

**Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon**

॥अंतरी पेटवू ज्ञानज्योत॥



'A' Grade
NAAC Re-Accredited
(3rd Cycle)

SYLLABUS

For

Master of Science (M. Sc.)

[Botany]

M.Sc. Part-Ist (Sem-I & II)

Choice Based Credit System

(Outcome Based Curriculum)

2021 - 2022

Program at a Glance

Name of the program (Degree)	: M. Sc. Botany
Faculty	: Science and Technology
Duration of the Program	: Two years (four semesters)
Medium of Instruction and Examination	: English
Exam Pattern	: 60: 40 (60 marks University exam and 40 marks continuous internal assessment)
Passing standards	: 40% in each exam separately (separate head of passing)
Evaluation mode	: CGPA
Total Credits of the program	: 88 (68 core credits including 4 credits of project/dissertation, 04 skill enhancement credits, 08 subject elective credits and 08 audit credits)

Summary of Distribution of Credits under CBCS Scheme for M.Sc. BOTANY

Sr. No	Type of course	Sem I	Sem II	Sem III	Sem IV
01	Core	16	20	16	12
02	Skill based	04	--	-	-
03	Elective	-	-	04	04
04	Project	-	-	-	04
05	Audit	02	02	02	02
06	Total Credits	22	22	22	22

Subject Type	Core	Skill based	School Elective	Project	Audit	Total
Credits	64	04	08	04	08	88
						Total Credits = 88

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon

M. Sc. Botany

Choice Based Credit System (Outcome Based Curriculum) with effect from 2021 -2022

Course credit scheme

Semester	(A) Core Courses			(B) Skill Based / Elective Course			(C) Audit Course (No weightage in CGPA)			Total Credits (A+B+C)
	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (Practical)	Total Credits	
I	4	8 + 8	16	1	4 + 0	4	1	2	2	22
II	4	12 + 8	20	1	0 + 0	--	1	2	2	22
III	4	8 + 8	16	1	4 + 0	4	1	2	2	22
IV	4	8 + 8	16	1	4 + 0	4	1	2	2	22
Total Credits		68			12			8		88

(T, Theory; P, Practical)

Structure of Curriculum

		First Year				Second Year				Total Credit Value
		Semester I		Semester II		Semester III		Semester IV		
		Credit	Course	Credit	Course	Credit	Course	Credit	Course	
(A)	Prerequisite and Core Courses									
	Theory	4	2	4	3	4	2	4	2	36
	Practical	4	2	4	2	4	2	4	2	28
(B)	Skill Based / Subject Elective Courses									
1	Theory /Practical	4	1	--	--	4	1	4	1	16
(C)	Audit Course (No weightage in CGPA calculations)									
1	Practicing Cleanliness	2	1							2
2	Personality and Cultural Development Related Course			2	1					2
3	Technology Related + Value Added Course					2	1			
4	Professional and Social + Value Added Course							2	1	2
	Total Credit Value	14	6	14	6	14	6	14	6	88

List of Audit Courses (Select any ONE course of Choice from Semester II; Semester III and Semester IV)

Semester I (Compulsory)		Semester II (Choose One)		Semester III (Choose One)		Semester IV (Choose One)	
		Personality and Cultural Development		Technology + Value Added Course		Professional and Social + Value Added Course	
Course Code	Course Title	Course Code	Course Title	Course Code	Course Title	Course Code	Course Title
AC-101	Practicing Cleanliness	AC-201A	Soft Skills	AC-301A	Computer Skills	AC-401A	Human Rights
		AC-201B	Sport Activities	AC-301B	Cyber Security	AC-401B	Current Affairs
		AC-201C	Yoga	AC-301C	Seminar + Review Writing	AC-401C	Banana Fruit Processing
		AC-201D	Music	AC-301D	Biodiversity & Conservation	AC-401D	Intellectual Property Rights (IPR)

Semester-wise Course Structure of M.Sc. Botany

Semester I

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
BOT-101	Core	Plant Systematics-I (Algae, Fungi & Bryophytes)	4	--	4	40	--	60	--	4
BOT-102	Core	Taxonomy of Angiosperms	4	--	4	40	--	60	--	4
BOT-103	Core	Practical Based on Bot. 101	--	4+4	8	--	40	--	60	4
BOT-104	Core	Practical Based on Bot. 102	--	4+4	8	--	40	--	60	4
BOT-105	Skill Based	Applied Plant Biotechnology	4	--	4	40	--	60	--	4
AC-101	Audit Course	Practicing Cleanliness		2	2	--	100	--	--	2
Total Credit for Semester I: 22 (T = Theory: 8; P = Practical:8; Skill Based:4; Audit Course:2)										

Semester II

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
BOT-201	Core	Plant Systematics-II (Pteridophytes, Gymnosperm & Palaeobotany)	4	--	4	40	--	60	--	4
BOT-202	Core	Plant Physiology and Biochemistry	4	--	4	40	--	60	--	4
BOT-203	Core	Cytogenetics and Molecular Biology	4	--	4	40	--	60	--	4
BOT-204	Core	Practical based on BOT 201 & BOT 202	--	4+4	8	--	40	--	60	4
BOT-205	Core	Practical based on BOT 203	--	4+4	8	--	40	--	60	4
AC-201 A/B/C/D	Audit Course (Select any one)	AC-201 A: Soft Skills AC-201 B: Sport Activities AC-201 C: Yoga AC-201 D: Music	--	2	2	--	100	--	--	2
Total Credit for Semester II: 22 (T = Theory: 12; P = Practical:8; Skill Based:00; Audit course:2)										

Semester III

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
BOT-301	Core	Plant Development & Reproduction	4	--	4	40	--	60	--	4
BOT-302	Core: Special Paper	BOT-302 A: Phycology Special Paper-I BOT-302 B: Mycology Special Paper-I BOT-302 C: Angiosperm Special Paper-I	4	--	4	40	--	60	--	4
BOT-303	Core	Practical Based on BOT 301	4		4	40	--	60	--	4
BOT-304	Core	Practical Based on BOT 302 (Special Paper)	--	4+4	8	--	40	--	60	4
BOT-305	Elective (Select any one)	BOT 305 A: Biostatistics and Bioinformatics BOT 305 B: Techniques in plant Sciences	4	--	4	40	--	60	--	4
AC-301 A/B/C/D	Audit Course (Select any one)	AC-301 A: Computer Skills AC-301 B: Cyber Security AC-301 C: Seminar and Review Writing AC-301 D: Biodiversity and Conservation		2	2		100	--	--	2
Total Credit for Semester III: 22 (T = Theory: 8; P = Practical:8; Skill Based:4; Audit Course:2)										

Semester IV

Course	Course Type	Course Title	Teaching Hours/ Week			Marks (Total 100)				Credits
			T	P	Total	Internal		External		
						T	P	T	P	
BOT-401	Core: Special Paper	BOT-401 A: Phycology Special Paper-II BOT-401 B: Mycology Special Paper-II BOT-401 C: Angiosperm Special Paper-II	4	--	4	40	--	60	--	4
BOT-402	Core: Special Paper	BOT-402 A: Phycology Special Paper-III BOT-402 B: Mycology Special Paper-III BOT-402 C: Angiosperm Special Paper-III	4	--	4	40	--	60	--	4
BOT-403	Core	Practical based on BOT 401 & BOT 402		4+4	8	--	40	--	60	4
BOT-404	Core	Practical: Project Dissertation	--	4+4	8	--	40	--	60	4
BOT-405	Elective (Select any one)	BOT-405 A: Plant Ecology & Phytogeography BOT-405 B: Industrial Botany	4	--	4	40	--	60	--	4
AC-401 A/B/C/D	Audit Course (Select any one)	AC-401 A: Human Right AC-401 B: Currant Affairs AC-401 C: Banana Fruit Processing AC-401 D: Intellectual Property right (IPR)		2	2		100	--	--	2
Total Credit for Semester IV: 22 (T = Theory: 8; P = Practical:8; Skill Based:4; Audit Course:2)										

Distribution of Course papers for M. Sc. Part I (Botany)

Subject Code	Title of the Paper		Duration (Hrs./Wk)	Max. Mark	Exam. Time (Hrs.)
M.Sc. Part I					
Semester I : Theory Courses					
BOT-101	Plant Systematics-I (Algae, Fungi & Bryophytes)	Core course	04	100	03
BOT -102	Taxonomy of Angiosperms	Core course	04	100	03
BOT-105	Applied Plant Biotechnology	Skill based	04	100	03
Semester I : Practical Courses					
BOT-103	Practical Based on Bot. 101	Core course	04+04	100	06
BOT-104	Practical Based on Bot. 102	Core course	04+04	100	06
AC-101	Practicing Cleanliness	Audit Course	02	100	
Semester II : Theory Courses					
BOT-201	Plant Systematics-II (Pteridophytes, Gymnosperm & Palaeobotany)	Core course	04	100	03
BOT-202	Plant Physiology and Biochemistry	Core course	04	100	03
BOT-203	Cytogenetics and Molecular Biology	Core course	04	100	03
Semester II : Practical Courses					
BOT-204	Practical based on BOT 201 & BOT 202	Core course	04+04	100	06
BOT-205	Practical based on BOT 203	Core course	04+04	100	06
AC- 201 A/B/C/D (Select any one)	AC- 201 A: Soft Skills AC- 201 B: Sport Activities AC- 201 C: Yoga AC- 201 D: Music	Audit Course	02	100	

M. Sc. I (Botany)			
Equivalence of Papers			
Semester-I			
Code	Title (Old)	Code	Title (New)
BOT 101	Angiosperm Taxonomy	BOT 102	Taxonomy of Angiosperms
BOT 102	Environmental Botany and Biostatistics	BOT-101	Plant Systematics-I
BOT 103	Cytogenetics, and Molecular Biology	BOT-105	Applied Plant Biotechnology
BOT 104	Practical –I (Based on BOT.101)	BOT-103	Practical Based on Bot. 101
BOT 105	Practical –II (Based on BOT.102 and BOT.103)	BOT-104	Practical Based on Bot. 102
Semester-I			
Code	Title (Old)	Code	Title (New)
BOT 201	Diversity of Lower Cryptogams	BOT-203	Cytogenetics and Molecular Biology
BOT 202	Diversity of Higher Cryptogams	BOT-201	Plant Systematics-II
BOT 203	Plant Physiology and Biochemistry	BOT-202	Plant Physiology and Biochemistry
BOT 204	Practical –I (Based on BOT.201)	BOT-205	Practical based on BOT 203
BOT 205	Practical –II (Based on BOT.202 and BOT.203)	BOT-204	Practical based on BOT 201 & BOT 202

M.Sc. Part I Semester I Botany: Core Courses

Core Course	BOT - 101: Plant Systematics-I (Algae, Fungi and Bryophytes)	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 	14L

	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, Metzerials 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) Manual 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

Core Course	BOT-102 Taxonomy of Angiosperms	Lecture 60
<p>Course Objectives:</p> <ol style="list-style-type: none"> To study aims, principles and methods in taxonomy. To study taxonomic structure of Angiosperms. To study Cronquist system of classification. To study recent APG system of classification and evolutionary trends. To study morphological peculiarities and biological importance of plants <p>Course outcomes:</p> <ol style="list-style-type: none"> Student provide with importance of classification in Angiosperms. They will get the knowledge of recent system of classification in Angiosperms. This course helps to make them aware of wild plants their habit and habitat from field tour. Student will know biological adaption and evolutionary trends of angiosperm. 		
Unit 1	<p>Taxonomy.</p> <ol style="list-style-type: none"> Aim, principles and methods in taxonomy. Basic Concepts of Biosystematics and Taxonomy, Trends in biosystematics- Chemotaxonomy, Cytotaxonomy. Taxonomic Tools – Floras, monographs, Herbaria, Botanical survey of India (Regional & zonal centre, activity) 	12
Unit 2	<p>System of classification.</p> <ol style="list-style-type: none"> Review of Pre- Darwinian and Post Darwinian classification Cronquist system of classification: Introduction, principles, Outline, Merits and demerits. 	12
Unit 3	<p>Angiosperm phylogeny group.</p> <ol style="list-style-type: none"> Principles of APG – I (1998), APG- II (2003), APG- III (2009) and APG- IV (2016) system of classification. APG-III (2003) system of classification: Introduction, APG III vs Bentham and Hookers classification, Outline classification. 	12
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>	12
Unit 5	<p>a) Biological importance and morphological peculiarities of the families. Nepenthaceae, Orobanchaceae, Balanophoraceae, Rafflesiaceae, Podostemnaceae, Orchidaceae</p> <p>b) Study of evolutionary trends in taxonomy</p> <ol style="list-style-type: none"> Evolution of Inflorescence Evolution of floral nectaries Evolution of Androecium Evolution of Gynoecium 	12
<p>Suggested readings:</p> <ol style="list-style-type: none"> Agashe SN (1995) Paleobotany, Oxford and IBH Publ. Co. Pvt. Ltd, New Delhi. Briggs David 2009. <i>Plant microevolution and Conservation in Human-influenced Ecosystems.</i> Cambridge University Press. Cook T (1903). The Flora of Presidency of Bombay, Vol. I (Indian Reprint) Bishen Singh, Mahendra Pal Singh, Dehradun Cronquist, A. 1981. <i>An Integrated System of Classification of Flowering Plants</i> 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. **Leadlay 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. **Sivrajan V V (1984).** Introduction to Principles of Plant Taxonomy, Oxford and IBH, New Delhi.
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26. **Sporne K R (1974).** Morphology of Angiosperms, Hutchinson University Library, London.
27. **Stace C A (1989).** Plant Taxonomy and Biosystematics.
28. **Stewart W N and Rothwell G W (2005).** Paleobotany and the Evolution of Plants, 2nd edn, Cambridge University Press.
29. **Subrahmanyam K.** Aquatic angiosperms. BSI. India
30. **Takhtajan, A. 1962.***Flowering plants- Origin and Dispersal.*
31. **Taylor, D. V. and L. J. Hickey 1997.** *Flowering Plants: Origin, Evolution and Phylogeny.*CBS Publishers & Distributers, New Delhi.

BOT 103
Practical-I (Core Course)
(Based on BOT 101)

Algae: (08 Practicals)

Practical -1 Cyanophyta: Any two members from Each Order

Practical- 2-4 Chlorophyta: Any two members from Each Order

Practical -5 Charophyceae: *Chara, Nitella*

Practical – 6 Phaeophyta: Any five members from All Orders

Practical – 7 Rhodophyta: Any five members from All Orders

Practical – 8 Class: i. Xanthophyceae – *Vaucheria, Botrydium*

ii. Bacillariophyceae- Any Five members

iii. Euglenophyceae- Any two members

Fungi: (08 Practicals)

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).

Practical – 9 Myxomycota -Any four forms

Practical – 10 Mastigomycotina - Any four forms

Practical – 11 Zygomycotina - Any three forms

Practical – 12-13 Ascomycotina - Any eight forms

Practical – 14-15 Basidiomycotina- Any eight forms

Practical – 16 Deuteromycotina - Any four form

Bryophytes: (08 Practicals)

Morphological, Anatomical and Reproductive studies of the following:

Practical – 17-18 Marchantiales: *Plagiochasma, Targionia, Asterella, Dumortiera*

Practical – 19-21 Jungermanniales: *Pellia, Fossombronia, Pallavicinia, Porella, Frullania*

Practical – 22 Anthocerotales : *Anthoceros, Notothylus*

Practical – 23-24 Musci : *Polytrichum, Pogonatum*

Note:

1. Excursion tour is compulsory to observe algae, fungi and bryophytes in nature.
2. Tour report along with photographs must be submitted at the time of practical examination.
3. Duly certified journals are compulsory at the time of practical examination.

BOT 104. Practical II (Core Course) (Based on BOT.102 Taxonomy of Angiosperms)	
Practical. 1-14.	Study of families (Sensu: Bentham & Hooker System) w.r.t. morphological characters, floral formula, floral diagram and classification with reasons- Ranunculaceae, Menispermaceae, Papaveraceae, Capparidaceae, Portulaceae, Sterculiaceae, Tiliaceae, Malpighiaceae, Zygophllaceae, Meliaceae, Rhamneae, Moringeae, Papilionaceae, Myrtaceae, Cucurbitaceae, Umbelliferae, Rubiaceae, Plumbagineae, Apocynaceae, Boraginaceae, Convulvulaceae, Scrophulariaceae, Bignoniaceae, Acanthaceae, Verbenaceae, Labiatae, Nyctagineae, Chenopodiaceae, Polygonaceae, Scitaminae, Amaryllideae, Liliaceae, Commelinaceae, Typhaceae, Cyperaceae, Graminae (Any 20 families from different series)
Practical. 15-18.	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. 19-20.	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. 21-23.	Study of morphological and biological peculiarities of the specimens from following families. Nepenthaceae, Balanophoraceae, Podostemnaceae, Orobanchaceae, Refflesiaceae, Orchidaceae.
Practical. 24.	Visit to campus & surrounding area, submission of excursion report and photographs (Any 20 wild plants)
Note: i) Excursion tour compulsory (different locality & geographical area) ii) Duly certified journals are compulsory at time of practical examination.	

M.Sc. Part I Semester I Botany: Skill Based Course

Skill Based Course	BOT 105 Applied Plant Biotechnology	Lecture 60
Course Objectives:		
<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 there by 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 		
Unit 1	BIOTECHNOLOGY: Basic concept and brief introduction of biotechnology, History, Scope and Importance, Commercial application of biotechnology.	04 L
Unit 2	INTRODUCTION TO TISSUE CULTURE: Principle of plant tissue culture, Tissue culture laboratory, Equipment's in Tissue culture laboratory, 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	06 L
Unit 3	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 tank reactors, isolation of single cells and their culture, measurement of growth.	10 L
Unit 4	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.	10 L
Unit 5	RECOMBINANT DNA TECHNOLOGY: Gene cloning, Vectors, Role of Agrobacterium, Gene cloning techniques - Gene gun, Electroporation, Microinjection, Liposome mediated gene transfer, Ultra sonication and Pollen Mediated gene transfer	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	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

M.Sc. Part I Semester I Botany: Audit Course

AC-101: Practicing Cleanliness (Compulsory; Campus-level Audit Course; Practical; 2 Credits)		
Course Objectives (CObs):		
<ul style="list-style-type: none">To make students aware of Clean India Mission and inculcate cleanliness practices among them.		
	<ul style="list-style-type: none">Awareness program on<ul style="list-style-type: none">Swachh Bharat Abhiyan (Clean India Mission)Clean Campus MissionRole of youth in Clean India MissionCleaning activities inside and surroundings of Department buildings.Tree plantation and further care of planted treesWaste (Liquid/Solid/e-waste) Management, Japanese 5-S practicesPlanning and execution of collection of Garbage from different sections of University campusRole of youth in power saving, pollution control, control of global warming, preservation of ground water and many more issues of national importance.Cleanest School/Department and Cleanest Hostel contestsPainting and Essay writing competitions	

Course Outcomes (COs):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC101.1	Identify need at of cleanliness at home/office and other public places.	2
AC101.2	Plan and observe cleanliness programs at home and other places.	4
AC101.3	Practice Japanese 5-S practices in regular life.	3

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

Core Course	Bot. 201 Plant Systematics- II (Pteridophytes, Gymnosperms and Palaeobotany)	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>General characteristics, Habitat, Reproduction (Vegetative & Asexual), Sporophyte, Gametophyte (Sexual reproductive phase), Fertilization & Zygote formation, Embryo development, Life cycles (Homosporous & Heterosporous), Apogamy & Apospory</p> <p>B) Classification of Pteridophytes</p> <p>Classification of Pteridophytes up to orders proposed by Reimers (1954)</p> <p>C) Economic Importance</p> <p>D) 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</i> , vii) <i>Glossopteris, Vertebraria, Scutum</i> viii) Bennettitales: <i>Williamsonia sewardiana, W. spectabilis</i> ix) Pentoxylales: <i>Pentoxylon sahnii</i> (reconstruction) x) Cordaitales: <i>Cordaites</i> (Stem) xi) 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 Black, London, UK.
12. Maheshwari, P and R.R. Konar (1971) Pinus CSIR New Delhi, India.
13. Pande B. P. (1994) Gymnosperms S. 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. Vasishta, 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.

Core course	BOT 202 Plant Physiology and Biochemistry	Lecture 60
<p>Course Objectives:</p> <ol style="list-style-type: none"> To understand plant-water relationships To understand the plant structures with respect to physiological functions of plants To understand physiology of photosynthesis and respiration in plants To understand lipid metabolism in plants To understand basic concepts in Biochemistry To understand the primary and secondary metabolites and their importance in the plants <p>Outcome of the course-</p> <ol style="list-style-type: none"> The students are aware about the knowledge of the process such as diffusion, osmosis and Imbibition that occurs in the plant cells Students will get the knowledge of the important process like Photosynthesis and respiration in plants. 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. Students will aware about the basic concepts of biochemistry. Students will get the structure, composition of primary and secondary metabolites 		
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 	15 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. 	20 L
Unit 3	<p>Fat 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) 	10 L

Unit 4	pH and Buffer 4.1. Hydrogen ion concentration 4.2. Buffer and its types. Importance of buffers 4.3 Brief account of Primary metabolites.	08 L
Unit 5	Secondary metabolites 5.1. Secondary metabolites –Shikimate Pathway and its role in biosynthesis of Secondary Metabolites. 5.2 Phosphorus Nutrition – Forms of phosphorus in soil. Phosphorus uptake, factors controlling ‘P’ uptake, ‘P’ fractions in plants. Role of Pyrophosphate in plant metabolism.	12 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. [Keith Wilson](#), [John M Walker](#) and [Andreas Hofmann](#); [Samuel Clokie](#) (2018) Wilson and Walker's principles and techniques of biochemistry and molecular biology Cambridge, United Kingdom ; New York, NY : Cambridge University Press
17. Lehninger, A. L (1984) Principles of Biochemistry CBS Publishing & Distributors, New Delhi, India.
18. Mehta, S. L. Lodha, M. L. and P.V. Sane (Eds.) (1989) Recent advances in PlantBiochemistry. Pub. ICAR, New Delhi, India.
19. Mukherji, S. and A. K. Ghosh (2005) Plant Physiology. New Central Book Agency Kolkata, India.
20. Nobel, P. S. (1999) Physio-chemical and Environmental Plant Physiology (II Eds.) Academic Press, Sandiago, USA.
21. Noggle, G. R. & G. J. Frtiz (1982) Introductory Plant Physiology. Prentice Hall of India New Delhi, India.
22. Taiz, L., Zeiger, P. E. E., Mller, P. E. I. M., & Murphy, P. A. C. A. (2018). Fundamentals of plant physiology. Sinauer Associates.

Core Course	BOT 203 Cytogenetics and Molecular Biology	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 		
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>Structure change in a chromosome - (Deletion, Duplication, Inversion, and Translocation), Numerical change in the chromosome (Euploidy, Aneuploidy and its types).</p>	11 L
Unit 4	<p>Cell Cycle, Cell Signalling 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 (Mirabilis jalapa, Zea mays).</p>	11 L
Unit 5	<p>Introduction to Molecular biology</p> <p>Definition, milestones of molecular biology, scope and importance molecular biology</p>	02 L
Unit 6	<p>DNA and its Replication</p> <p>Physical and chemical properties of nucleic acids, discovery, and types of nucleic</p>	07 L

	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).	
Unit 7	Transcription 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 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) Definition and Properties of Genetic Code	08
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, NewDelhi,

India.

13. Powar, C. B. (1992) Cell Biology, Himalaya Publishing House Nagpur, India.
14. Powar, C. B (2003) Genetics I & II Himalaya Publishing House, Nagpur, India.
15. Swanson, C. P. T. Merz, and W.J. Young (1982) Cytogenetics; Prentice Hall of India Pvt. Ltd., New Delhi, India.
16. Russel, P.J. (1998) Genetics (5th edition); The Benjamin/ Cummings Publishing Company Inc., USA.
17. Verma, Agarwal, (2005) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology: S. Chand and Company, New Delhi, India.

Bot. 204
Practical-I (Core Course)
(Based on Bot. 201 and Bot. 202)

Pteridophytes: (04 Practicals)

Morphological, anatomical and reproductive studies of the following

Practical 1: Lycopodium, Isoetes

Practical 2: Ophioglossum, Osmunda

Practical 3: Gleichenia, Lygodium

Practical 4: Pteris, Adiantum, Asplenium

Gymnosperms: (04 Practicals)

Practical 5-6: 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: Pinus, Thuja, Cedrus, Cupressus, Sequoia, Araucaria, Agathis, Podocarpus, Cryptomeria, Juniperus

Practical 7: Study of External morphology of male and female cones of any six of the following: Pinus, Thuja, Cedrus, Cupressus, Sequoia, Araucaria, Agathis, Podocarpus, Cryptomeria, Juniperus

Practical 8: Study of External morphology, anatomy (T. S.) and morphology of reproductive organ of Ephedra. Study of External morphology, anatomy and morphology of reproductive organs of Ginkgo (with P. S./ Specimen)

Paleobotany: (04 Practicals)

Practical 9: Study of following fossils with P.S. or Specimens *Rhynia*, *Lepidodendron* Stem, *Lepidocarpon* *Calamites* Stem, *Annularia*, *Sphenophyllum* Stem

Practical 10: Study of following fossils with P.S. or Specimens *Lyginopteris oldhamia* (Stem), *Neuropteris*, *Glossopteris* *Vertebraria*,

Practical 11: Study of following fossils with P.S. or Specimens *Rodeites*, *Pentoxylon*, *Cordaites*

Practical 12: Study of following fossils with P.S. or Specimens: *Palmoxylon*, *Cyclanthodendron*, *Tricocites* *Sahnipushpam*, *Sahnianthus*, *Enigmocarpon*

Plant Physiology and Biochemistry (12 Practicals)

Practical 13: To Determine the DPD by suitable osmometer method.

Practical 14: To Determination of osmotic potential of plant cell any suitable method.

Practical 14-15: 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 16-17: To study the effect of light intensity and bicarbonate concentration on rate of photosynthesis

Practical 18: To determine the rate of respiration by using Ganong's Potometer

Practical 19-20: Preparation of solutions and buffers

Practical 21-21: Biochemical test from suitable material for.

- a. Tannins
- b. Alkaloids
- c. Phenols

Practical 23-24 Biochemical test from suitable material for.

- a. Carbohydrates
- b. Proteins
- c. Lipids

Bot. 205
Practical-II (Core Course)
(Based on Bot. 203)

Practical 1 -2 To Study any four-cell organelles as per syllabus (SEM/TEM Photographs/Image.)

Practical 3: Demonstration- principle working and uses of following equipments.

- 1) Research microscope,
- 2) Camera lucida,
- 3) Digital camera,
- 4) Micrometry Ocular and stage micrometer or software measurement technique

Practical 4-5 Karyomorphological studies from slide/photograph.

Practical 6: Preparation of Cytological fixative (Carnoy's fluid I, II, Navashin' s fluid etc.)

Practical 7: Preparation of stains, Aceto-carmin, Haematoxyline, and Feulgen Stain.

Practical 8: Techniques of preparation of permanent and semi permanent slides.

Practical 9-10: Study of Mitosis in pretreated root tips of *Alium cepa*, *Alium sativum*, *Medicago falcate* (*Methi*), *Zea mays*

i)By Acetocarmine squash preparation

ii)By Haematoxyline squash technique

iii)By Feulgen squash technique

Practical 11-12: i) Study of Meiosis by anther squash and smear technique in *Aloe vera*, *Alium cepa*, *Tradescantia*, *Zea mays*, *Rhoeo discolor* flower buds

ii) Study of stages of Meiosis division by Permanent slides.

Practical 13: Determination of Mitotic index and Metaphase frequency in *Allium cepa* or other plant material.

Practical 14: Isolation and purification of nuclei and their staining with feulgen Stain.

Practical 15: Demonstration of salivary gland chromosome preparations (*Chironomus* larvae/*Drosophila*).

Practical 16-17: Isolation and estimation of DNA from suitable plant material.

Practical 18: Study of chromosomal aberrations with the help of permanent slides or in plant (*Rhoeo discolor*).

Practical 19: Isolation and Janus green staining of mitochondria.

Practical 20: Isolation of chloroplasts to study.

Practical 21: Demonstration of blotting techniques.

Practical 22: Study of polyploidy in onion root tips.

Practical 23: Restriction digestion of plant DNA, its separation by agarose gel electrophoresis, and visualization by ethidium bromide staining.

M.Sc. Part I Semester II Botany: Audit Courses

AC-201(A): Soft Skills (Personality and Cultural Development Related Audit course; Practical; 2 Credits) (Optional)		
Unit 1	Introduction to soft skills Formal definition, Elements of soft skills, Soft vs. Hard skills, Emotional quotient, Goal setting, life skills, Need for soft skills, Communication skills, Etiquettes & Mannerism.	2 h
Unit 2	Self-Assessment Goal setting, SWOT analysis, attitude, moral values, self-confidence, etiquettes, non-verbal skills, achievements, positive attitude, positive thinking and self-esteem. Activity: The teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects.	4 h
Unit 3	Communication Skills Types of communication: Verbal, Non-verbal, body language, gestures, postures, gait, dressing sense, facial expressions, peculiarity of speaker (habits). Rhetoric speech: Prepared speech (topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver, Extempore speech (students deliver speeches spontaneously for 5 minutes each on a given topic), Storytelling (Each student narrates a fictional or real-life story for 5 minutes each), Oral review (Each student orally presents a review on a story or a book read by them) Drafting skills: Letter, Report & Resume writing, business letters, reading & listening skills Activity: The teacher should teach the students how to write the letter, report and build resume. The teacher should give proper format and layouts. Each student will write one formal letter, one report and a resume.	8 h
Unit 4	Formal Group Discussion, Personal Interview & Presentation skills Topic comprehension, Content organization, Group speaking etiquettes, driving the discussion & skills. Preparation for personal interview: dress code, greeting the panel, crisp self-introduction, neatness, etiquettes, language tone, handling embarrassing & tricky questions, graceful closing. Activity: Each batch is divided into two groups of 12 to 14 students each. Two rounds of a GD for each group should be conducted and teacher should give them feedback. Mock interview are to be conducted.	4 h
Unit 5	Aptitude and analytical skills Quantitative aptitude, Numerical reasoning, verbal reasoning, diagrammatic test, situational tests, logical thinking. Analytical skills: Definition, Types, problem solving	8 h
Unit 6	Life skills Time management, critical thinking, sound and practical decision making by dealing with conflicts, stress management, leadership qualities Activity: The teacher can conduct a case study activity to train students for decision making skills. The teacher should conduct a session on stress management and guide students on how to manage stress. The teacher may conduct a stress relieving activity in the class. He/she may counsel students individually to know their problems and guide them on dealing with them effectively.	4 h
Suggested readings:		
<ol style="list-style-type: none"> 1. Basics of Communication In English: Francis Sounderaj, MacMillan India Ltd. 2. English for Business Communication: Simon Sweeney, Cambridge University Press 3. An Introduction to Professional English and Soft Skills: Das, Cambridge University Press 4. Quantitative Aptitude: R.S. Agrawal 		

AC-201(B): Practicing Sports Activities (Personality and Cultural Development Related Audit course; Practical; 2 Credits) (Optional: Campus-level)				
SR NO.	NAME OF THE SPORT/GAME (Select ONE of the Following)	SYLLABUS OF THE COURSE	TIMING (02 Hours in a Week)	SEMESTER
1	Volleyball	<ul style="list-style-type: none"> • General Fitness • Basic Fitness • Specific Fitness • History of the Game • Basic Skill of the Game • Major Skill of the Game • Technique & Tactics of the Game • Game Practice 	<p style="text-align: center;">Morning: 07 to 09 AM</p> <p style="text-align: center;">OR</p> <p style="text-align: center;">Evening: 05 to 07 PM</p>	<p style="text-align: center;">Total 30 Hours in Each Semester</p>
2	Athletics			
3	Badminton			
4	Cricket			
5	Basketball			
6	Handball			
7	Kabaddi			
8	Kho-Kho			
9	Table-Tennis			
10	Swimming			

AC-201(C): Practicing Yoga (Personality and Cultural Development Related Audit course; Practical; 2 Credits) (Optional)	
	<p>Course Objectives:</p> <ul style="list-style-type: none"> • To motivate students towards yoga and provide them required training.
	<ul style="list-style-type: none"> • Yog: Meaning, Definition & Introduction, Objectives • Primary Introduction of Ashtanga Yoga • Preparation of Yogabhyas • Omkar Sadhana, Prayer, Guru Vandana • Sukshma Vyayamas • Suryanamaskar (12 Postures) • Asanas : <ul style="list-style-type: none"> ▪ Sitting (Baithaksthiti) - Vajrasana, Padmasan, Vakrasan, Ardha-Pashchimotanasanan ▪ Supine (Shayansthiti) - Uttan Padaasan(Ekpad/Dwipad), Pavanmuktasana, Viparitakarani Aasan, Khandarasan, Shavasana ▪ Prone (Viparitshayansthiti) - Vakrahasta, Bhujangasana, Saralhasta Bhujangasana, Shalabhasana(Ekpad/Dwipad), Makarasana ▪ Standing (Dhandsthiti) - Tadasana , TiryakTadasana, Virasana, Ardh Chakrasana • Primary Study of Swasana: Dirghaswasana, Santhaswasana, JaladSwasana - 6 Types • Pranayama : Anuloma-viloma, Bhramari

AC-201(D): Introduction to Indian Music (Personality and Cultural Development Related Audit course; Practical; 2 Credits) (Optional: Campus-level)	
	<p>Course Objectives:</p> <ul style="list-style-type: none"> • To motivate students towards Indian music and provide them minimum required training.
	<ul style="list-style-type: none"> • Definition and brief about generation of Swar, Saptak, Thaata, Raaga, Aavartan, Meend, Khatka, Murkee, Taal, Aalaap etc. • Taal and its uses - Treetaal, Daadraa, Zaptaal, Kervaa. • Information of Badaakhyaal, Chhotaakhyaal (one), Sargam, Lakshangeet (information) • Detailed information of Tambora • Detailed information of Harmonium and Tablaa. • Five filmy songs based on Indian Classical Music (Theory and Presentation) • Sound Management - Basic information of Sound Recording (including Practicals) • Composition of Music as per the Story • Preparing news write-ups of the Seminars, Library Musical Programmes held at the nearest Akashwani, by personal visits.

