



Shri Vile Parle Kelavani Mandal's
**MITHIBAI COLLEGE OF ARTS, CHAUHAN INSTITUTE OF SCIENCE &
AMRUTBEN JIVANLAL COLLEGE OF COMMERCE AND ECONOMICS
(AUTONOMOUS)**

*NAAC Reaccredited 'A' grade, CGPA: 3.57 (February 2016),
Granted under RUSA, FIST-DST & -Star College Scheme of DBT, Government of
India,
Best College (2016-17), University of Mumbai*

Affiliated to the
UNIVERSITY OF MUMBAI

Program: S.Y.B.Sc Botany

Course: PLANT BIODIVERSITY-III

FORM AND FUNCTION-III

CURRENT TRENDS IN PLANT SCIENCES-I

Semester III

**Choice Based Credit System (CBCS) with effect from the
Academic year 2019- 2020**

PROGRAMME SPECIFIC OUTCOMES (PSO'S)

On completion of the B.Sc Botany programme, the learners should be enriched with knowledge and be able to-

PSO1: Identify different groups of Botany and appreciate Plant Biodiversity.

PSO2: Understand the current developments in the different areas of Botany.

PSO3: Analyze and apply the methodologies and techniques learnt during the course of studying Botany.

PSO4: Integrate the knowledge acquired in botany to solve problem, take real time decisions and innovate, while working with plants.

PSO5: Share social and environmental consciousness with their fellow citizens.

PSO6: To develop better understanding of good laboratory practices and safety .

PSO7: Synthesize the scientific character of observation, reasoning and apply the knowledge in designing experiments.

PSO8: Develop skills to pursue career in the arena related to plant sciences namely Medicinal Botany, forestry and floristic pursuits

PSO9: To Acquire technological and analytical skills needed for industrial support services.

Preamble

As Autonomy has been granted to the college the F.Y.B.Sc syllabus has been restructured last year.

Keeping in tune with the revised syllabi of F.Y.B.Sc., the committee has taken utmost care to maintain the continuity in the flow of information of higher level at S.Y.B.Sc. Hence some of the modules of the earlier syllabus of S.Y.B.Sc. have been upgraded with the new modules in order to make the learners aware about the recent developments in various branches of Botany like Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms, Angiosperms, Genetics, Molecular Biology, Anatomy, Physiology, Biotechnology with an objective to raise the students awareness in interdisciplinary courses such as Biostatistics, Bioinformatics, instrumentation, Palynology, Embryology, Medicinal Botany & Cosmetology.

I am thankful to all the members of the Committee for their great efforts and for timely submission of the draft syllabus.

Evaluation Pattern

The performance of the learner will be evaluated in two components. The first component will be a Continuous Assessment with a weightage of 25% of total marks per course. The second component will be a Semester end Examination with a weightage of 75% of the total marks per course. The allocation of marks for the Continuous Assessment and Semester end Examinations is as shown below:

a) Details of Continuous Assessment (CA)

25% of the total marks per course:

Continuous Assessment	Details	Marks
Component 1 (CA-1)	Test/ Assignment	15 marks
Component 2 (CA-2)	Test/ Assignment	10 marks

b) Details of Semester End Examination

75% of the total marks per course. Duration of examination will be two and half hours.

Question Number	Description	Marks	Total Marks
Q1.	Answer any 2 out of 3 questions	10 Marks	20 Marks
Q2.	Answer any 2 out of 3 questions	10 Marks	20 Marks
Q3.	Answer any 2 out of 3 questions	10 Marks	20 Marks
Total of 3 questions			60 Marks
Q4.	Short notes Answer any 3 out of 6	05 Marks	15 Marks
		Total	15 Marks
Total Marks			75

Signature

Signature

Signature

HOD

Approved by Vice –Principal

Approved by Principal

Program: B.Sc (2019-20)				Semester: III	
Course: PLANT BIODIVERSITY-III				Course Code: USMABO301	
Teaching Scheme				Evaluation Scheme	
Lecture per week	Practical per week	Tutorial	Credit	Continuous Assessment (CA) (Marks - 25)	Semester End Examinations (SEE) (Marks- 75 in Question Paper)
3	3	-	3	25	75
Learning Objectives:					
<p>Plant diversity is an undergraduate S .Y. B.Sc. Botany course that deals with both conceptual and practical tools for identifying, classifying & studying the life cycles of algae and bryophyta . It develops knowledge of life cycle, economic importance & outline of their classification in general. Knowledge of Bentham & Hooker’s classification deals with imparting knowledge about angiosperm families. The lessons also give students hands-on competence for studying families like Cruciferae, Tiliaceae, Asteraceae, Solanaceae, Apocynaceae, Amaranthaceae and Palmae in nature & identifying them based on their morphological features. This course will also help students to build on the basic skills regarding modern techniques to study plant diversity which includes microscopy, preservation methods, chromatography and gel electrophoresis.</p>					
Course Outcomes:					
<p>After completion of the course, learners would be able to:</p> <p>CO1: Understand the life-cycles of Sargassum and Dictyota</p> <p>CO2: Understand Anthocerotae among Bryophyta along with life-cycle of Anthoceros</p> <p>CO3: Understand how to identify and classify plants based on Bentham & Hooker’s classification.</p> <p>CO4: Understand basic concepts of preservation methods, microscopy, chromatography and gel electrophoresis.</p>					
Outline of Syllabus: (per session plan)					
Module	Description				Duration
1	Thallophyta (Algae) & Bryophyta				48 mins
2	Angiosperms				48 mins
3	Modern Techniques to Study Plant Diversity				48 mins
	Total				2hrs 24 mins
PRACTICALS					2hrs 24 mins

Unit	Topic	2 Credits
Module 1	Thallophyta (Algae) & Bryophyta - <ul style="list-style-type: none"> • Structure, life cycle, economic importance and systematic position of Sargassum & Dictyota. • General Account of Class Anthocerotae. • Structure, life cycle, economic importance and systematic position of Anthoceros. 	15L
Module 2	Angiosperms <ul style="list-style-type: none"> • Morphology: Thalamus, Accessory whorls, essential whorls. • With the help of Bentham and Hooker's system of Classification for flowering plants study the vegetative, floral characters and economic importance of the following families: <ul style="list-style-type: none"> ○ Cruciferae/ Brassicaceae ○ Tiliaceae/ Malvaceae ○ Asteraceae ○ Solanaceae ○ Apocynaceae ○ Amaranthaceae ○ Palmae 	15L
Module 3	Modern Techniques to Study Plant Diversity <ul style="list-style-type: none"> • Preservation methods :Dry and Wet method • Microscopy – Principle and working of Light, and electron microscope. • Chromatography- Principles and techniques in paper and thin layer chromatography. • Principles and techniques of Horizontal and Vertical electrophoresis. 	15L

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL I

- **Algae & Bryophyta**

- Study of stages in the life cycle of *Sargassum* & *Dictyota* from fresh/ preserved material and permanent slides.
- Study of stages in the life cycle of *Anthoceros* from fresh/ preserved material and permanent slides.

- **Angiosperms**

- Study of flower morphology as per theory.
- Study of one plant from each family prescribed for theory: morphological peculiarities and economic importance of the members of these families.

- **Techniques to study Plant Diversity**

- Preparation of herbarium and wet preservation technique
- Separation of Carotenoids by thin layer chromatography
- Horizontal and Vertical Gel Electrophoresis – Demonstration

Suggested Readings

- Agashe, S.N. 1995. Paleobotany, Oxford and IBH Publ. Co. Pvt. Ltd, New Delhi.
- Bhojwani, S.S. and Bhatnagar, S.P. 1984. Embryology of Angiosperms. Vikas Publ. House, New Delhi.
- Briggs, David. 2009. Plant microevolution and Conservation in Human-influenced Ecosystems. Cambridge University Press.
- Cooke, T. 1903-1908. The Flora of Presidency of Bombay, Vol. I-III.
- Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
- Cronquist, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.
- Davis, P. H. and V. H. Heywood 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi.
- Eames A.J. 1961. Morphology of Angiosperms, McGraw Hill Book Co.
- Erdtman, G. 1966. Pollen Morphology and Plant Taxonomy of Angiosperms (An introduction to Palynology I), Hafner Pub.Co. London.
- Fahn, A. 1979. Plant Anatomy, Pergamon Press, London.
- Henry A N An Aid to the International Code of Botanical Nomenclature
- Hickey, M. and King, C. 2000. The Cambridge Illustrated Glossary of Botanical Terms. Cambridge University Press, UK.
- Hutchinson, J. 1959. Families of Flowering plants. Clarendon Press, Oxford.
- Jain S.K. and Rao R.R. 1976. Handbook of Field and Herbarium Methods, Today and Tomorrow Publishers, New Delhi.
- Johri, B. M. 1984. Comparative embryology of Angiosperms. Ind. Nat. Sc. Acad. New Delhi. Jones, S. B. and Luchinger A.E. 1986. Plant Systematics 2nd edn, McGraw Hill Book Co.
- Judd Walter S., Campbell, C. S., Kellogg, E. A., Stevens, P.F. and M. J. Donoghue. 2008. Plant Systematics- A Phylogenetic Approach. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.

- Kubitzki, K. 1977. Flowering Plants Evolution and Classification of Higher Categories. Plant Systematics – Evolution Supplement I.
- Kuijt J. 1969. The biology of parasitic flowering plants. California University Press.
- Lawrence, G. H. M. 1951. Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi.
- Mabberly, T. J. 1997. The Plant Book 2nd edn Cambridge University Press, Cambridge.
- Maheshwari, P. 1985. An Introduction to Embryology of Angiosperms. Tata McGraw Hill, New Delhi.
- Manilal, K. S. and M. S. Muktesh Kumar [ed.] 1998. A Handbook of Taxonomic Training. DST, New Delhi.
- Naik, V. N. 1984. Taxonomy of Angiosperms. Tata McGraw-Hill, New Delhi.
- Nair, P.K.K. 1966. Pollen morphology of Angiosperms. Periodical Expert Book Agency, New Delhi.
- Paech, K. and M.V. Tracey. 1956. Modern Methods of Plant Analysis. Vol-I & II. Springer-Verlag.
- Pandey S N and Mishra S D *Taxonomy of Angiosperms* Sambamurthy A V S S *Taxonomy of Angiosperms* Vashishtha P C *Taxonomy of Angiosperms* S Chand Publ. Subramanyam N S *Modern Plant Taxonomy*
- Quicke, Donald L. J. 1993. Principles and Techniques of Contemporary Taxonomy. Blakie Academic & Professional, London.
- Radford A.E. 1986. Fundamentals of Plant Systematics, Harper and Row N Y. 28. Sharma A.K. and A. Sharma. 1980. Chromosome Technique: Theory and Practices (3rd ed.) Butterworths, London.
- Sharma O P *Text book of Algae* Tata Mc Graw Hill Publ. India Sharma Kanika *Text Book of Microbiology* Ane Books Pvt Ltd
- Shivanna, K.R. and N.S. Rangaswamy. 1992. Pollen Biology- A Laboratory Manual. Springer-Verlag.
- Shivanna, K.R., Tandon, Rajesh . 2014. Reproductive Ecology of Flowering Plants: A Manual. Springer-Verlag.
- Simpson, M.G. 2010. Plant Systematics. Elsevier, Amsterdam.
- Singh G. 2004. Plant Systematics, 2nd edn, Oxford and IBH, New Delhi.
- Sivarajan, V.V. 1984. Introduction to Principles of Plant Taxonomy, Oxford and IBH, New Delhi.
- Smith G M *Cryptogamic Botany Vol I Algae and Fungi* Mc Graw Hill Publ.
- Smith G M *Cryptogamic Botany Vol II Bryophytes and Pteridophytes* Mc Graw Hill Publ.
- Gangulee, H C and Kar *College Botany Vol. II* New Central Book Agency
- Smith, P. M. 1976. The Chemotaxonomy of Plants, Edward Arnold Pub. Ltd.
- Sporne, K. R. 1974. Morphology of Angiosperms, Hutchinson University Library, London.
- Stace, C. A. 1989. Plant Taxonomy and Biosystematics. Edward Arnold, London.
- Stewart, W. N. and Rothwell, G. W. 2005. Paleobotany and the Evolution of Plants, 2nd edn, Cambridge University Press.
- Takhtajan, A. 1969. Flowering plants-Origin and Dispersal. Oliver and Boyd, Edinburgh.
- Taylor, D.V. and L.J. Hickey 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributors, New Delhi.

- Vashishtha B R, Vashi Sinha AK and Anil Kumar *Botany for Degree Students Part I - Algae*. S ChandPubl.
- Vashishtha B R, Vashi Sinha AK and Anil Kumar *Botany for Degree Students Part II - Fungi* S ChandPubl.
- Vashishtha B R, Vashi Sinha AK and Anil Kumar *Botany for Degree Students Part III - Bryophyta* S ChandPubl.

Program: B.Sc (2019-20)				Semester: III	
Course: FORM AND FUNCTION-III				Course Code: USMABO302	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutori al (Hour s per week)	Credit	Continuous Assessment (CA) (Marks - 25)	Semester End Examinations (SEE) (Marks- 75 in Question Paper)
3	3	-	3	25	75
Learning Objectives: Form & Function is an undergraduate S .Y. B.Sc. Botany course that deals with both conceptual and practical tools for studying the cell organelles, mitosis and meiosis. Knowledge of cytogenetics renders learning about plastid inheritance and chromosomal aberrations. Students are expected to grasp the idea of nucleic acid, DNA, RNA and mechanism of replication in prokaryotes and eukaryotes. Students will also be able to learn the concept of inheritance of sex linked diseases, genic balance theory in Drosophila and Lyon's hypothesis.					
Course Outcomes: After completion of the course, learners would be able to: CO1: Understand the life-cycles of Sargassum and Dictyota CO2: Understand Anthocerotae among Bryophyta along with life-cycle of Anthoceros CO3: Understand how to identify and classify plants based on Bentham & Hooker's classification. CO4: Understand basic concepts of preservation methods, microscopy, chromatography and gel electrophoresis.					
Outline of Syllabus: (per session plan)					
Module	Description				Duration
1	Cell Biology				48 mins
2	Cytogenetics				48 mins
3	Molecular Biology				48 mins
	Total				2hrs 24 mins
PRACTICALS					2hrs 24 mins

Unit	Topic	2 Credits
Module 1	<p>Cell Biology</p> <ul style="list-style-type: none"> • Ultra Structure and functions of the following cell organelles: • Peroxisomes and Glyoxysomes • Vacuole • Cell Division and its significance • Cell Cycle, structure of Interphase Nucleus (nuclear envelope, chromatin network, nucleolus and nucleoplasm) • Mitosis & Meiosis • Differences between Mitosis and Meiosis 	15L
Module 2	<p>Cytogenetics</p> <ul style="list-style-type: none"> • Variation in Chromosome structure (Chromosomal Aberrations) <ul style="list-style-type: none"> ○ Definition, Origin, Cytological and Genetic Effects of the following: ○ Deletions, Duplications, Inversions and Translocations. • Sex determination, Sex linked, sex influenced and sex limited traits : <ul style="list-style-type: none"> ○ Sex determination- Chromosomal Methods: heterogametic males and heterogametic females. Sex determination in monoecious and dioecious plants. Genic Balance Theory of sex determination in <i>Drosophila</i>, Lyon's Hypothesis of X chromosome inactivation. ○ Sex linked- eye colour in <i>Drosophila</i>, Haemophilia, colour blindness ○ Sex influenced- baldness in man • Extranuclear Genetics <ul style="list-style-type: none"> ○ Organelle heredity- Chloroplast determines heredity - Plastid transmission in plants, ○ Streptomycin resistance in <i>Chlamydomonas</i>. ○ Male sterility in maize 	15L
Module 3	<p>Molecular Biology</p> <ul style="list-style-type: none"> • Nucleic Acids: Types, structure & Functions of DNA & RNA 	15L

	<ul style="list-style-type: none"> • DNA replication : Modes of Replication, Messelson and Stahl Experiment, DNA replication in prokaryotes and eukaryotes- enzymes involved and molecular mechanism of replication. 	

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL II

- **Cell Biology**
 - Study of the ultra-structure of cell organelles prescribed for theory from Photomicrographs.
 - Estimation of DNA from plant material (one Std & one Unknown, No Std Graph)
 - Estimation of RNA from plant material (one Std & one Unknown, No Std Graph)
- **Cytogenetics**
 - Study of inheritance pattern with reference to Plastid Inheritance.
 - Study of cytological consequences of chromosomal aberrations (Laggards, Chromosomal Bridge, Ring chromosome, Chromosomal ring) from permanent slides or photomicrographs.
 - Study of mitosis from suitable plant material.
- **Molecular Biology**
 - Determining the sequence of amino acids in the protein molecule synthesized from the given m-RNA strand (prokaryotic and eukaryotic).

Suggested Readings

- Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. 1989. Molecular biology of the Cell (2nd edition). Garland Pub. Inc., New York.
- Atherly, A.G., Girton, J.R. and McDonald, J. F. (1999) The science of genetics. Saunders College Pub. Fort Worth USA.
- Burnham, C.R.(1962) Discussions in cytogenetics. Burgess Pub. Co., Minnesota.
- Cooper G M and Hausman R E, 2007, The Cell: Molecular Approach 4thEdn, SinauerAssociates,USA
- David Freifelder, Microbial Genetics.
- De Robertis and De Robertis, 1988, Cell and Molecular Biology, 8thedn, Info-Med, Hongkong
- Buchanan, Grisse and Jones, 2000, Biochemistry and Molecular Biology of Plants, American Soc. Plant Biologists, Waldorf
- Gardner E J *Principles of Genetics*.
- Genes IX– Benjamin Lewin, Jones and Bartlett, 2008
- Genes X– Benjamin Lewin, Jones and Bartlett, 2011
- Glick B R and Pasternak J J, *Molecular Biotechnology- Principles and Application of Recombinant DNA*.
- Griffiths, A.J.F and Gilbert, W.M (2nd edn). Modern genetic analysis. W.H. Freeman and Company, New york.
- Hartl, D.L., Jones E.W.(2001). Genetics: Principle and analysis (4th edn) Jones and Barlett Pub., USA.

- Karp, G. 1999. Cells and Molecular Biology: Concepts & Experiments. John Wiley and Sons, Inc., USA.
- Khush, G S (1973) Cytogenetics of Aneuploids. Academic press New York, London.
- Lewin, B. 2000. GENE VII. OxfordUniversityPress, New York, USA
- Lewin, B. Genes VIII. Oxford, University press. New York, USA.
- Lodish S, Baltimore B, Berk, C and Lawrence K, 1995, Molecular Cell Biology, 3rd edn, Scientific American Books, N.Y
- Mishra and Pandey *Plant Tissue Culture* Ane Books Pvt Ltd.
- Molecular Biology of the Cell – Alberts, B, Bray, D, Raff, M, Roberts, K and Watson JD, Garland Publishers, 1999
- Panima Publ Corporation.
- Principles of Biochemistry – Lehninger, W.H. Freeman and Company, 2005
- Rastogi Veer Bala *Fundamentals of Molecular Biology* Ane Books Pvt Ltd Hill
Economic Botany.
- Russel, P.J. 1998. Genetics (5th edn). The Benjamin/ Cummins Pub. Co., Inc. USA.
- Snustad, D.P. and Simmons, M.J. 2000. Principles of genetics (4th edn). John Wiley and Sons, Inc., USA.
- Strickberger, M.W: Genetics (4th edn). Mcmillan Publishing company, New York.

Program: B.Sc (2019-20)				Semester: III	
Course: CURRENT TRENDS IN PLANT SCIENCES-I				Course Code: USMABO303	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutorial (Hours per week)	Credit	Continuous Assessment (CA) (Marks - 25)	Semester End Examinations (SEE) (Marks- 75 in Question Paper)
3	3	-	3	25	75
Learning Objectives: “Current trends in plant sciences” is an undergraduate S .Y. B.Sc. Botany course that deals with both conceptual and practical tools for studying pharmacognosy and phytochemistry. The learners will be able to understand about pharmacopoeia both Indian herbal and Ayurvedic. They will also learn monograph study of a few plants. Learners will be able to study adulterants based on the knowledge of macroscopic features, microscopy, and chemical tests. Students will also learn about forestry in terms of agro-forestry and urban forestry, organic farming, silviculture, plant based fibres, spices and paper. They will also learn the concept of aromatherapy, nuetraceuticals and biofuels and will learn Vitamin C and protein estimation techniques.					
Course Outcomes: After completion of the course, learners would be able to: CO1: Understand monograph study from pharmacopoeia CO2: Understand study of detection of adulterants CO3: Understand plant product sources pertaining to fibers, spices, condiments and paper CO4: Understand the concept of aromatherapy, nuetraceuticals, plant enzyme industry and biofuels CO5: Understand the technique of Vitamin C and Protein estimation					
Outline of Syllabus: (per session plan)					
Module	Description				Duration
1	Pharmacognosy and phytochemistry				48 mins
2	Forestry and Economic Botany				48 mins
3	Industry based on plant products				48 mins
	Total				2hrs 24 mins
PRACTICALS					2hrs 24 mins

Unit	Topic	2 Credits
Module 1	Pharmacognosy and phytochemistry <ul style="list-style-type: none"> • Introduction to pharmacopoeia • Indian pharmacopoeia, Indian Herbal Pharmacopoeia and Ayurvedic Pharmacopoeia • Study of Monograph from pharmacopoeia e.g. <i>Saraca</i>, <i>Eclipta</i> • Secondary Metabolites: Sources, properties, uses and adulterants, regional and seasonal variations. • Adulterants: <i>Saraca asoca</i>, <i>Polyalthia longifolia</i>. 	15L
Module 2	Forestry and Economic Botany <ul style="list-style-type: none"> • Forestry: Outline of types of forest in India • Forestry: Agro-forestry, Urban forestry, organic farming, Silviculture • Economic Botany: <ul style="list-style-type: none"> ○ Types of fibers: Jute and cotton ○ Spices and condiments: Saffron, cardamom, Nutmeg & mace ○ Paper: Types of paper, paper yielding plants- Bamboo & Eucalyptus, paper processing. 	15L
Module 3	Industry based on plant products <ul style="list-style-type: none"> • Aromatherapy- Introduction, Uses with few examples. Jojoba, lemon, Jasmine. • Botanical and nutraceuticals -<i>Spirulina</i>, <i>Garcinia indica</i>/ <i>Garcinia cambogia</i>, <i>Chlorella</i>, Mushrooms and <i>Kale</i>. • Enzymes industry: Cellulases, Papain, Bromelain • Biofuels. 	15L

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL III

- Study of Eclipta & Saraca asoca- Macro, microscopy, chemical tests
- Study of adulterants - Saraca & Polyalthia- Macro, microscopy, chemical tests
- Types of Forests in India- [Champion & Seth].
- Study of biodiversity (Visit to National Park/ Botanical Garden)
- Sources of:
 - Fibres & Paper
 - Spices & condiments (as per theory)
- Measurement of fibres- Micrometry
- Estimation of Vitamin C from Garcinia (Kokum)
- Estimation of Proteins from Mushrooms by Lowry's method (With Multiplication Factor)
- Identification of sources of biofuels.

Suggested Readings

- Bajaj, Y.P.S., Ed. (1988) Biotechnology in Agriculture and Forestry – vol. 4, SpringerVerlag, Berlin, Heidelberg, New York, Tokyo.
- Buchanan B. B., Grissem W. and Jones R. L. (2015) Biochemistry and Molecular Biology of Plants. Second Edition. Wiley Blackwell.
- Chandra S., Lata H. and Varma A. (2013) Biotechnology for Medicinal Plants. Micropropagation and Improvement. Springer-Verlag, Berlin, Heidelberg. Charlwood B.V. and Rhodes MV.Edt (1999), Secondary products from plant tissue culture. Clarendon Press, Oxford. Cseke L. J., Kirakosyan A., Kaufman P. B., Warber S., Duke J. A. and Brielman H. L. (2006) Natural Products from Plants. 2nd Edition, CRC Press, Taylor & Francis Group.
- Das H. K. (Editor) (2007) Textbook of Biotechnology. 3rd Edition. Wiley India (P) Ltd.
- Dewick Paul M. (2002) Medicinal Natural Products (A Biosynthetic Approach), 2nd Edition, John Wiley and Sons Ltd., England.
- DiCosmo F. and Misawa M. (Editors) (1996), Plant Cell Culture Secondary Metabolism Toward Industrial Application. CRC Press, Boca Raton, New York.
- European Pharmacopoeia. 9th Edition. (2017). 3 Volume Set.
- Evans W. C. (2009) Trease and Evans' Pharmacognosy. Elsevier Health Sciences.
- Farooqi A. A. and Sreeramu B.S. (2004) Cultivation of Medicinal and Aromatic Crops. Revised Edition. Universities Press (India) Pvt. Ltd.
- Fu T.-J., Singh G. and Curtis W. R. (2000) Plant Cell and Tissue Culture for the Production of Food Ingredients. Springer International Edition. Springer (India) Pvt. Ltd., New Delhi.
- Greene J. J. and Rao V. B. (1998) Recombinant DNA – Principles and Methodologies. CRC Press.
- Harborne A. J. (1998) Phytochemical Methods A Guide to Modern Techniques of Plant Analysis. Third Edition. Chapman and Hall.
- Indian Pharmacopoeia 7th Edition (2014). 4 Volume Set.
- Jain S. M. and Saxena P. K. (2009) Protocols for in vitro Cultures and Secondary Metabolite Analysis of Aromatic and Medicinal Plants. Humana Press.
- Kaushik A and Kaushik C P Perspective in Environmental Sciences. Santra S C Environmental Science New Central Book Agency.
- Kurz W.G.W., Ed. (1989) Primary and Secondary Metabolism of Plant and Cell Cultures, Springer Verlag, Berlin.

- Morris, A.H. et al., Eds (1986) *Secondary Metabolism in Plant Cell Cultures*, Cambridge Univ. Press, Cambridge, U.K.
- Prasad and Kumar *Principles of Horticulture*
- Primrose S. B. and Twyman R. (2006). *Principles of Gene Manipulation and Genomics*. 7th Edition, Wiley-Blackwell.
- Pushpangadan P., Nyman U. L. F., George V. (1995) *Glimpses of Indian Ethanopharmacology*. Tropical Botanic Garden and Research Centre Thiruvananthapuram, India and The Royal Danish School of Pharmacy, Copenhagen, Denmark..
- Rai M. and Carpinella M. C. (2006) *Naturally Occurring Bioactive Compounds*. Elsevier B. V.
- Raman N. (2006) *Phytochemical Techniques*. New India Publishing Agency, New Delhi, India. Ramawat K. G. and Goyal Shaily (2009) *Comprehensive Biotechnology*. 1st Edition. S. Chand Publishing.
- Ramawat K. G. and Merillon J-M. (Editors) (1999) *Biotechnology: Secondary metabolites*, Oxford IBH Publishing Co., New Delhi
- Ramawat K. G. and Merillon J-M. (Editors) (2008) *Bioactive Molecules and Medicinal Plants*. Springer Verlag, Berlin, Heidelberg.
- Randhawa and Mukhopadyay. *Floriculture in India* Allied Publ. Dash M C *Fundamentals of Ecology*. Tata Mc GrawHillPubl.
- Schirmer, R.E., (2000), *Modern Methods of Pharmaceutical Analysis*, Vol. 1, 2. CRC Press, Boca Raton, Florida.
- Sensen C. W. (Editor) (2002) *Essentials of Genomics and Bioinformatics*, Wiley-VCH, Germany.
- Smith, P. M. (1976) *The Chemotaxonomy of Plants*. Edward Arnold, UK
- Staba, E.J. (Editor) (1980) *Plant Tissue Culture as a Source of Biochemicals*. CRC Press, Boca Raton, Florida.
- Swain T. E. (1963) *Chemical Plant Taxonomy*, Academic Press, London and New York.
- Trease and Evans *Pharmacognosy* Shah and Qadry *Pharmacognosy*
- Trigiano R. N. and Gray D. J. (1999) *Plant Tissue Culture Concepts and Laboratory Exercises*. 2nd Edition. CRC Press, Boca Raton, New York.
- Tyler, V. E., Brady, L. R. and Robbers J. E. (1976) *Pharmacognosy*, Balliere Tindall, Calcutta. Vasil I. K. (Editor) (1986) *Cell culture and somatic cell genetics of plants*. Vol. 4. Academic Press, New York.
- Verma V *Text book of Economic Botany* Ane Books Pvt Ltd. Sagreiya K P *Forests and Forestry*. NBT India Higman, Mayers, Bass, Judd, *Sustainable Forestry – Handbook*.
- Verpoorte R. and Alferman H. W. (Editors) (2003) *Metabolic engineering of plant secondary metabolites*. Kluwar Academic Publishing.
- Wagner H. and Bladt S. (1996) *Plant Drug Analysis A Thin Layer Chromatography Atlas*. 2nd Edition. Springer.
- Wagner, H. and Wolff P. (Editors) (1977) *New Natural Products and Plant Drugs with Pharmacological, Biological or Therapeutical Acitivity*. Springer Verlag, Berlin, Heidelberg, New York.
- Wickens G *Economic Botany*. Springer. Pandey B P *Economic Botany* S Chand Publ.



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**MITHIBAI COLLEGE OF ARTS, CHAUHAN INSTITUTE OF SCIENCE &
AMRUTBEN JIVANLAL COLLEGE OF COMMERCE AND ECONOMICS
(AUTONOMOUS)**

*NAAC Reaccredited 'A' grade, CGPA: 3.57 (February 2016),
Granted under RUSA, FIST-DST & -Star College Scheme of DBT, Government of
India,
Best College (2016-17), University of Mumbai*

Affiliated to the
UNIVERSITY OF MUMBAI

Program: S.Y.B.Sc Botany

Course: PLANT BIODIVERSITY-IV

FORM AND FUNCTION-IV

CURRENT TRENDS IN PLANT SCIENCES-II

Semester IV

**Choice Based Credit System (CBCS) with effect from the
Academic year 2019- 2020**

SVKM's Mithibai College of Arts, Chauhan Institute of Science & Amrutben Jivanlal
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Program: B.Sc (2019-20)				Semester: IV	
Course: PLANT BIODIVERSITY IV				Course Code: USMABO401	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutori al (Hour s per week)	Credit	Continuous Assessment (CA) (Marks - 25)	Semester End Examinations (SEE) (Marks- 75 in Question Paper)
3	3	-	3	25	75
Learning Objectives: Plant diversity is an undergraduate S .Y. B.Sc. Botany course that deals with both conceptual and practical tools for identifying, classifying & studying the life cycles of fungi, lichens, pteridophytes and gymnosperms. It develops knowledge of the plant pathology, economic importance & outline of their classification in general. Knowledge of paleobotany renders information about ancient ecological systems and climate. The lessons also give students hands-on competence for studying fungi, lichens, pteridophytes and gymnosperms in nature & identifying them based on their morphological & anatomical features. This course will help students to build on the basic information regarding classification of plant kingdom groups and render information about paleobotany.					
Course Outcomes: After completion of the course, learners would be able to: CO1: Understand Ascomycetae among fungi along with the life-cycles of Erysiphe and Xylaria CO2: Understand how to identify and classify Lichens based on general characters. CO3: Understand basic concepts of plant pathology & their modes of nutrition & significance in nature. CO4: Understand the concept of Geological time-scale and fossil formation process CO5: Understand Coniferophyta among Gymnosperms along with life cycles and their economic importance.					
Outline of Syllabus: (per session plan)					
Module	Description				Duration
1	Thallophyta: Fungi, Plant pathology & Lichens				48 mins
2	Pteridophyta & Paleobotany				48 mins
3	Gymnosperms				48 mins
	Total				2hrs 24 mins
PRACTICALS					2hrs 24 mins

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Unit	Topic	2 Credits
Module 1	<p>Thallophyta: Fungi, Plant Pathology and Lichens</p> <ul style="list-style-type: none"> • Fungi - <ul style="list-style-type: none"> ○ General characters of Ascomycetae ○ Structure, life cycle and systematic position of <i>Erysiphe</i> and <i>Xylaria</i> • Plant Pathology- Symptoms, causative organism, disease cycle and control measures of <ul style="list-style-type: none"> ○ Powdery mildew and Late blight of potato. • Lichens- Classification, Structure, Method of Reproduction, Economic Importance and Ecological Significance of Lichens. 	15L
Module 2	<p>Pteridophyta and Paleobotany</p> <p>Pteridophyta- Structure, life cycle and systematic position of <i>Selaginella</i> & <i>Equisetum</i>. Paleobotany- The geological time scale; Formation and types of fossils; Structure and systematic position of form genus <i>Asteroxylon</i></p>	15L
Module 3	<p>Gymnosperms</p> <ul style="list-style-type: none"> • Structure life cycle and systematic position of <i>Pinus</i>. • Structure and systematic position of the form genus <i>Cordaites</i>. 	15L

*To develop scientific temper and interest by exposure through industrial visits and study/educational
tour is recommended in each semester*

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PRACTICAL I

Fungi and Plant Pathology

- Study of stages in the life cycle of *Erysiphe* from fresh/ preserved material and permanent slides.
- Study of stages in the life cycle of *Xylaria* from fresh/ preserved material and permanent slides.
- Study of fungal diseases as prescribed for theory.
- Study of Lichens (crustose, foliose, & fruticose).

Pteridophyta and Palaeobotany

- Study of stages in the life cycle of *Selaginella* from fresh/ preserved material and permanent slides.
- Study of stages in the life cycle of *Equisteum* from fresh/ preserved material and permanent slides.
- Study of form genera *Asteroxylon* with the help of permanent slides/ photomicrographs.

Gymnosperms

- Study of stages in the life cycle of *Pinus* from fresh/ preserved material and permanent slides.
- Study of the form genus *Cordaites* with the help of permanent slide/ photomicrographs.

Suggested Readings

- Agashe SN (1995) Paleobotany, Oxford and IBH Publ. Co.Pvt. Ltd., New Delhi.
- Anold AC (2005 Repr.) An Introduction to Paleobotany, Agrobios (India), Jodhpur.
- Bhatnagar Sp and Motia A (1996) Gymnosperms. New Age International, New Delhi.
- Biswas C and Johri BM (1997) Gymnosperms. Narso. Pub., New delhi.
- Chamberlain CJ (1986) Structure and Evolution. CBS Punlishers, New Delhi
- Eames EJ (1983) Morphology of Vascular Plants. Standard University Press.
- Johari M, Sneh Lata and Kavita Tyagi (2012) A textbook of Gymnosperm.Dominant Publishers and Distributors, New delhi
- Rashid A (1999) An introduction to Pteridophyta. Vikas Publishing house Pvt.Ltd. New Delhi. Sharma OP (1990) textbook of Pteridophyta. Mac Millan India Ltd. Delhi.
- Singh VP (2006) Gymnosperms (Naked seed plants): Structure and development, Sarup and sons, New Delhi.
- Smith GM (1955) Cryptogamic Botany Vol. II Mc Grew Hill.
- Sporne KR (1986) The morphology of Pteridophytes. Hutchinson University Press. London. Stewart WN and Rothwell GW (2005) Paleobotany and the Evolution of plants, 2nd Edn. Cambridge University Press.
- Sundara Rajan S. (1999) Introduction to Pteridophyta. New Age International Publishers, New Delhi.
- Surange KR (1966) Indian fossil Pteridophytes. Council of Scientific and Industrial research. Parihar NS (1976) Biology and morphology of the Pteridophytes. Central Book Depot.

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Program: B.Sc (2019-20)				Semester: IV	
Course: FORM & FUNCTION IV				Course Code: USMABO402	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutori al (Hour s per week)	Credit	Continuous Assessment (CA) (Marks - 25)	Semester End Examinations (SEE) (Marks- 75 in Question Paper)
3	3	-	3	25	75
Learning Objectives:					
<u>Learning Objectives:</u>					
Form & Function is an undergraduate S .Y. B.Sc. Botany course that deals with both conceptual and practical tools for studying anatomical characters of stem and root. Students will learn about growth rings and their significance. Also the chapter broadens the students' understanding on types of plant tissues and vascular bundles. They also learn about basic physiological pathways occurring in plant ranging from respiration to photoperiodism and vernalization mechanisms. Another objective is to make the students understand the concepts of ecology such as biogeochemical cycles, concepts of environmental factors and community ecology.					
Course Outcomes:					
After completion of the course, learners would be able to:					
CO1: Understand the different types of plant tissues and their role in plant body					
CO2: Understand various physiological processes in plant body					
CO3: Understand the concept of long-day and short-day plants					
CO4: Understand the application of chromatography for separation of sugars and fermentation exercises					
CO5: Understand biogeochemical cycles and their importance and study of community ecology both on the basis of qualitative and quantitative characters.					
CO6: Learn soil organic matter analysis and quadrat study in field					
Outline of Syllabus: (per session plan)					
Module	Description				Duration
1	Anatomy				48 mins
2	Physiology & Plant Biochemistry				48 mins
3	Ecology & Environmental Botany				48 mins
	Total				2hrs 24 mins
PRACTICALS					2hrs 24 mins

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Unit	Topic	2 Credits
Module 1	Anatomy <ul style="list-style-type: none"> • Normal Secondary Growth in Dicotyledonous stem and root. • Growth rings, periderm, lenticels, tyloses, heart wood and sap wood. • Mechanical Tissue system <ul style="list-style-type: none"> ○ Tissues providing mechanical strength and support and their disposition ○ I-girders in aerial and underground organs • Types of Vascular Bundles. 	15L
Module 2	Plant Physiology and Plant Biochemistry <ul style="list-style-type: none"> • Respiration: Aerobic: Glycolysis, TCA Cycle, ETS & Energetics of respiration; Anaerobic respiration. • Photorespiration • Photoperiodism: Phytochrome Response with reference to flowering in higher plants, Physico-chemical properties of phytochrome, Pr-Pfr interconversion, role of phytochrome in flowering of SDPs and LDPs; • Vernalization mechanisms and applications. 	15L
Module 3	Ecology and Environmental Botany <ul style="list-style-type: none"> • Biogeochemical Cycles- Carbon, Nitrogen and Water. • Ecological factors: Concept of environmental factors. Soil, Air, Water, organism. Soil as an edaphic factor, Soil composition, types of soil, soil formation, soil profile. • Community Ecology- Characters of community – Qualitative & Quantitative characters 	15L

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

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PRACTICAL II

Anatomy

- Study of normal secondary growth in the stem and root of a Dicotyledonous plant.
- Types of mechanical tissues, mechanical tissue system in aerial, underground organs.

Plant Physiology and Plant Biochemistry

- Q10 – germinating seeds using Phenol red indicator.
- Separation of sugars by paper chromatography.
- NR activity – in-vivo- With standard graph.
- Fermentation by Kuhne's tube.

Ecology and Environmental Botany

- Study of the working of the following Ecological Instruments- Soil thermometer, Soil testing kit, pH meter, Wind anemometer.
- Mechanical analysis of soil by the sieve method & pH of soil.
- Quantitative estimation of organic matter of the soil by Walkley and Blacks' Rapid titration method.
- Study of vegetation by the list quadrat method.

Suggested Readings

- Plant Anatomy by Chandurkar P J, , Plant Anatomy Oxford and IBH publication Co. New Delhi 1971
- Plant Anatomy, By P Pandey, S Chand and Co. Ltd, New Delhi 1978
- An introduction to Modern Biology By Greulach V A and Adams J E Plant-, Toppen Co. Ltd, Tokyo,
- An Introduction to Plant Anatomy, By Eams and Mc Daniel, McGraw –Hill Book Co. Ltd and Kogakusha Co, Tokyo, Japan
- Practical Plant Anatomy, By Adriance S Foster D Van Nostrand Co. INC, Newyork
- Plant Anatomy, By Esau, Wiley Toppan Co. California, USA
- Plant Anatomy, By Pijush Roy New Central Book Agency Ltd, Kolkata
- Plant Anatomy and Embryology, By Pandey S N and Ajanta Chadha, Vikas Publishing House, Pvt, Ltd, New Delhi
- Plant Physiology by S. N. Pandey and B. K. Sinha (2014)., Vikas Publishing House Pvt. Ltd., India. Buchanan B.B, Gruissem W. and Jones R.L (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists Maryland, USA.
- Plant physiology by Salisbury F.B and Ross C.W (1992). (Fourth Edition) Wadsworth Publishing Company, California, USA.
- Introduction to Plant Physiology by William G. Hopkins (1995), Published by – John Wiley and Sons, Inc.
- Plant Physiology (3rd edition), by Lincoln Taiz and Eduardo Zeiger (2003). Published by – Panima Publishing Corporation R. G. S. Bidwell (revised edn.)-
- Plant Physiology by Verma S.K. and Verma Mohit (2007). A.T.B of Plant Physiology, Biochemistry and Biotechnology, S.Chand Publications.
- Principles of Biochemistry, by Leninger A.C (1987). CBS Publishers and Distributers (Indian Reprint) Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) 1997.

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- Biochemistry and Physiology of Plant Hormones by Moore T.C. 1989. Springer – Verlag, New York, USA.
- Concept in Photobiology; Photosynthesis and Photomorphogenesis. by Singhal G.S., Renger G., Sopory, S.K. Irrgang K.D and Govindjee 1999. Narosa Publishing House, New Delhi . Taiz L. and Zeiger E. 1998. Plant Physiology (Second Edition). Sinauer Associates, Inc. Publishes, Massachusetts, USA.
- Plant Physiology, Biochemistry and Biotechnology, by Verma S.K. and Mohit Verma 2007. A.T.B of S.Chand Publications.
- Textbook of Remote sensing and GIS (Third edition, 2006) by M. Anji Reddy, BS Publication, Hyderabad 2. George Joseph Fundamentals of remote sensing (Second edition, 2005) by Universities press (India) Private Ltd., Hyderabad.
- Remote sensing of the environment (2000), by John R. Jensen Dorling Kindersley India Pvt. Ltd,
- Fundamentals of Ecology. By E.P. Odum. 1996. Natraj Publishing, Dehradun.
- Plants and Environment- A Text Book of Plant Ecology (3rd edition). By Daubenmire R.F. 1974. John Wiley & Sons. New York.
- Ecology with Special Reference to Animals and Man. By Kendeigh S.C. 1980. Prentice Hall of India Pvt. Ltd., New Delhi.
- Modern Concepts of Ecology (3rd edition). By Kumar H.D. 1996. Vikas Publishing House Pvt., Ltd. Delhi. 11.Kumar.H.D. 1997. General Ecology. Vikas Publishing Pvt. Ltd., Delhi.
- Concepts of Ecology. By Kermondy F.J. 1996. Prentice Hall of India Pvt. Ltd., New Delhi.
- Ecology and Field Biology (5th edition). By Smith L.R. 1996. Harper Collins College Publishers, USA.
- Plant Ecology. By Weaver. J.E. and Clements. S.E. 1966. Tata McGraw Publishing Co. Ltd. Bombay.
- Elements of Ecology. (4th edition). By Smith L.R. and Mith T.M. 1998. An imprint of Addison Wesley, Longman ink., California.

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Program: B.Sc (2019-20)				Semester: IV	
Course: CURRENT TRENDS IN PLANT SCIENCES II				Course Code: USMABO403	
Teaching Scheme				Evaluation Scheme	
Lecture (Hours per week)	Practical (Hours per week)	Tutori al (Hour s per week)	Credit	Continuous Assessment (CA) (Marks - 25)	Semester End Examinations (SEE) (Marks- 75 in Question Paper)
3	3	-	3	25	75
Learning Objectives:					
<u>Learning Objectives:</u>					
<p>“Current trends in plant sciences” is an undergraduate S .Y. B.Sc. Botany course that deals with both conceptual and practical tools for studying Biotechnology, Horticulture, biostatistics and bioinformatics. Students are expected to learn about the concept of types of garden and garden locations. They are exposed to the art, science, technology of garden planning. The learners get to know about the concept of national parks and botanical garden. The students learn about plant tissue culture laboratory techniques and get familiarized with the concept of gene cloning and organ culture. Solving problems of biostatistics and getting hand- on training related to bioinformatics tools is also the prime objective of the course.</p>					
Course Outcomes:					
After completion of the course, learners would be able to:					
<ul style="list-style-type: none"> • Understand and plan the garden designs both formal and informal. • Understand the technique of bottle garden and dish garden preparations. • Understand various sterilization techniques, seed sterilization, callus induction • Understand through the problems of biostatistics, the technique of extrapolating the knowledge to biological problems. • Understand the application of bioinformatics tools. 					
Outline of Syllabus: (per session plan)					
Module	Description				Duration
1	Horticulture				48 mins
2	Biotechnology				48 mins
3	Biostatistics & Bioinformatics				48 mins
	Total				2hrs 24 mins
PRACTICALS					2hrs 24 mins

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Unit	Topic	2 Credits
Module 1	<p>Horticulture and Gardening:</p> <ul style="list-style-type: none"> • Introduction to Horticulture: Branches of Horticulture, Gardening: • Locations in the garden- edges, hedges, lawn, flower beds, avenue, water garden (with names of two plants for each category). Focal point. • Types of garden: Formal and informal gardens • National Park: Sanjay Gandhi National Park. • Botanical Garden: Veer Mata Jijabai Udyan (Ranicha Baug). 	15L
Module 2	<p>Biotechnology</p> <ul style="list-style-type: none"> • Introduction to plant tissue culture <ul style="list-style-type: none"> ○ Laboratory organization and techniques in plant tissue culture ○ Totipotency ○ Organogenesis ○ Organ culture – root cultures, meristem cultures, anther and pollen culture, embryo culture. • R-DNA technology- <ul style="list-style-type: none"> ○ Gene cloning ○ Enzymes involved in Gene cloning ○ Vectors used for Gene cloning. 	15L
Module 3	<p>Biostatistics and Bioinformatics</p> <p>Biostatistics:</p> <ul style="list-style-type: none"> • The chi square test. • Correlation – Calculation of coefficient of correlation. <p>Bioinformatics</p> <ul style="list-style-type: none"> • Information technology: History and tools of IT, Internet and its uses. • Introduction to Bioinformatics- goal, need, scope and limitation • Aims of Bioinformatics: Data organization, Tools of 	15L

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	Bioinformatics- tools for web search, Data retrieval tools- Entrez, BLAST • Bioinformatics program in India.	

To develop scientific temper and interest by exposure through industrial visits and study/educational tours is recommended in each semester

PRACTICAL III

Horticulture

- Study of five examples of plants for each of the garden locations as prescribed for theory
- Preparation of garden plans – formal and informal gardens
- Bottle and dish garden preparation.

Biotechnology

- Various sterilization techniques
- Preparation of Stock solutions, Preparation of MS medium.
- Seed sterilization, callus induction
- Regeneration of plantlet from callus.
- Identification of the cloning vectors – pBR322, pUC 18, Ti plasmid.

Biostatistics and Bioinformatics

- Chi square test
- Calculation of coefficient of correlation
- Web Search – Google, Entrez.
- BLAST

Visits : A minimum of four field excursions with at least one beyond the limits of Maharashtra for habitat studies are compulsory and record of visits should be duly certified and presented at practical examination

Suggested Readings

- Recombinant DNA – Principles and Methodologies. Greene JJ and Rao VS, Marcel Dekker, New York, 1998.
- Principles of gene manipulation. Primrose SB, Twyman RM and Old RW, 6th Edition, Blackwell Science, Oxford, 2001
- Differentially expressed gene in plants. Hansen and Harper, Taylor and Francis Ltd. London, 1997.
- Engineering plants for commercial products and applications. Eds. Collins GB and Shepherd RJ, NY Acad. Of Science Publishers 1996
- DNA markers. Eds. Caetano-Anolles and Gresshoff, Wiley-VCH Publishers, NY, 1998
- Introduction to Bioinformatics. Attwood, T.K., Parry-Smith, DJ, Addison Wesley Longman, Harlow, Essex, 1999
- Bioinformatics. Westhead, DR, Parish JH and Twyman, RM, BIOS Scientific Publishers Ltd., Oxford, 2003

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- Bioinformatics – Sequence and genome analysis. D.W. Mount, CBS Publishers, NewDelhi, 2003
- Collins GB and Shepherd RJ Eds., 1996, Engineering plants for commercial products and application. NY Acad. Of Science Publishers
- Senson CW Edt, 2002, Essentials of Genomics and Bioinformatics,. Wiley-VCH Publishers, NY,
- Charlwood B.V. and Rhodes MV Edt. 1999, Secondary products from plant tissue culture.Clarendon Press, Oxford.
- Dicosmo F and Misawa M, Edt 1996, Plant cell culture: Secondary metabolism towards industrial application, CRC press, Boca Raton ,N.Y.
- Ramawat K G and Merillon J M, Edt.,1999 Biotechnology: Secondary metabolites, Oxford IBH Publishing Co., New Delhi
- Buchanan BB, Grussem Wand Jones RL, 2000, Biochemistry and molecular biology of plants, IK International Pvt Ltd. New Delhi
- Verapoorte R and Alferman HW Eds, 2002 Metabolic engineering of plant secondary metabolites. Kluwar Academic Publ., Netherlands
- Statistical Methods – Snedecor G.W. and Cochran W.G. Affiliated East-West Press Pvt. Ltd. 1989
- Statistical methods in Agriculture and Experimental Biology – Mead, R. and Curnow, R.N. Chapman and Hall, 1983
- Practical statistics and experimental design for plant and crop science – Clewer, A.G. and Scarisbrick, A.H., John Wiley, New York, 2001
- Bioinformatics - Westhead, DR, Parish JH and Twyman, RM, BIOS Scientific Publishers Ltd., Oxford, 2003
- Bioinformatics – Sequence and genome analysis. D.W. Mount, CBS Publishers, New Delhi, 2003
- Bioinformatics and Molecular Evolution – Higgs PG and Attwood TK, Blackwell Publishing, Oxford, UK, 2005
- Bioinformatics A Practical Guide to the Analysis of Genes and Proteins- Baxevanis A. D., Francis Ouellette B. F. John Wiley & sons Inc., 2001