of Field and Herbarium Methods*, Today and Tomorrow Publishers, New Delhi.
11. **Jones S B and Luchinger A E (1986).** *Plant Systematics 2nd edn*, McGraw Hill Book Co.
12. **Judd et al. (2007)** *Plant Systematics – A phylogenetic approach*. Sinauer Pub. 3rd edition
13. **Judd W. S., Campbell, C. S., Kellogg, E. A., Stevens P. F. and M. J. Donoghue 2008.** *Plant Systematics: A phylogenetic Approach*. Sunderland, Massachusetts, USA.
14. **Kubitzki K (1977).** *Flowering Plants Evolution and Classification of Higher Categories*. *Plant Systematics – Evolution Supplement I*.
15. **Kuijt J. (1969).** *The biology of parasitic flowering plants*. California University Press.
16. **Lawrence George H. M. 195.1** *Taxonomy of Vascular Plants*. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi.
17. **Leadley E. and S. Jury (ed.) 2006.** *Taxonomy and Plant conservation*. Cambridge University Press.
18. **Manilal, K. S. and M. S. Muktesh Kumar [ed.] 1998.** *A Handbook of Taxonomic Training*. DST, New Delhi.
19. **Naik, V. N. 1984.** *Taxonomy of Angiosperms*. Tata McGraw-Hill Publication Com. Ltd. New Delhi
20. **Quicke, Donald, L. J. 1993.** *Principles and Techniques of Contemporary Taxonomy*. Blakie Academic & Professional, London
21. **Radford A E (1986).** *Fundamentals of Plant Systematics*, Harper and Row N Y.
22. **Simpson M.** *Plant Systematics*, Academic Press, 2nd edition.
23. **Singh G (2004).** *Plant Systematics*, 2nd edn, Oxford and IBH, New Delhi.
24. **Stewart W N and Rothwell G W (2005).** *Paleobotany and the Evolution of Plants*, 2ndedn, Cambridge University Press.
25. **Subrahmanyam K.** *Aquatic angiosperms*. BSI. India
26. **Takhtajan, A. 1962.** *Flowering plants- Origin and Dispersal*.
27. **Taylor, D. V. and L. J. Hickey 1997.** *Flowering Plants: Origin, Evolution and Phylogeny*. CBS Publishers & Distributers, New Delhi.

DSC 27 {T}	BOT-MJ-503 Applied Plant Biotechnology	Credits 4 Lecture 60
<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To the fundamentals of totipotency, plant tissue culture techniques. 2. To study transgenic technology for the improvement of quality and quantity of Plant and thereby product. 3. To understand the advantages of in vitro propagation in various areas. 4. To understand the application and importance of plant tissue culture and transgenic plant in the field of botany <p>Course outcomes:</p> <ol style="list-style-type: none"> 1. This paper deals with different biological processes at molecular level and different modern techniques in the field of biotechnology with reference to plants. 2. This paper will help in getting employment in ‘Plant Tissue Culture Industry/Lab, Biotechnology Industry/Lab, Faculties/ Scientists in the Colleges/University/Research Institutes. 3. Further, the students can start their own entrepreneurship unit/Startup. 		
Unit 1	<p>Biotechnology: Basic concept and brief introduction of biotechnology, History, Scope and Importance, Commercial application of biotechnology.</p>	04 L
Unit 2	<p>Introduction to Tissue Culture: Principle of plant tissue culture, Tissue culture laboratory, Equipment’s in Tissue culture laboratory, Types of Media, Preparation of Media, Media composition, Cellular totipotency Plant Growth Regulators and their Role, Different type of media, Different types of explants of, Sterilization, Different methods of sterilization -Heat, Radiation and chemical</p>	06 L
Unit 3	<p>Cell and Organ Culture: Plant organ culture; shoot tip, shoot apical meristem, root, leaf, embryo culture, factors influencing embryogenesis, suspension culture in stationary and stirred tankreactors, isolation of single cells and their culture, measurement of growth.</p>	10 L
Unit 4	<p>Practical Approaches of Single Cell Culture: Somatic embryogenesis, protoplast isolation, regeneration of protoplasts and protoplasts fusion, Synthetic seeds, generation of cybrid and hybrids, cryopreservation of plant cells.</p>	10 L

Unit 5	Recombinant DNA Technology: Tools and Techniques in RDT, Gene cloning, Vectors, Direct and Indirect Gene transfer methods.	08 L
Unit 6	Transgenic Plants: Transgenic crops in India, Resistance against Abiotic and biotic stress, Improved crops productivity, Nutraceutical improved crops, transgenic plants for edible vaccine and antibodies.	08 L
Unit 7	Applications of Plant Tissue Culture: Applications in agriculture and Horticulture, Application in Forestry, Application of Tissue culture in pharmaceutical industry. In situ and ex-situ conservation. In vitro mutagenesis and its application. Production of transgenic plants	12 L

Suggested readings:

1. Henry, R.J. Practical application of plant molecular Biology, Champman and Hall
2. Kalyan kumar De. Introduction to Plant Tissue culture,
3. Bhojwani, Plant Tissue Culture.
4. Montell S.H. Mathews, J.A., Meker, R.A. Principles of Plant Biotechnology.
5. Glover, D.M. and Hanes, B.D. (eds.) 1995. DNA cloning 1: A practical approach, core techniques, 2nd edition, PAS, IRL press at Oxford University Press.
6. Plant cell culture protocols. Humana Press, Inc. New Jersey, USA.
7. Shaw, C.H. (ed.) 1998, Plant Molecular Biology. A practical approach IRI Press, Oxford.
8. Smith, R.H. 2000. Plant Tissue culture: Techniques and Experiments. Academic Press, New York.
9. Susan R. Barnum (1998). Biotechnology: an introduction. Thomson Brooks/cole.
10. George Acquaah (2005). Understanding biotechnology. Pearson.
11. Biotechnology; P.K. Gupta
12. B. D. Singh (2006) Plant Biotechnology, Kalyani Publishers

DSC 28 {P}	BOT- MJP-504 Practical Based on BOT- MJ-501, BOT- MJ-502 & BOT-MJ-503	Credits 4 Lectures 120
Practical's Based on BOT-MJ-501 Plant Systematics I		
Practical 1-2	Representative genera with respect to vegetative, reproductive structures and classification with reasons Cyanophyta: Any two members from Each Order Chlorophyta: Any two members from Each Order	
Practical 3-4	Representative genera belonging to following divisions and subdivisions of fungi with respect to vegetative, reproductive structures and classification with reasons according to Ainsworth et al. (1973). Myxomycota - Any one form Mastigomycotina - Any one form Zygomycotina - Any one form Ascomycotina - Any one form Basidiomycotina- Any one form Deuteromycotina - Any one form	
Practical 4-5	Morphological, Anatomical and Reproductive studies of the following: Marchantiales: Plagiochasma, Targionia, Jungermanniales: Pellia, Fossombronia, Anthocerotales : Anthoceros, Musci : Polytrichum	
Practical's Based on BOT-MJ-502 Taxonomy of Angiosperms		
Practical 6	Study of families (Sensu: Bentham & Hooker System) w.r.t. morphological characters, floral formula, floral diagram and classification with reasons- (Any 10 families from different series available in local area)	
Practical 7	Identification of genus and species from locally available wild plants using regional and state floras (At least 20 plant species from locally available families).	
Practical 8	Preparation of artificial bracketed/indented dichotomous keys based on vegetative & reproductive characters from different families, genera and species. (Specimens from different family, same family, different genera of same family, Species from same genera.)	
Practical 9	Study of morphological and biological peculiarities of the specimens from following families. Nepenthaceae, Orobanchaceae, Rafflesiaceae, Orchidaceae.	
Practical 10	Visit to campus & surrounding area, submission of excursion report and photographs/Herbarium (Any 10 wild plants)	

Practical's Based on BOT-MJ-503 Applied Plant Biotechnology

Practical 11	Introduction and awareness of lab safety measures
Practical 12	Preparation of plant tissue culture media and techniques for initiation of aseptic culture.
Practical 13	Micropropagation of economically important local plants.
Practical 14	Somatic Embryogenesis using appropriate plant.
Practical 15	Restriction digestion of the plasmid and estimation of the size of various DNA fragments.

Note:

- i) Excursion tour compulsory (different locality & geographical area)
- ii) Duly certified journals are compulsory at time of practical examination.

DSE 5 {T}	BOT-EC-521 Plant Pathology	Credit 4 Lecture 60
<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To acquaint the students with the science of phytopathology 2. To learn general concepts and classification of plant diseases. <p>Course outcomes:</p> <ol style="list-style-type: none"> 1. After completion of these courses' students will be able to understand- 2. Know the concept, scope and importance of Plant pathology. 3. Understand causes of disease development. 4. Account of Plant disease classification. 5. Know the prevention and control measures of plant diseases. 6. Knowledge of Bio-control and Integrated Pest management. 		
Unit 1	Historical development and present status of phytopathology, Concept of plant disease, Classification of plant diseases, Pathogenesis and disease development; Pathogenicity, Host-pathogen interaction, Pathogenesis and role of enzymes and toxins in pathogenesis	12 L
Unit 2	Fungal diseases- Symptoms and transmission-; Rusts, Smuts and powdery mildews; damping-off of seedlings, late blight of potato, Red rot of sugarcane, Tikka Disease of Groundnut, Angular Leaf Spot of Cotton,	12 L
Unit 3	Bacterial diseases of plant symptoms and transmission, Plant responses against bacterial Infection, Study of citrus canker, Bacterial leaf blight on wheat, Crown gall diseases caused by Agrobacterium, bacterial blight of rice, Ear cockle of wheat- <i>Anguina tritici</i> , Root knot of vegetables-Meloidogyne incognita, <i>M. javanica</i> , <i>M. arenaria</i> ; little leaf of brinjal	12 L
Unit 4	Viral disease of plant, Life cycle of TMV, Gemini Virus, viral diseases symptoms, transmission, Isolation and purification of virus, Multiplication. Basic control measures and production of virus-free plants. Yellow vein mosaic of bhindi	12 L
Unit 5	Host-pathogen interaction. Plant disease diagnosis; Koch's postulates with special reference to parasitism. Defense mechanism in host, effect of infection on host physiology, Dissemination of plant disease; disease forecasting and management plant disease. Post-harvest diseases and mycotoxins. Integrated pest disease management	12 L
<ol style="list-style-type: none"> 1. Agrios G. Plant Pathology (5th edition). Academic Press. 2. Mehrotra RS Plant Pathology. Tata McGraw Hill. 3. Bonnie H. Ownley, Robert N. Trigiano (2016) Plant Pathology Concepts and Laboratory Exercises. CRC Press 4. Singh RS Introduction To Principles Of Plant Pathology, 5th edition. MedTech 5. Stephen Burchett and Sarah Burchett. Plant Pathology. CRC Press 6. Sharma PD (2013) Plant Pathology. Deep and Deep Publications 7. Cooke, B. Michael, Jones, D. Gareth, Kaye, Bernard (2006) The Epidemiology of Plant Diseases. Springer, Netherland 		

DSE 5 {T}	BOT-EC-522 Anatomy and Histochemistry	Credit 4 Lecture 60
<p>Course Objectives:</p> <ol style="list-style-type: none"> To acquaint the students with the science of plant anatomy To know the anatomical parts of plants and its organ. <p>Course outcomes:</p> <ol style="list-style-type: none"> Syllabus gives the basics of anatomy of vascular plants The working of various instruments useful for anatomical studies is given This trains students particularly in camera lucida and sectioning through microtomes All the useful staining techniques are also included These methods will be useful if students take up higher studies (Research) or they can set up a biological. 		
Unit 1	<p>Primary vegetative body of the plant: Stem: Arrangement of tissues, epidermis, cortical bundles, medullary bundles, steles of various types: Leaf-Structure of foliage leaves, petiole and node of dicot leaves, vascular system of monocot leaves, stem-leaf junction of monocots, structure of fern and gymnosperm leaves: Structure of modified leaves-Kranz anatomy and C4 photosynthesis. Xerophytic and submerged foliage leaves, cataphylls, hypsophylls Root-Structure of primary root, mucigel, epidermis, exodermis, dimorphic roots, root nodules.</p>	15 L
Unit 2	<p>Ultra-structure of the cell wall and differentiation. Ultrastructure and differentiation of xylem and phloem: tracheary elements and their differentiation, sieve elements and their differentiation. Meristems: Apical meristems, shoot apex of Pteridophytes, gymnosperms and angiosperms, root apex and intercalary meristems. Secondary growth of the plant body: Periderm, variations in wood structure. Anomalous secondary growth in climbers and monocots. Floral anatomy: Flower, flower parts and their arrangement, vascular system, floral meristem, origin and development of floral parts. Pathological Anatomy.</p>	15 L
Unit 3	<p>Plant Histochemistry: Minerals, Carbohydrates, Lignins, Polyphenols, Proteins, Nucleic acids and Histones, Lipids, Cutin, Suberin and Waxes, Ascorbic acid. Study of the instruments, their principles and uses (a) Camera lucida, (b) Micrometry (c) Microtomes –sledge Rocking, Rotary (d) Fluorescence microscope (e) Electron Microscope.</p>	15 L
Unit 4	<p>Staining technique –Principles of histochemical stains, Killing, fixing & staining of plant tissues; Important reagents & chemicals needed in the fixatives; FAA, Carnoy’s fluid, Navashins solution, fleminge; Dehydrating agents, mounting media, Double staining, Saffranin, Fast green, Embedding: TBA method, embedding for electron microscope, Sectioning, Whole mounts maceration. Histochemical-PAS Test, Sudan black lipids, Feulgen reaction –N acids.</p>	15 L
<p>Suggested Readings</p> <ol style="list-style-type: none"> Abraham F. 1982. Plant Anatomy. 3rd edn. Pergamon Press. Oxford. Cariquist S, 1967. Comparative Plant Anatomy-Holt Reinert and Winston, NY. Cutter D G, 1971. Plant Anatomy-Part 1, Cell and Tissues Edward Arnold London. Cutter D G, 1971. Plant Anatomy-Part 1, Cell and Tissues Edward Arnold London. Part-II. Eames and McDaniel 1947, II edn., “ Plant Anatomy” McGraw Hill, N.Y. Esau K 1965, Plant Anatomy, John Wiley and Sons, N.Y. James D Mauseth, 1998. Plant anatomy The Benjamin/ Cummins Publishing Co.Inc. 		

8. Katherine Esau, 1979, Anatomy of seed plants-first Wiley eastern reprint. New Delhi.
9. Krishnamurthy K. V. 1988. Methods in Plant Histochemistry. S. Viswanathan (Printers and Publishers) Pvt. Ltd. Madras.

RM {T}	BOT-RM-541 Research Methodology	Credit 4 Lecture 60
<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To familiarize Students with basic of research and the research process. 2. To enable the participants in conducting research work and formulating research synopsis and report. 3. To impart knowledge for enabling students to develop data analytics skills and meaningful interpretation to the data sets so as to solve the business/Research problem. <p>Course outcomes:</p> <ol style="list-style-type: none"> 1. Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling. 2. Have basic knowledge on qualitative research techniques 3. Have adequate knowledge on measurement & scaling techniques as well as the quantitative data analysis 4. Have basic awareness of data analysis-and hypothesis testing procedures 5. Understand about research tools. 		
Unit 1	<p>Introduction to Research Methods: Types of research philosophies (positivist, interpretivist, pragmatist and realistic), various steps in scientific research, Scientific temper and attitude, Experimental Design, Defining Controls, deductive and inductive reasoning; reductionist and holistic approaches of scientific research.</p>	05 L
Unit 2	<p>Scientific Methodology: Problem identification, Critical thinking, hypothesis formulation and hypothesis testing (Power analysis) Difference between hypothesis, reasoning, theory and scientific law</p>	05 L
Unit 3	<p>Data Collection and analysis: Types of Data, Methods and Techniques of data collection Methods of primary data collection (observation/ experimentation/ questionnaire/ interviewing/ case/ pilot study) Methods of secondary data collection (internal/ external), schedule method Research data organization: Creating, Analyzing, Formatting Data & Content using Spreadsheets Insert, View, Edit etc. Managing Lab Work books, Data tabulation, Calculations, Equations and analyzing biological Data using statistical tools. Data Analysis: Data distributions, Statistical tests for comparison of sample means and sample variance-t-test, non-parametric tests, Correlation and Regression, F, t and Z distribution; goodness of fit, chi-square. Introduction to multivariate analysis Mathematical models Simulation as a tool to test these models. Software for data processing: Multidimensional Use of Excel; GraphPad, SPSS, Journals in Botany</p>	20 L
Unit 4	<p>Research in Practice: Literature review, Journals, Conference Proceedings, Journal Impact factor, Citation Index, h, g, h-g index, Reading a scientific paper.</p>	05 L
Unit 5	<p>Research Ethics: Social implications of research, bio-safety issues Animal experimentation ethics, wild-life ethics and human experimentation ethics Data fudging and plagiarism: Use of URKUND, Turnitin and iThenticate software</p>	05 L

Unit 6**Scientific Communication:**

Importance of scientific communication, Types of scientific communications, Logical organization of scientific data and documentation
Different modes of scientific communication:
Scientific Writing: Characteristic of good scientific writing, Structure and content, Style, Literature references,
Report Writing: Types of research reports, guidelines for writing a report, report format, Details of research Proposal writing, Research paper writing, Thesis writing (Introduction, Literature review, Materials and Methods, Results, Discussion, Conclusion and Implications, conflict of interest)
Tools for Writing a thesis and proposals
Funding Agencies

20 L**Suggested Reading**

1. H. Hofmann, Scientific Writing and Communication Papers, Proposals, and Presentations. New York: Oxford University Press, 2010, pp. xv–xvi.
2. T. L. J. Ferris, E. Sitnikova, and A. H. Duff, “Building graduate capabilities to communicate research and plans successfully,” *Int. J. Eng. Educ.*, vol. 26, no. 4, pp. 891–899, 2010
3. Michael Alley, *The Craft of Scientific Writing*, fourth edition, Springer, 2018.
4. Stephen B. Heard, *The Scientists Guide To Writing*, Princeton University Press, 2018.
5. Anthony M. Graziano, Michael L. Raulin, *Research Methods: A Process of Inquiry* (2012) 8th Edition, Pearson Publication, Delhi

**Department of Botany
Pratap College, Amalner (Autonomous)**



**SYLLABUS FOR
ONE/TWO YEAR POST GRADUATE PROGRAMME IN BOTANY**

AS PER

NATIONAL EDUCATION POLICY- 2020

BASED ON CBCS

M.Sc. Part I Botany

(Level 6.0) SEMESTER- II

Discipline Specific Core Courses (Major)

BOT-MJ-551 Plant Systematics II (Pteridophytes, Gymnosperms & Paleobotany)

BOT-MJ-552 Plant Physiology and Metabolism

BOT-MJ-553 Cytogenetics and Molecular Biology

BOT-MJP-554 Practical Based on BOT-MJ-551, BOT-MJ-552 & BOT-MJ-553

Discipline Specific Elective Courses (Major-Any One)

BOT-EC-571 Plant Breeding and Seed Technology

BOT-EC-572 Plant Ecology and Phytogeography

On Job Training/Internship/Apprenticeship/Field Project/Research Project

BOT-OJT-591 On Job Training/Internship/Apprenticeship

M.Sc. Part I Semester II (Botany): Courses

DSC 29 {T}	BOT-MJ-551 Plant Systematics- II (Pteridophytes, Gymnosperms and Palaeobotany)	Credits 4 Lecture 60
<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To know the Classification, economic importance of Pteridophytes & Gymnosperms. 2. To Know the distribution of Pteridophytes & Gymnosperms in India. 3. To understand the biodiversity of Pteridophytes and Gymnosperms. 4. Scope, importance, applied aspect of Palaeobotany & methods to study various fossils. 5. To study the important fossils in different group of plants and Indian fossil record. <p>Course Learning Outcomes:</p> <ol style="list-style-type: none"> 1. Examine the distribution, morphology, anatomy & reproduction mentioned in the syllabus 2. Students will know about economic importance of Pteridophytes & Gymnosperms 3. Understand the significance of Palaeobotany 4. Familiarize the basic skills to identify Cryptogams & Gymnosperms 		
Unit 1	<p>A) Introduction of Pteridophytes</p> <p>B) General characteristics, Habitat, Reproduction (Vegetative & Asexual), Sporophyte, Gametophyte (Sexual reproductive phase), Fertilization & Zygote formation, Embryo development, Life cycles (Homosporous & Heterosporous), Apogamy & Apospory</p> <p>C) Classification of Pteridophytes Classification of Pteridophytes up to orders proposed by Reimers (1954)</p> <p>D) Economic Importance</p> <p>E) Soral Evolution</p>	05 L
Unit 2	<p>Distinguishing features, morphology, anatomy, reproduction, phylogeny, evolutionary tendencies and affinities of following orders:</p> <ol style="list-style-type: none"> i) Lycopodiales ii) Isoetales iii) Ophioglossales iv) Osmundales v) Filicales (at least 2 families) 	15 L
Unit 3	<p>Gymnosperms</p> <ol style="list-style-type: none"> A) Introduction, General Characters, Distinguishing features of Gymnosperms. B) Outline system of classification of Gymnosperms by Sporne (1965) C) Economic importance 	05 L
Unit 4	<p>General characters, morphology, anatomy, sporogenesis, gametogenesis, embryology, affinities, evolutionary trends and phylogeny of following orders</p> <ol style="list-style-type: none"> i) Ginkgoles ii) Coniferales iii) Gnetales (Except <i>Gnetum</i>) 	15 L

Unit 5	Palaeobotany A) Introduction, Scope and importance B) Applied aspect of Paleobotany C) Techniques for fossil study, Ground thin section, Peel method, Maceration, Indian fossil flora from Upper and Lower Gondwana	05 L
Unit 6	Study of distinctive fossil genera along with their external, internal features of following orders i) Psilophytales: <i>Rhynia</i> , ii) Lepidodendrales: <i>Lepidodendron</i> (complete reconstruction), iii) Calamitales : <i>Calamites, Annularia, Calamostachys, Paleostachya</i> iv) Sphenophyllales: <i>Sphenophyllum</i> , v) Hydropteridinae: <i>Rodeites dakshinii</i> vi) Pteridospermales: <i>Lyginopteris oldhamia</i> (Stem) , <i>Neuropteris, Glossopteris, Vertebraria, Scutum</i> vii) Bennettitales: <i>Williamsonia sewardiana, W. spectabilis</i> viii) Pentoxylales: <i>Pentoxylon sahnii</i> (reconstruction) ix) Cordaitales: <i>Cordaites</i> (Stem) x) Fossil Angiosperms: Monocot: <i>Palmoxylon, Cyclanthodendron, Tricocites</i> Dicot: <i>Sahnipushpam, Sahnianthus, Enigmocarpon</i>	15 L

Suggested Readings:

1. Andrews, H.N. (1961) Studies in Palaeobotany, New York, London
2. Arnold, C.A. (1947) An Introduction to Palaeobotany McGraw Hill Co., New York, USA.
3. Banks, H.P. (1970) Evolution and plants of the Past. McMillan Press Ltd. London, U.K.
4. Bierhorst, D.W. (1971) Morphology of vascular plants Mcmillan Co. New York
5. Bhatnagar, S. P. and Alok Moitra (1996) Gymnosperms, New Age International (P) Limited, Publishers, New Delhi.
6. Chamberlain, C.J. (1935) Gymnosperms: Structure And Evolution. Dover publ. INC., New York, USA.
7. Eames, A.J. (1974) Morphology of vascular plants Mc. Grow Hill Publication Co. New Delhi
8. Foster, A.S. & Gifford E.M. (1959) Comparative morphology of vascular plants San Francisco
9. Ganguli, H.C. and Kar A. K. (2001) College Botany Vol. II Book and allied Press. Ltd.

Calcutta, India.

10. Ganguly & Kar (2011) College Botany Vol-II New Central Book Agency Pvt. Ltd. 4th edition
11. John Waltan (1953) Introduction to Study of fossil Plants. Adam and Charles Block, London, UK.
12. Maheshwari, P and R.R. Konar (1971) Pinus CSIR New Delhi, India.
13. Pande B. P. (1994) Gymnosperms. Hand and Co. New Delhi, India.
14. Pandey B.P. (2010) College Botany Vol-2: v.II S.Chand & company, 2nd edition
15. Parihar N.S. (1977) Biology & Morphology of Pteridophytes Central book Depot. Allahabad
16. Parihar N.S. (2019) An Introduction to Embryophyta, Pteridophytes, Surjeet publication 5th edition
17. Pant D. D. (1973) Cycas and the Cycadales Central Book Depot, Allahabad, India.
18. Rashid A. (1999) An Introduction to Pteridophyta, South Asia Books, II edition
19. Saxena and Sarabhai, R. M. (1972) Text Book of Botany, Vol. II,
20. Sharma O.P. (2017) Pteridophyta Mc. Grow Hill Education
21. Seward, A.C. (1969) Fossil Plants Vol.I to IV, Hafner Publ. Co. New York, USA.
22. Shukla, A. C. and S.P. Misra (1982) Essentials of Palaeobotany Vikas Publishing House Pvt. Ltd. Delhi, India.
23. Siddiqui, K.A. (2002) Elements of Paleobotany Kitab Mahal, Allahabad
24. Sporne K.R. (1966) Morphology of Pteridophyta Hutchinson Univ. Library London
25. Sporne K.R. (1967) Morphology of Gymnosperms Hutchinson Univ. Library, London, UK.
26. Surange K.R. (1966) Indian Fossil Pteridophytes CSIR, New Delhi, India.
27. Vasishtha, P. C. (1983) Botany for Degree Students Vol V Gymnosperms S.Chand & Co. New Delhi, India.
28. Vashishta P.C., Sinha A.K., Anil Kumar (2010) Pteridophyta, S Chand and Company
29. Wilson N. Stewart and Gar W. Rothwell (1993) Palaeobotany and Evolution of Plants- II. Cambridge Univ. Press. Cambridge.

DSC 30 {T}	BOT-MJ-552 Plant Physiology and Metabolism	Credit 2 Lecture 30
<p><i>Course Objectives:</i></p> <ol style="list-style-type: none"> 1. To understand plant-water relationships 2. To understand the plant structures with respect to physiological functions of plants 3. To understand physiology of photosynthesis and respiration in plants 4. To understand lipid metabolism in plants 5. To understand basic concepts in metabolism 6. To understand the primary and secondary metabolites and their importance in the plants <p><i>Course Learning Outcomes:</i></p> <ol style="list-style-type: none"> 1. The students are aware about the knowledge of the process such as diffusion, osmosis and Imbibition that occurs in the plant cells. 2. Students will get the knowledge of the important process like Photosynthesis and respiration in plants. 3. The students will able to know the stepwise reactions occur in plant process like photosynthesis, respiration and fatty acid synthesis as well as catabolic activities. 4. Students will aware about the basic concepts of metabolism. 		
Unit 1	<p>Plant-Water relationships</p> <ol style="list-style-type: none"> 1.1: Properties of water. 1.2. Permeability, water potential, 1.3. Concept of apoplastic and symplastic movement 1.4. Brief account of different types of physical and physiological processes: Diffusion, Osmosis and Imbibition in plant cells. 1.5: OP, TP and WP, Types of Solutions 	10 L
Unit 2	<p>Photosynthesis and Respiration</p> <p>A) Photosynthesis-</p> <ol style="list-style-type: none"> 2.1 A brief outline of Photosynthetic pigments and the pigment organization in thylakoid membrane 2.2 Light and Dark Reaction 2.3 Regulation of PCR Cycle and C4 Pathway, RUBISCO and PEP Case, C3 – C4 intermediates. <p>B) Respiration-</p> <ol style="list-style-type: none"> 2.4 Brief account of Respiration in plants 2.5 Glycolysis and its regulation in plants 2.6 Regulation of Pentose Phosphate Pathway and TCA Cycle 2.7 Regulation of electron transport chain and role of alternate oxidase. 	10 L
Unit 3	<p>Fat & Nitrogen Metabolism</p> <ol style="list-style-type: none"> 3.1 Introduction, Synthesis of fatty acids and glycerol, Condensation of fatty acids and glycerol 3.2 Glyoxylate cycle (C2 cycle), Nitrogen Cycle, N2 Fixation Pathway 	10 L

Suggested readings

- 1.** Amarsingh (1977) Practical Plant Physiology. Kalyani Publishers, New Dehli, India.
- 2.** Anand, B. K. & S. K. Manchanda (1976) Text Book of Physiology. Tata McGraw Hill Publications Co. Ltd, Dehli, India.
- 3.** Arditt, J. (1969) Experimentl Plant Physiology, Holt Rinehrt & Winst on Inc, NewYork.
- 4.** Bidwell, R. G. (1979) Plant Physiology. McMillan Publishing Co. Inc. NewYork 26
- 5.** Bonner, J. and J. E. Varner (Eds.) (1976) Plant Biochemistry 3rd Eds. Academic PressLondon, UK.
- 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.** Con, E. F. and P. F. Stumpf (1976) Outlines of Biochemistry Wiley Eastern Ltd., New Dehli, India.
- 8.** De. Robertis, E. D. P. and De Robertis, E. M. T. (1987) Cell and Molecular Biology. VIII Eds. Lea & Febiger International Edition Info -Med. Hongkong.
- 9.** Deb, A. C. (2004) Viva & Practical Biochemistry. New Central Book Agency, Kolkata, India.
- 10.** Delvin, R. M. and F. H Whittam (1986) Plant Physiology IV eds. CBS Publishers & Distributors, New Delhi, India.
- 11.** Grewal, R. C. (2000) Plant Physiology. Campus Books International, Darya Ganj, New Delhi, India.
- 12.** Hess, D. (1975) Plant Physiology. Narosa Publishing House, New Delhi, India.
- 13.** Hill, R. & C. P. Whittingham (1957) Photosynthesis. London, UK.
- 14.** Hopkins, W. G. (1995) Introduction to Plant Physiology. John Wiley & Sons, New Jersey, USA.
- 15.** Jain J. L., Sunjay Jain and Nitin Jain (2008), Fundamentals of Biochemistry, S. Chand & Co Ltd.
- 16.** Lehniger, A. L (1984) Principles of Biochemistry CBS Publishing & Distributors, New Delhi, India.
- 17.** Mukherji, S. and A. K. Ghosh (2005) Plant Physiology. New Central Book Agency Kolkata, India.
- 18.** Noggle, G. R. & G. J. Frtiz (1982) Introductory Plant Physiology. Prentice Hall of India New Delhi, India.
- 19.** Taiz, L., Zeiger, P. E. E., Mller, P. E. I. M., & Murphy, P. A. C. A. (2018). Fundamentals of plant physiology. Sinauer Associates.

DSC 31 {T}	BOT-MJ-553 Cytogenetics and Molecular Biology	Credit 4 Lecture 60
<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To study structural organization and variation in the chromosome as well as karyotype analysis. 2. To study extra-chromosomal inheritance in the plant system. 3. To study molecular biology about genetic material, its inheritance, modification, replication, and repair. 4. To study transcription, translation post-translation modification of a protein. 5. To study gene regulation in prokaryotes and eukaryotes <p>Course Outcomes:</p> <ol style="list-style-type: none"> 1. The students gain knowledge about hereditary molecule. 2. Students will learn about cytogenetics. 3. To acquire knowledge of central dogma of molecular biology. 		
Unit 1	<p>Membrane Structure and Function</p> <p>Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes).</p>	03 L
Unit 2	<p>Structural Organization and Function of Organelles</p> <p>Nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of the cytoskeleton and its role in motility.</p>	05 L
Unit 3	<p>Chromosomes and its Aberration</p> <p>Types of chromosomes based on centromere, Special types of chromosomes (Polytene Chromosome, Lampbrush chromosome, and B-chromosomes) Organization of chromatin and histones and nonhistone proteins, nucleosomal organization of chromatin, higher levels of chromatin organization in chromosomes. Heterochromatin and Euchromatin, Molecular structure of the Centromere and Telomere.</p> <p>Structural; change in a chromosome - (Deletion, Duplication, Inversion, and Translocation), Robertsonian Translocation, Numerical change in the chromosome (Euploidy, Aneuploidy and its types).</p>	11 L
Unit 4	<p>Cell Cycle, Cell Signaling and Cytoplasmic Inheritance</p> <p>Cell cycle, steps in cell cycle, regulation, and control of cell cycle. Cell division Mitosis and meiosis. Apoptosis – a process of programmed cell death, extrinsic and intrinsic pathways of apoptosis</p> <p>Cell communication - general principles. Signaling molecules and their receptors, external and internal signals that modify metabolism, growth, and development of plants.</p> <p>Cytoplasmic inheritance: - Cytoplasmic inheritance involving plastid inheritance and mitochondrial inheritance with suitable examples (<i>Mirabilis jalapa</i>, <i>Zea mays</i>).</p>	11 L

Unit 5	Introduction to Molecular biology Definition, milestones of molecular biology, scope and importance molecular biology	02 L
Unit 6	DNA and its Replication Physical and chemical properties of nucleic acids, discovery, and types of nucleic acids, various types of DNA. DNA replication, repair, and recombination (Unit of replication, enzymes involved, replication origin and replication fork, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination).	07 L
Unit 7	Transcription Gene Structure, RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, RNA transport, and polyadenylation, structure, and function of different types of RNA).	08 L
Unit 8	Translation Definition and Properties of Genetic Code, Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, aminoacylation of t-RNA, t-RNA-identity, aminoacyl t-RNA Synthetase, and translational proof-reading, translational inhibitors, Post-translational modification of proteins)	08 L
Unit 9	Gene Regulation Gene regulation in Prokaryotes (Operon concept, LAC Operon TRP Operon), Eukaryotic transcriptional regulation (promoter enhancer and silencer, Gene battery), and post-transcriptional regulation.	05 L

Suggested readings:

1. Benjamin Lewin (2009) Genes– VI, VII, VIII and IX; Oxford, Univ. Press, USA.
2. Chaudhari, B.D. (2000) Elementary Principles of plant Breeding (2nd Edt.) Oxford & IBH pub. New Delhi, India.
3. De Robertis and De Robertis (2005) Cell and Molecular Biology, 8thEd, LippincottWilliamandWilkins U.S.A.4. Eldon john Gardner, Michel J. Simmons and D. Peter Snustad(1991) Princiles ofgenetics 8thEd . Wiley India edition, New Delhi, India.
4. David E Sadava (2009). Cell biology: Organelle structure and function. CBS.
5. Gupta, P. K. (2007) Genetics: Classical to Modern. Rastogi Publications, Meerut, India.
6. 4 Gerald Karp (2008). *Cell and Molecular biology: Concepts and experiments* (V Edn). John Wiley & Sons
7. Hartl D L and Jones E W (1998) Genetics Principles and Analysis; (4thed.). Jonesand Barflett Publishers, USA.
8. Harvey Lodish, Arnold Berk, Lawrence Zipursky, Paul Matsudaira, David Baltimore, James Darnell (2000). *Molecular cell biology* (IV Edn). W H Freeman & Company.
9. HexterW and Yost Jr. H T., (1977) The Science of Genetics; Prentice Hall of IndiaPvt. Ltd., New Delhi, India.
10. Kar and Halder, (2009) Cell BiologyGeneticsMolecular Biology; New Central BookAgency (P) Ltd. Kolkata, India.
11. Karp, G. (1999) Cells and Molecular Biology concepts and Experiments; HohnWiley& Sons Inc. USA.
12. Phundan Singh, (1996) Essentials of Plant Breeding; Kalyani publication, New Delhi,

DSC 32 {P}	BOT-MJP-554 Practical Based on BOT-MJ-551, BOT-MJ-552 & BOT-MJ-553	Credits 4 Lectures 120
Practical's Based on BOT-MJ-551 Plant Systematics II		
Practical 1-2	Morphological, anatomical and reproductive studies of the following <i>Lycopodium, Selaginella, Ophioglossum, Osmunda, Pteris, Adiantum</i>	
Practical 3-4	Study of External morphology, wood anatomical features, by double stained preparation by taking T. S., T. L. S. and R. L. S. of any six of the following: <i>Pinus, Thuja,</i> Study of External morphology of male and female cones of any six of the following: <i>Pinus, Thuja,</i> Study of External morphology, anatomy (T. S.) and morphology of reproductive organ of <i>Ephedra</i> . Study of External morphology, anatomy and morphology of reproductive organs of <i>Cycas</i>	
Practical 4-5	Study of following fossils with P.S. or Specimens <i>Rhynia, Lepidodendron</i> Stem, <i>Lepidocarpon, Calamites</i> Stem, <i>Annularia, Sphenophyllum</i> Stem Study of following fossils with P.S. or Specimens <i>Lyginopteris oldhamia</i> (Stem), <i>Neuropteris, Glossopteris, Vertebraria,</i> Study of following fossils with P.S. or Specimens <i>Rodeites, Pentoxylon, Cordaites</i>	
Practical's Based on BOT-MJ-552 Plant Physiology and Metabolism		
Practical 6	To Determine the DPD by suitable osmometer method.	
Practical 7	To Determination of osmotic potential of plant cell any suitable method.	
Practical 8	To study the effect of light intensity and bicarbonate concentration on rate of photosynthesis.	
Practical 9-10	Demonstration Experiments: a. Osmosis by Curling experiments b. To demonstrate the presence of photosynthate in leaves c. R.Q. (Respiratory Quotient) d. Kuhne's tube experiments	
Practical's Based on BOT-MJ-553 Cytogenetics and Molecular Biology		
Practical 11	Karyomorphological studies from slide/photograph.	
Practical 12	Study of chromosomal aberrations with the help of permanent slides or in plant (<i>Rhoeo discolor</i>).	

Practical 13	Isolation and Quantification of DNA from suitable plant material. (C-TAB and Spectroscopic method)
Practical 14	Study of Mitosis in pretreated root tips of <i>Alium cepa</i> , <i>Alium sativum</i> , <i>Zea mays</i>
Practical 15	Demonstration of blotting techniques.

Note:

- i) Excursion tour compulsory (different locality & geographical area)
- ii) Duly certified journals are compulsory at time of practical examination.

DSE 6 {T}	BOT-EC-571 Plant Breeding and Seed Technology	Credit 4 Lecture 60
<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. Student will know early development in plant breeding 2. To know the seed quality, seed health testing and production methods <p>Course outcomes:</p> <ol style="list-style-type: none"> 1. Basic knowledge on breeding in self-pollinated crops, pure line theory 2. Knowledge on types of hybridization can be used in the area of seed production. 3. Students can establish seed production units and generates employment. 		
Unit 1	Introduction: Definition, Scope and objectives and History of Plant breeding in India	02 L
Unit 2	<p>Techniques and practices of plant breeding</p> <p>A. Plant Introduction • Definition • Types (Primary and Secondary) • Procedure • Merits and Demerits • Important Achievements</p> <p>B. Selection methods • Concept, • Types of selections –mass selection, pure line selection and clonal selection. • Advantage and disadvantages of selection • Achievements of selection breeding</p> <p>C. Hybridization • Definition, Concept and Objectives • Precaution to be taken during hybridization • Types: Intervarietal and Distant • General procedure of hybridization • Methods of hybridization: Pdigree and bulk • Hybrid vigour and heterosis</p>	12 L
Unit 3	<p>Advanced techniques in Plant breeding</p> <p>A. Mutation breeding: Definition and concept • Mutagens (Physical and Chemical) • Mutants • Types of mutation (Spontaneous and Induced) • Application of mutation breeding • Limitations of mutation breeding</p> <p>B. Tissue Culture • Definition and concept • Totipotency • Application of tissue, embryo and anther culture in seed production</p>	08 L
Unit 4	<p>Introduction to Seed Technology</p> <p>Seed as a basic input in agriculture</p> <p>Classes of seed 1. Nucleus 2. Breeder 3. Foundation 4. Certified</p> <p>Certified Role of seed technology</p>	04 L
Unit 5	<p>Seed legislation & Seed Production</p> <p>Introduction • Seed legislation in India (Seed Act)</p> <p>Seed Production • Introduction • National Seed Corporation (NSC) and its objectives</p> <p>State Seed Corporation (SSC) and its objectives • General procedure for Seed Production , Location and Season, Land requirement o Importance of soil and water testing o Cultural practices o Isolation distance o Plant protection o Weed Control o Rouging o Harvesting o Threshing o Seed Processing</p> <p>Seed Certification • Definition, Objectives and Concept • Phases of Seed Certification • General procedure of seed certification • Field inspection • Duties of seed inspector</p>	12 L
Unit 6	<p>Seed Testing</p> <p>A. Physical Purity Analysis • Definition of purity components • Physical Purity Work Board • Procedure</p> <p>B. Moisture Testing • Concept • Air oven method • Digital Moisture Meter</p> <p>C. Germination testing • Definition and objectives • Procedure and methods for germination testing (Paper, Sand and Soil) • Seedling evaluation (Normal Seedlings, Abnormal Seedlings, Multigerm Seed Units and Non-germinated Seeds)</p>	12 L
Unit 7	<p>Seed Pathology, Entomology and Storage</p> <p>• Definition • Seed Borne pathogens o Fungi o Bacteria o Viruses • Influence of seed borne pathogens on seed production • Common insect pest and its impact on seed production</p>	10 L

	• Seed treatment • Management of seed storage structures o Sanitization o Dehumidification o Fumigation	
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Suggested Readings

1. Laxmi Lal Somani and Devidas Patel (2020) Textbook of seed science and technology, Agrotech publishing co.
2. Vijay Pal Singh Panghal and Akshay Bhuker (2020) Seed Science and Technology. Kalyani publisher
3. Gardner and Simmons Snustad 2005 (Eighth Edition). Principles of Genetics, John Wiley and Sons, Singapore.
4. Sharma J.R 1994 Principles and practices of Plant Breeding. Tata McGraw-Hill Publishers Company Ltd., New Delhi.
4. Singh B.D 1996 Plant Breeding – Principles and methods. Kalyani Publications, Ludhiana.
5. Allard R.W 1995. Principles of Plant Breeding. John Wiley and Sons, Inc., Singapore.
6. Agarwal R.L. --- Seed Technology, Oxford & IBH Publishing Co Pvt. Ltd

DSE 6 {T}	BOT-EC-572 Plant Ecology and Phytogeography		Credit 4 Lecture 60
<p>Course objectives:</p> <ol style="list-style-type: none"> 1. To know concept, scope and importance of the discipline. 2. To study ecosystem ecology and community ecology. 3. To make aware about conservation of biodiversity, energy and Pollution. 4. To study botanical regions of India and vegetation types of Maharashtra. 5. To study Bioremediation, Global warming and climate change. <p>Course outcomes:</p> <ol style="list-style-type: none"> 1. Able to know concept, scope and importance of the discipline. 2. Able to describe ecosystem ecology and community ecology. 3. Higher cognitive skills about conservation of biodiversity, energy and pollution will develop. 			
Unit 1	<p>A) Plant Ecology: Definition, Concept and Scope of Ecology, Branches of Ecology.</p> <p>B) Ecosystem Ecology:</p> <ol style="list-style-type: none"> i) Introduction, kinds of ecosystems, structure and functions of ecosystem. ii) Productivity of ecosystem iii) Food chain and food web iv) Major ecosystems- Pond ecosystem, Ocean (Marine) ecosystem, Grassland ecosystem, Forest ecosystem, Desert ecosystem, Cropland ecosystem. v) Biogeochemical (Nutrient) cycles in ecosystem: Water cycle, Carbon cycle, Nitrogen cycle and impact of human activities on them. 	12 L	
Unit 2	<p>C) Community Ecology:</p> <ol style="list-style-type: none"> i) Definition and concept of community ii) Structure- Zonation and Stratification iii) Characters used to describe community structure: Quantitative and Qualitative characters iv) Methods of community studies <p>D) Community Dynamics:</p> <ol style="list-style-type: none"> i) Ecological succession- Definition causes and types. ii) Process of succession- Hydrosere and Xerosere iii) Climax concept- Monoclimax and Polyclimax 	12 L	
Unit 3	<p>Conservation Ecology:</p> <p>A) Biodiversity and its Conservation:</p> <ol style="list-style-type: none"> i) Definition and importance ii) Types of Biodiversity: Genetic, Species, Ecosystem. iii) Indian Hot spots of biodiversity: Eastern Himalayas and Western Himalayas. iv) Conservation of Biodiversity: In-situ and Ex-situ In-situ Conservation: Biosphere reserves, National parks, Wildlife Sanctuaries. Ex-situ Conservation: Botanical gardens/Herbal gardens, Seed (Germplasm) bank, Pollen bank. <p>B) Energy Conservation:</p> <ol style="list-style-type: none"> i) Sources of Energy: Conventional and non conventional 	12 L	

	ii) Non conventional sources: Solar energy, Tidal energy, Biomass energy. Perspective alternatives for energy: Petroplants, Biogas energy.	
Unit 4	A) Pollution: i) Air pollution: Sources, types, effect of air pollution on plants, effect of air pollutants on human. ii) Water pollution: causes, effects, control measures. iii) Global warming and climate change: Greenhouse effect, Ozone depletion, El NINO and LA NINA. B) Bioremediation: i) Definition, concept, need and scope. ii) Phytoremediation: a) Recovery of heavy metals from soil b) Reclamation of industrial waste and municipal waste water c) Revegetation of industrial deserts.	12 L
Unit 5	A) Phytogeography: i) Main Botanical Regions of India. ii) Detailed study of vegetation types in Maharashtra B) Ecological Indicators: i) Introduction ii) Plants as indicators: Soil, pH, Ground water, Minerals. Metals and Pollution C) Endemism: Causes and types. D) Biogeography: Dispersal- Barriers and means of dispersal.	12L

Suggested readings:

1. Agrawal, K.C. (1996). Environmental Biology, Agro-Botanical Publisher, Bikaner India
2. Ambasta, R.S. (1988). A Text of Plant Ecology, Student Friends & Co. Varanasi, India.
3. Ambasta, R.S. (1990). Environmental and Pollution, Student Friends & Co. Varanasi, India.
4. Chapman, and Reiss, M.J. (1998). Ecology: Principles and Applications. Cambridge University Press, Cambridge
5. Dash, M.C. (1993). Fundamentals of Ecology, Tata McGraw Hill Publishing Co. Ltd. New Delhi, India.
6. Heywood, V.H. and Watson, R.T. (1995). Global Biodiversity Assessment, Cambridge University Press, Cambridge.
7. Hill, M. K. (1997). Understanding Environmental Pollution, Cambridge University Press, Cambridge.
8. Kapur, P. And Govil, S.R. (2000). Experimental Plant Ecology S.K. Jain for CBS Publishers and Distributors, New Delhi, India.
9. Kothari, A. (1997). Understanding Biodiversity: Life Sustainability and Equity Orient Longman.
10. Krebs, C.J. (1989). Ecological Methodology. Harper and Row, New York, USA.
11. Kumar, H.D. (1996). Modern Concept of Ecology (4th Ed.) Vikas Publishing House (P.) Ltd. New Delhi.
12. Kumar, H.D. (1997). General Ecology, Vikas Publishing House (P.) Ltd. New Delhi,
13. Kochhar, P. L. Plant Ecology. Genetics and Evolution, S. Nagin & Co. Ltd. New Delhi.
14. Moore, P.W. and Chapman, S.B. (1986). Method in Plant Ecology. Blackwell Scientific Publications.
15. Mukherjee B. Environmental Biology. Tata McGraw Hill Publishing Ltd.
16. Purohit S.S. and Ranjan R. (2007). Ecology, Environment and Pollution. Agrobios (India)
17. Sharma P.D. (2018) Ecology and Environment. Rastogi Publications, Meerut-New Delhi.

OJT/INT {P}	BOT-OJT-591 On Job Training/Internship/Apprentiship/Field Work	Credit 4 Lecture 60
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Goal

Provide the students with practical and professional experience

Purpose

To give students hands-on training regarding career development

The On Job Training / Field Projects (OJT/FP) shall expose the student to practical hands-on training necessary for their professional and personal enhancement. The institutions/companies/organizations/academicians hosting the intern are envisaged to benefit from the creative contributions of the students. The students must complete the on-job training/internship/field of 04 credits during summer break. The (OJT/FP) program forms a practical programme of 100 marks.







