

St. Xavier's College (Autonomous),
Mumbai



Syllabus of the courses offered by the
Department of Botany
(2015-16)

ST. XAVIER'S COLLEGE
SYLLABUS UNDER AUTONOMY
BOTANY
M. Sc.

SEMESTER- I

COURSE: ME.BOT.1.01

PLANT DIVERSITY—~~VII~~ I (ALGAE AND FUNGI) (60 L)

UNIT I: Algae (15)

Classification of Algae up to orders, according to the system proposed by G.M.Smith; diversification of habitat; general distribution, habitat distribution, thallus organization, origin and evolution, fossil algae.

UNIT II: Applied Phycology (15)

Algal collection and preservation, techniques of culturing Algae, concept of photo-bioreactor, Algae as biofuel, algae causing biological hazards.

UNIT III: Fungi and Lichens (15)

Fungi: Classification of fungi up to orders according to the system proposed by Alexopoulos; general account of spore bearing organs and their arrangements in various groups of fungi; spore release and dispersal.

Lichens: History of Lichenology, role of lichens in biomonitoring, economic importance and ecological significance, life cycles of Usnea and Parmelia.

UNIT IV: Applied Mycology and Lichnology (15)

Nutritive values of edible mushrooms, cultivation of edible mushroom, poisonous mushrooms.

Study of the following diseases with reference to symptoms, causal organism and disease cycle and control measures, a) Citrus canker, b) Loose smut of wheat, c) Early blight of potato. Lichens: Economic and ecological significance, role of lichens in bio-monitoring.

Continuous Internal Assessment (CIA)

CIA I and II – MCQ / Quiz / Assignment / Presentation / Submission of Report

Reference books:

1. Smith, Gilbert M; Cryptogamic Botany Algae & Fungi Volume 1; 2nd edition; McGraw-hill Book Comp. Tokyo, 1955.

Usnea

2. Vasishtha B.R. And Sinha A. K. - Botany for degree students Part 1 ALGAE; S. Chand & Company Ltd, 1st edition, revised 2005.
3. Vasishtha B.R. And Sinha A. K. - Botany for degree students Part 2 FUNGI; S. Chand & Company Ltd, 1st edition, revised 2005.
4. Alexopoulos, Constantine J.; Mims, Charles W; Introductory mycology; 3rd edition; New Delhi : Wiley Eastern Limited , 1983.
5. Kar, Ashok Kumar; Gangulee, Hirendra Chandra; College botany : Volume II; 2nd edition; Kolkata : New Central Book Agency (P) Ltd , 1989, 2006.
6. Sharma, O.P.; Textbook of fungi; 3st edition; New Delhi : Tata Mcgraw-Hill Publishing Company Limited , 1989.



ST. XAVIER'S COLLEGE
SYLLABUS UNDER AUTONOMY
M. Sc. BOTANY PRACTICALS

List of practicals and the skeleton question paper for the same

The total practical assessment consists of 50 marks, which includes 15 marks for Practical CIA, 5 marks for journal and 30 marks for End Semester Practical Exam.

SEMESER- I

Course: M. Sc. BOT. PR. 1.01

1. Study of the following type with reference to their systematic position, thallus and reproductive structures: *Scytonema*, *Lyngbya*, *Anabaena*, *Volvox*, *Scenedesmus*, *Ulothrix*, *Enteromorpha*, *Pithophora*, *Closterium*, *Nitella*, *Padina* and *Gracillaria*.
2. Extraction of algal pigments and their separation by paper chromatography.
3. Study of the following types with reference to their systematic position, thallus and reproductive structure: *Stemonitis*, *Saprolegnia*, *Phytophthora*, *Xylaria*, *Peziza*, *Daedalea*, *Claviceps*, *Fusarium* and *Trichoderma*.
4. Study of disease mentioned in the theory syllabus with reference to the symptoms, causal organisms and disease cycle.
5. Estimation of biomass from suitable algal culture.
6. Study of growth curve of algae using haemocytometer.
7. Study of life cycle of *Usnea* and *Parmelia*.
8. Estimation of proteins from Mushroom.

Usne

ST. XAVIER'S COLLEGE
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SEMESTER-I

COURSE: M.Sc.BOT.1.02

PLANT DIVERSITY-VIII TAXONOMY I (GYMNOSPERMS AND ANGIOSPERMS) (60 L)

UNIT I: Gymnosperms (15)

Classification of gymnosperms upto orders according to the system proposed by Coulter and Chamberlain, general characters, affinities and interrelationships of Cycadofilicales, Bennettitales, Cordaitales, Cycadales, Coniferales and Gnetales. Life cycle of Araucaria, Cupresses, Podocarpus and Pinus.

UNIT II: Angiosperms-I (15)

Origin of angiosperms: origin and evolution of angiosperms; the primitive angiospermic flower; primitive and advanced character in angiosperms, systematic classification of Angiosperms: development of system of classification, pre-Linnaean systems of classification, contemporary works based on Linnaean systems, classification systems used in India, Bentham and Hooker and later Floristic work based on it.

UNIT III: Angiosperms-II (15)

Principles for assessment of relationships, delimitation of taxa and attribution of rank: a) criteria, b) guidelines, c) practical considerations, d) use of categories.

Evolution, variation and speciation, biosystematics categories, biotypes and ecotypes, concept of characters: introduction, type, function, values of taxonomic characters - numerical taxonomy, chemotaxonomy, molecular systematic.

UNIT IV: Angiosperms-III (15)

Study of the following plant families, their morphological peculiarities and economic importance: Menispermaceae, Portulacaceae, Guttiferae, Passifloraceae, Rhamnaceae, Sapindaceae, Lythraceae, Boraginaceae, Chenopodiaceae, Liliaceae, Cyperaceae, Polygonaceae, Asteraceae.

Use

Continuous Internal Assessment (CIA)

CIA I and II – MCQ / Quiz / Assignment / Presentation / Submission of the report

Reference Books:

1. Dutta, A.C.; A Class-book of Botany; 15th edition; Calcutta: Oxford University Press, 1976.
2. Sivarajan, V.V.; Introduction to the principles of plant taxonomy; 2nd edition; Cambridge University Press, 1991.
3. Subramaniam, N.S.; Modern plant taxonomy; New Delhi : 1st edition; Vikas Publishing House Pvt. Ltd. , 1995.
4. Lawrence, George H.M.; Taxonomy of Vascular Plants; 1st edition; New Delhi : Oxford & IBH Publishing Co., 1967.
5. Sharma, O.P.; Plant Taxonomy; 1st edition, reprint; New Delhi : Tata McGraw-Hill Publishing Co. Ltd. , 1993(2002)
6. Gangulee, Das, and Dutta – College Botany Vol I. 1st edition, reprint; New Central Book Agency (P) Ltd., 1991.
7. Judd, Walter S.; Campbell, Christopher S.; Kellogg, Elizabeth A.; Stevens, Peter F.; Plant systematics : a phylogenetic approach; 2nd edition; Sunderland : Sinauer Associates, Inc. , 2002.
8. Singh, Gurcharan; Plant systematics : theory and practice; 2nd edition; New Delhi : Oxford & IBH Publishing Co. Pvt. Ltd. , 2004;
9. Naik, V.N.; Taxonomy of angiosperms; 1st edition; New Delhi : Tata McGraw-Hill Publishing Company Limited , 1984.
10. Kar, Ashok Kumar; Gangulee, Hirendra Chandra; College botany : Volume II; 2nd edition; Kolkata : New Central Book Agency (P) Ltd , 1989, 2006.
11. Chamberlain, Charles Joseph; Coulter, John Merle; Morphology of Gymnosperms; 2nd edition; Allahabad : Central Book Depot , 1964.

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List of practicals and the skeleton question paper for the same

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SEMESTER- I

Course: M.Sc. BOT. PR. 1.02

1. Gymnosperms: Study of following types- Cordaites (Fossils), Araucaria, Cupresses, Podocarpus, Pinus.
2. Angiosperms: A study of the following plant families their morphological peculiarities and economic importance: Menispermaceae, Portulacaceae, Guttiferae, Passifloraceae, Rhamnaceae, Sapindaceae, Lythraceae, Boraginaceae, Chenopodiaceae, Liliaceae, Cyperaceae, Polygonaceae, Asteraceae.
3. Identification of genus and species with the help of flora volumes (In addition to the above mentioned families, all families studied at undergraduate classes are included)

Use

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SEMESTER- I

COURSE: M.Sc. BOT.1.03

PLANT PHYSIOLOGY AND BIOCHEMISTRY II (60 L)

UNIT I: Enzymes (15)

Mode of action, Kinetics – K_m and V_{max} , Lineweaver-Burk plot, Inhibition, immobilization of enzymes, allosteric enzymes and inhibition, feedback inhibition

UNIT II: Photosynthesis – I (15)

Chloroplast structure, organization of photosynthetic apparatus, light absorbing pigments, organization of light antenna systems, mechanism of electron transport, proton transport and ATP synthesis in chloroplasts

UNIT III: Photosynthesis - II (15)

Repair and regulation of photosynthetic machinery, role of carotenoids, regulation of C3, C4 and CAM pathways

UNIT IV: Assimilation of nutrients in plants (15)

Phosphorus, sulphur, cations and molecular oxygen assimilation in plants.

Continuous Internal Assessment (CIA)

CIA I and II – MCQ / Quiz / Assignment / Presentation

Reference Books:

1. Noggle, Ray G.; Fritz, George J.; Introductory plant physiology; 2nd edition; New Delhi : Prentice-Hall Of India Private Limited , 1991.
2. Sinha, B.K.; Pandey, S.N.; Plant Physiology; 1st edition; New Delhi : Vikas Publishing House Pvt. Ltd. , 1981.
3. Verma, V.; Textbook of plant physiology; New Delhi : Ane Books India , 2007.
4. Salisbury, Frank B.; Ross, Cleon W.; Plant physiology; 3rd edition, Reprint; New Delhi : CBS Publishers & Distributors , 1986(2001).
5. Devlin, Robert M.; Witham, Francis H.; Plant Physiology; 4th edition, Indian reprint;

Use

Delhi : CBS Publishers & Distributors , 1986(2001).

6. Kochhar, P.L.; A textbook of Plant Physiology; 7th edition; Delhi : Atma Ram & Sons 1964.
7. Verma S. K. Textbook of Plant physiology and Biochemistry ; 4th editon; S. Chand & Company Ltd, 2003.
8. Hans Heldt, Plant Biochemistry
9. Taize and Zigger, Plant physiology
10. Mukherji and Ghosh, Plant Physiology

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SEMESTER- I

Course: M. Sc. BOT.PR.1.03

Major experiments

1. Enzyme kinetics: Determination of K_m and V_{max} of the enzyme amylase.
2. Immobilisation of yeast cells and study of Invertase activity.
3. Study of Hill Reaction in C3, C4 and CAM plants.
4. Estimation of GOT and GPT from suitable plant material.
5. Estimation ATPase activity in plant material.

Minor experiments

1. A study of the enzyme polyphenol oxidase, from potato peels.
2. Solvent extraction of chlorophyll a/b, xanthophylls and study of absorption pattern.
3. Study of ratio of chl a and chl.b in C3 and C4 plants
4. Quantitative study of diurnal fluctuation in titratable acid number (TAN) in CAM plant.

Use

SEMESTER I COURSE MSBOT 1.04 Molecular Biology**Learning objectives****The students will learn**

1. The genetic regulation in cells of living organisms.
2. How the higher plant organism change over time and what are the molecular mechanisms underlying these changes
3. - Identify the basic methods and approaches used in molecular biology.
4. - Explain the role played by the molecular components of the genetic machinery.

CONTENTS:**UNIT I: GENE REGULATION I****(15)****Control of gene expression in eukaryotes**

- Chromatin remodelling
- Transcriptional control
- m RNA processing control
- m RNA translocation control
- m RNA degradation control
- Protein degradation control

UNIT II**GENE REGULATION II****(15)****Genetic control of development in plants.**

- Cell differentiation function of gene regulation
- Genes regulated by developmental program , environmental cues
- Homeobox and homeobox proteins

UNIT III**BICTECHNOLOGY****(15)****Recombinant DNA Technology: Vectors in gene cloning:**

- PUC 19, phage, cosmid BAC and YAC vectors.

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- High and low copy number plasmids and its regulation
 - Restriction enzymes, Types of restriction enzymes.
 - Process of gene cloning (*Agrobacterium*)

UNIT IV Application of recombinant DNA technology (15)

Application of recombinant DNA technology for

- production of herbicide resistant plants,
- insect resistant plants,
- improving seed storage proteins
- golden rice.

Practicals

MS BOT. 1.04

- Isolation of plasmid
- Quantification of DNA
- Agarose gel electrophoresis separation for plasmid DNA
- Restriction enzyme digestion and separation of fragments
- Transformation of *E.coli* cell by plasmid DNA
- B-galactoside expression and assay.

Reference books:

- Buchanan, B. B., Gruissem, W., and Jones, R. L. (2000) *Biochemistry & Molecular Biology of Plants*. American Society of Plant Physiologists, Rockville, MD.
- Karp, G. (1996) *Cell and Molecular Biology. Concepts and Experiments*. Wiley, New York.
- Lodish, H., Baltimore, D., Berk, A., Zipursky, S., Matsidaira, P., and Darnell, J. (1995) *Molecular Cell Biology*. Scientific American Books, New York.
- Lewin, B. 2000. *Genes*. 7th ed. New York: Oxford University Publishing.
- Peter Russell; iGenetics, 2nd edition prarsons international, (2006)
- Bernard Glick Molecular biotechnology Principles and applications.

**ST. XAVIER'S COLLEGE
SYLLABUS UNDER AUTONOMY
M. Sc. BOTANY PRACTICALS**

List of practicals and the skeleton question paper for the same

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SEMESTER- I

Course: M.Sc.BOT.PR.1.04

1. *Practicals*

Practicals

- Isolation of plasmid
- Quantification of DNA
- Agarose gel electrophoresis separation for plasmid DNA
- Restriction enzyme digestion and separation of fragments
- Transformation of *E.coli* cell by plasmid DNA
- B-galactoside expression and assay.

Reference books:

- Buchanan, B. B., Gruissem, W., and Jones, R. L. (2000) *Biochemistry & Molecular Biology of Plants*. American Society of Plant Physiologists, Rockville, MD.
- Karp, G. (1996) *Cell and Molecular Biology. Concepts and Experiments*. Wiley, New York.
- Lodish, H., Baltimore, D., Berk, A., Zipursky, S., Matsudaira, P., and Darnell, J. (1995) *Molecular Cell Biology*. Scientific American Books, New York.
- Lewin, B. 2000. *Genes*. 7th ed. New York: Oxford University Publishing.
- Peter Russell; iGenetics, 2nd edition prarsons international, (2006)
- Bernard Glick Molecular biotechnology Principles and applications.

Unit III: Biotechnology : Recombinant DNA Technology: Vectors in gene cloning: PUC 19, phage, cosmid BAC and YAC vectors, High and low copy number plasmids and its regulation, Restriction enzymes, Types of restriction enzymes, Process of gene cloning (*Agrobacterium*),
Unit IV: Application of recombinant DNA technology: application of recombinant DNA technology for production of herbicide resistant plants, insect resistant plants, improving seed storage proteins, golden rice.

Practicals MS.BOT.PR.1.04

- 1) Isolation of plasmid
- 2) Quantification of DNA
- 3) Agarose gel electrophoresis separation for plasmid DNA
- 4) Restriction enzyme digestion and separation of fragments
- 5) Transformation of *E.coli* cell by plasmid DNA
- 6) B-galactoside expression and assay.

Course: MS.BOT.2.01 Plant Diversity- III (Bryophytes and Pteridophyta)

Unit I: Bryophyta I : Introduction to Bryophyta: General characteristics, Classification up to order as per the system proposed by G. M. Smith, ecological and economic importance of Bryophytes. Distribution, morphological, reproductive studies and comparative account of Gametophytes, Sporophytes and interrelationships of the following groups: Hepaticae: Sphaerocarpaceae, Calobryales, Takakiales, Marchantiales, Jungermanniales. Anthocerotae: Anthocerotales. Musci: Sphagnales, Andraeales, Polytrichales, Buxbaumiales, Funariales.

Unit II: Bryophyta II : Origin and evolution of Bryophyta with reference to habitat and form. Evolution of the Sporophyte in Bryophyta.

Unit III: Pteridophyta I : General characters and Classification of Pteridophyta. Comparative account of Psilotales, Lycopodiales, Selaginellales, Isoetales, Equisetales, Ophioglossales, Marattiales, Osmundales, Filicales, Marsileales and Salviniaceae.

Unit IV: Pteridophyta II : Apospory and apogamy, Heterospory. Soral evolution, Fossil Pteridophytes. Economic importance of Pteridophyta. Cultivation and Maintenance of ornamental Ferns.

Practicals MS.BOT.PR.2.01

- 1) Study of vegetative and reproductive features of available representatives from each of the following groups (minimum 1 type from each group)
- 2) Study of vegetative and reproductive features of available representatives / fossils (if any) from the following groups (minimum 1 type from each group) : Psilotales, Lycopodiales, Selaginellales, Isoetales, Equisetales, Ophioglossales, Marattiales, Osmundales, Filicales, Marsileales and Salviniaceae.

Course: MS.BOT.2.02 Anatomy, Developmental Botany and Palynology

Unit I: Anatomy I : Meristems and sensory and Tactile tissue system: 1) Meristems: Definition type of meristems, Apical cell theory, Histogen theory and Tunica corpus theory. 2) Sensory and tactile tissue system: Tactile sense organs, Gravitational and Optical sense organs.

Unit II: Wood Anatomy: Types of wood elements. Macroscopical and microscopical features of wood. Physical and mechanical properties of wood. Protection and treatment of wood.

Unit III: Developmental Botany-I : Organization of shoot and root apical meristems. Shoot and root development, leaf development and phyllotaxy. Transition of flowering. Floral meristems and floral development in *Arabidopsis* and *Antirrhinum*.

Unit IV: Developmental Botany-II : 1) Pollen development and gene expression, male sterility, sperm dimorphism and hybrid seed production; pollen tube growth and guidance; pollen storage; pollen embryos. 2) Types of embryo sacs; structure of embryo sac cells. 3) Pollination, pollen-pistil interaction and fertilization: floral characteristics. 4) Mechanism of pollination and fertilization: structure of the pistil; pollen-stigma interaction, sporophytic and gametophytic self-incompatibility (cytological, biochemical and molecular aspects); double fertilization; *in vitro* fertilization. 5) Seed development and fruit growth: endosperm development during Early, Maturation and Desiccation stages; embryogenesis, ultrastructure and nucellar cytology; cell lineage during late embryo development; storage proteins of endosperm and embryo; embryo culture

Practicals MS.BOT.PR.2.02

- 1) Study of wood elements in *Annona*, *Michelia*, *Sterculia* and *Thuja*, using the maceration technique.
- 2) Study of the following leaves with respect to leaf surface characters (wax, cuticle, epidermis, stomata, epidermal outgrowth): *Pistia*, *Ficus*, *Avicennia* and *Peperomia*.
- 3) Photosynthetic system in *Pinus* (arm palisade), *Cyperus*, *Ficus* and *Oxalis*.
- 4) In-vitro germination of pollen grains, effect of temperature on pollen viability and short term storage.
- 5) Study of morphology of the pollen (using Chitale's and acetolysis method) from families Malvaceae, Asteraceae, Convolvulaceae, Labiatae and Graminea.

Course: MS.BOT.2.03 Ecology and Environmental Botany

Unit I: Natural resources and environmental Pollution : Natural resources- renewable and non-renewable resources, conservation of natural resources, equitable use of resources. Environmental pollution- Bioremediation for pollution cleanup with reference to algae. Environmental monitoring and Impact assessment.

Unit II: Autecology of species: Biological clock. Liebig's law of minimum and Shelford's law of tolerance. Combined concept of limiting factors. Ecological concept of Species and Individual. Species richness. Community resistance to invasion by Exotic species.

Unit III: Population –Structure and Dynamics: Basic concepts- Hardy-Weinberg Principle and Hardy-Weinberg equilibrium. Population characteristics. Population dynamics.

Unit IV: Community structure and classification: Classification of community, characters used in community structure . methods of study of communities, classification of communities and main concept of classification.

Practicals MS.BOT.PR.2.03

- 1) To record temperature, relative humidity, light intensity, wind speed and windfall.
- 2) To determine the minimum size of the quadrat by Species-Area-Curve method.
- 3) To study the community by quadrat method by determining frequency, density and abundance of different species present in the community.
- 4) To study the vegetation by line transect method, determining the frequency of individual species.
- 5) To compare the biomass and net primary production.
- 6) Measurement of water quality based on hardness, total alkalinity, total solids and total dissolved solids in water samples and determine potability of water based on these parameters.

Course: MS.BOT.2.04 Medicinal Botany

Unit I: Sources and Geographical Distribution of Medicinal Plants : Sources and geographical distribution of medicinally important plants. Study of the following plant constituents: Alkaloids- Vasaka leaves, Cinchona bark. Glycosides- Digitalis, *Glycyrrhiza glabra*, *Dioscorea sp*, *Artemisia*. Tannins- *Terminalia bellerica*, *Terminalia chebula*. Essential oils- *Citronella*, Fennel, Lemon grass.

Unit II: Quality control of crude drugs : Morphological examination- Exomorphic characters. Microscopical evaluation- Anatomical characters. Chemical tests. Development of standardization parameters- Moisture content, Ash value, Solvent extraction value, Bitter value, Foaming index, Heavy metals detection.

Unit III: Nutraceuticals: Introduction, Scope and future prospects. Nutraceuticals bridging the gap between food and drugs. Nutraceutical remedies for common disorders. Nutraceutical rich supplements.

Unit IV: Screening of plants for biological activity : Screening of plants for following properties: antibacterial, antidiabetic, antioxidant, hypertensive, antipyretic, immunomodulators, anticancer, antiprotozoal.

Practicals MS.BOT.PR.2.04

- 1) Identification of exomorphic and endomorphic features of plant studied in theory.
- 2) Solvent extractive value, moisture content and ash value of the given sample.
- 3) MIC of the plant extract inhibiting the growth of microorganisms.
- 4) Study of antioxidant activity of the plant extract.
- 5) Estimation of vitamin C in plant sample.
- 6) Estimation of vitamin E in plant sample.
- 7) Analyze the nutrition value of honey (estimation of total soluble sugars and reducing sugars)

Department of Botany, St. Xavier's College (Autonomous), Mumbai-1
Botany Msc part I Syllabus (for BOS March 2016)

Course: MS.BOT.3.01 Biostatistics, Bioinformatics and Nanotechnology

Unit I: Biostatistics : Chi square test, Hypothesis testing: Type I and type II errors, Null hypothesis, P-values- one v/s two tail P values, t-test (paired and unpaired), z-test, Test of significance, Introduction to ANOVA, One-way / multiple factor? ANOVA. Correlation and Regression: calculation of Coefficient of correlation.

Unit II: Bioinformatics : Organization of biological data; Databases (raw and processed); Querying in databases; Gene finding, motif finding and multiple sequence alignment; Protein sequence analysis (theory and algorithms); Exploration of databases, retrieval of desired data, BLAST.

Unit III: Nanotechnology : Introduction, synthesis of nanomaterials- various methods for green synthesis of nanomaterial : a) Polysaccharide method, b) Tollens method, c) Irradiation method, d) Biological methods and e) Polyoxometalates method. Biosynthesis of nanoparticles using biological agents like bacteria, fungi, actinomycetes, yeast, algae and plants.

Unit IV: Scientific writing : scientific writing- literature survey, selecting a topic, hypothesis; Aims and objective/s, introduction, method, results and discussion; Citing of references- analysing journal articles and essays, basic mechanics and major errors, citing and using sources. Executive summaries; formatting documents; revising your paper- typesetting punctuation, summarizing.

Course: MS.BOT.2.04 Medicinal Botany

Unit I: Sources and Geographical Distribution of Medicinal Plants : Sources and geographical distribution of medicinally important plants. Study of the following plant constituents: Alkaloids- Vasaka leaves, Cinchona bark. Glycosides- Digitalis, *Glycyrrhiza glabra*, *Dioscorea sp*, *Artemisia*. Tannins- *Terminalia bellerica*, *Terminalia chebula*. Essential oils- *Citronella*, Fennel, Lemon grass.

Unit II: Quality control of crude drugs : Morphological examination- Exomorphic characters. Microscopical evaluation- Anatomical characters. Chemical tests. Development of standardization parameters- Moisture content, Ash value, Solvent extraction value, Bitter value, Foaming index, Heavy metals detection.

Unit III: Nutraceuticals: Introduction, Scope and future prospects. Nutraceuticals bridging the gap between food and drugs. Nutraceutical remedies for common disorders. Nutraceutical rich supplements.

Unit IV: Screening of plants for biological activity : Screening of plants for following properties: antibacterial, antidiabetic, antioxidant, hypertensive, antipyretic, immunomodulators, anticancer, antiprotozoal.

Practicals MS.BOT.PR.2.04

- 1) Identification of exomorphic and endomorphic features of plant studied in theory.
- 2) Solvent extractive value, moisture content and ash value of the given sample.
- 3) MIC of the plant extract inhibiting the growth of microorganisms.
- 4) Study of antioxidant activity of the plant extract.
- 5) Estimation of vitamin C in plant sample.
- 6) Estimation of vitamin E in plant sample.
- 7) Analyze the nutrition value of honey (estimation of total soluble sugars and reducing sugars)

Department of Botany, St. Xavier's College (Autonomous), Mumbai-1
Botany Msc part II Syllabus (for BOS March 2016)

Course: MS.BOT.3.01 Biostatistics, Bioinformatics and Nanotechnology

Unit I: Biostatistics : Chi square test, Hypothesis testing: Type I and type II errors, Null hypothesis, P-values- one v/s two tail P values, t-test (paired and unpaired), z-test, Test of significance, Introduction to ANOVA, One-way / multiple factor? ANOVA. Correlation and Regression: calculation of Coefficient of correlation.

Unit II: Bioinformatics : Organization of biological data; Databases (raw and processed); Querying in databases; Gene finding, motif finding and multiple sequence alignment; Protein sequence analysis (theory and algorithms); Exploration of databases, retrieval of desired data, BLAST.

Unit III: Nanotechnology : Introduction, synthesis of nanomaterials- various methods for green synthesis of nanomaterial : a) Polysaccharide method, b) Tollens method, c) Irradiation method, d) Biological methods and e) Polyoxometalates method. Biosynthesis of nanoparticles using biological agents like bacteria, fungi, actinomycetes, yeast, algae and plants.

Unit IV: Scientific writing : scientific writing- literature survey, selecting a topic, hypothesis; Aims and objective/s, introduction, method, results and discussion; Citing of references- analysing journal articles and essays, basic mechanics and major errors, citing and using sources. Executive summaries; formatting documents; revising your paper- typesetting punctuation, summarizing.

Practicals MS.BOT.PR.3.01

- 1) Hypothesis testing, Normal deviate test
- 2) Test of significance of means, paired and unpaired t-test
- 3) Application of analysis of variance (ANOVA).
- 4) Software recommended : PSPP software provides a basic set of capabilities: frequencies, cross tabs comparison of means (t-tests and one way ANOVA); linear regression, logistic regression and re-ordering data, non-parametric tests, factor analysis, cluster analysis, principal component analysis, chi-square analysis.
- 5) Multiple alignments- phylogenetic tree.
- 6) BLAST
- 7) Motif finding
- 8) Synthesis of nanoparticles and its characterization using UV-visible absorption spectrometry.
- 9) Antimicrobial activity of the fabricated nanoparticles.

Course: MS.BOT.3.02 Plant pathology

Unit I: Plant pathogens, Symptoms and Classification of plant diseases: Plant pathogens- Host pathogen relationship; Dissemination of pathogens; Epidemiology; Disease forecasting. Classification of plant diseases. Symptoms: Necrotic, Atrophic, Hypertrophic.

Unit II: Host defence mechanism, Prevention and Control of Plant diseases : Defence mechanisms of host; Prevention and control, Prophylaxis, therapy and Immunization.

Unit III: Plant diseases-1 : Methods of studying plant diseases. Post harvest diseases and protection of stored and perishable product. Microbes responsible for spoilage in storage: Diseases of post harvest durables i) Factors affecting spoilage, ii) Management of storage fungi; Diseases of post harvest perishables i) Factors affecting post harvest decays; ii) Management of post harvest decays of perishables.

Unit IV: Plant diseases-2 : Causal organism, symptoms, overview of life-cycle and control measures for following diseases: Diseases caused by fungi- wart disease of potato, white rust of crucifers, red rot of sugarcane, downy mildew of pea / grape, tikka disease of ground nut, powdery mildew of cereals / grasses, looser smut of wheat, brown spot of rice. Bacterial disease- citrus canker, bacterial brown rot of potato. Viral diseases- tobacco mosaic, leaf curl of potato. Diseases caused by nematodes- root knot disease of potato / sugarcane.

Practicals MS.BOT.PR.3.02

- 1) Study the symptoms and causal organism of the plant diseases mentioned in theory (at least three from group 1 and one each from the rest)
- 2) To identify the various symptoms of plant diseases.
- 3) Field trip to any Agricultural Institute / University.

Course: MS.BOT.3.03 Horticulture

Unit I: Operational Classification systems and Essential Environmental factors : Classification based on seasonal growth cycle- annual, biennial, perennial; Kinds of stem; Common stem growth forms- erect, decubent, creeping, climbing. Classification of ornamental plants- Herbaceous ornamentals, Woody ornamentals. Classification based on adaptation (hardiness). Essential environmental factors- an overview, Abiotic- air, water, temperature, light, soil. Biotic- microorganisms, insects, birds, rodents.

Unit II: Plant propagation : Sexual: seminal- sowing seeds, hybrid seeds; transplanting. Asexual: cutting, budding ,grafting, layering, underground plant parts, micropropagation, pre and post planting care.

Unit III: Cultivation of plants : ornamental plants, growing vegetables and fruit crops, succulents, floriculture, pest management.

Unit IV: Landscaping : goals of landscaping, categories of landscaping- residential and public, commercial, speciality. Landscape designing- basic principles, basic components. Selecting plants.

Practicals MS.BOT.PR.3.03

- 1) Garden tools and implements- Axe, shovel, knives, pruning shears, saw, secateurs, sieve, lawnmower, sprinkler, watering can, rubber hose, hand fork, labels (visit to a plant nursery)
- 2) Propagation by seed, cutting, layering, budding.
- 3) Biofertilizers- Identification of Nostoc, VAM and Rhizobium.
- 4) Identification of ornamental plants
- 5) Physical properties of soil
- 6) Measuring the soil pH and its correction by adding chemicals.
- 7) Formulating potting mix
- 8) Preparing manure from vegetable wastes / preparing compost.

Course: MS.BOT.3.04 Angiosperms- Evolution

Unit I: Evolution : Plesiomorphic and Apomorphic characters, Character weighing, The effects of evolutionary theory on systematic, monographic, and floristic development : Primitive versus advanced, Homology and Analogy, Parallelism and Convergence.

Unit II: Phylogeny, Phylogenetic Techniques : Use of cladistic in classification; Phylogenetic classification systems-Takhtajan, Cronquist, APGI, II, III; Understanding phylogeny, constructing phylogeny, Monophyly, Paraphyly and polyphyly; Patterns of variation and phylogenetic trees; Building Trees-Rooting Technique, Distance methods, Maximum likely hood methods, Bootstrapping using trees. Phyllocode.

Unit III: Nomenclature : International code of Botanical Nomenclature 1830-Paris Code to 2011-Melbourne code; Major adaptations considered in these International Botanical Congress. Important Rules of ICBN, Typification, Type concept and Types of type, Basionym, Homonym, Tautonym, Taxonomic and nomenclature synonyms.

Unit IV: Keys and GB : Types of keys- single access and multi access keys, preparation of keys for Taxon, keys based on exomorphic characters. Green -belt planning- Concept and recommendations; Utility of GBP; List of plants, ornamental, Flowering, shady; Importance of Green Belt in the current environmental conditions in India.

Practicals MS.BOT.PR.3.04

- 1) Preparation of Dichotomous Key of Five Families (min 5 genera / species from each family)
- 2) Use of keys for identification of family, genus and species.
- 3) Writing of species description using taxonomic terminology.
- 4) Cluster analysis of any family using Cladistics techniques based on morphological characters. (practical will continue the whole semester)
- 5) Preparation of Herbarium specimens. 10 specimens to be prepared and submitted during practical examination.
- 6) Study of published Floras, Revision and Monograph; identification, listing and analysis of their components.

Course: MS.BOT.3.05 Plant Biochemistry II

Unit II: Vitamins and Coenzymes : general characteristics of vitamins; Structure, occurrence, functions and activity of all water soluble and fat soluble vitamins. Structure, classification and actions of various coenzymes.

Unit II: Storage Proteins and Lectins : storage proteins and their storage mechanism. Plant lectins.

Unit III : Carbohydrate Metabolism : The hexose phosphate pool, biosynthetic pathways that consume hexose phosphate, synthesis of sucrose and starch; Catabolic pathways that generate hexose phosphates; degradation of sucrose and starch; triose / pentose phosphate metabolite pool; Interaction between the hexose phosphate and pentose phosphate / triose phosphate pools.

Unit IV: Nucleotide Biosynthesis and Degradation: Nucleotide structure, Nitrogenous bases- Pyrimidine bases, purine bases. Purine nucleotides biosynthesis and degradation. Pyrimidine nucleotides biosynthesis and degradation.

Practicals MS.BOT.PR.3.05

Estimation of riboflavin.

Estimation of ascorbic acid.

Estimation of vit A.

Separation of seed proteins by PAGE.

Estimation of starch by anthrone method.

Estimation of total carbohydrates.

Course: MS.BOT.4.01 Techniques and Instrumentation

Unit I: Microscopy and Spectroscopy : Dark field microscopy.; Phase contrast microscopy- theory, of phase contrast, construction and working of microscope, Applications. The fluorescence microscopy- antigen-antibody reaction, working of microscope, applications. Electron microscopy- construction and working of microscope, specimen preparation, scanning and transmission electron microscopy, application of electron microscopy. UV-visible spectrometer, IR/NMR/atomic absorption.

Unit II: Centrifugation : Principles; Preparative centrifugation- Differential Centrifugation, Rate-zonal centrifugation, Isopycnic centrifugation, Equilibrium isodensity centrifugation. Density Gradient Centrifugation- Nature of gradient materials, formation of density gradients, (Discontinuous and Continuous techniques), sample application to the gradient, removal of gradients from centrifuge tubes. Preparative centrifuges and their uses- General purpose centrifuges, High speed centrifuges, Preparative ultracentrifuges. Rotor design and selection- angle vs swing-out rotors. Analytical ultracentrifugation- Principles, Construction, Applications: Determination of molecular weights, Sedimentation velocity method, Sedimentation equilibrium method; Estimation of purity of macromolecules, Detection of conformational changes in macromolecules.

Unit III: Chromatography: General principles, general techniques, Column Chromatography- types of columns, packing of columns, Application of sample, column development, fraction collection and analysis. Adsorption Chromatography- Adsorbents, Solvents, Applications. Partition chromatography- liquid-liquid chromatography, Normal vs reverse phase, Countercurrent distribution. Gas-liquid Chromatography- Principle, Support, Stationary phase, Detection systems. Ion exchange chromatography- Principle, Materials, Practical procedure, Application. Exclusion

Chromatography- Principle, Materials, Applications. Affinity Chromatography- Principle, Supporting medium, Applications.

Unit IV: Tracer techniques : Principle and application of tracer techniques in biology. Radioactive isotopes and autoradiography. Geiger Muller counter. Liquid Scintillation Counter.

Practicals MS.BOT.PR.4.01 : No Practical course.

Course: MS.BOT.4.02 Angiosperm Diversity

Unit I: Families II : Angiosperm Diversity. Study the following families with reference to its systematic position, distribution, salient features, floral formula, floral diagram, morphological peculiarities and enlist economic important plants and their uses. Nymphaeaceae, Onagraceae, Vitaceae, Nyctaginaceae, Balsaminaceae, Boraginaceae, Gentianaceae, Lentibulariaceae and Commelinaceae. A detailed study of the present status, affinities, phylogeny and interrelationships of the above families.

Unit II: Taxonomic Evidences in relation with Anatomy: Wood Anatomy, Trichomes, epidermal features & Stomata, Leaf Anatomy, Floral Anatomy.

Unit III: Taxonomic Evidences in relation with Embryology and Palynology : 1) Families with distinct embryological features – Podostemaceae, Cyperaceae and Onagraceae. 2) Specific examples of use of embryology in interpreting taxonomic affinities – *Trapa*, *Paeonia*, *Exocarpos*, Loranthaceae. 3) Palynology – Basic structure of Pollen grains and pollen aperture types – Eurypalynous and Stenopalynous Taxa, Evolution of Pollen aperture types. 4) Pollinia in Orchidaceae and Asclepiadaceae

Unit IV: Intellectual Property Rights (IPR) : IPR, Patent, Copy Right, India's IPR System, Traditional Knowledge and IPR, www.iprindia.com, www.ipindia.nic.in, www.copyright.gov.in.

Practicals MS.BOT.PR.4.02 :

- 1) Study of Angiosperm families mentioned for theory with importance of its members with the help of locally available plants.
- 2) Floral Anatomy – Calyx and Androceium in Lamiaceae, Androceium in leguminosae.
- 3) Study of leaf architecture. Prepare permanent slides of any leaf/ leaflet architecture (submission).
- 4) Study of Pollen apertures done in theory; pollinia of Orchidaceae and Asclepiadaceae.
- 5) Embryo mounting –dicot, monocot and polyembryony.
- 6) Study of trichomes, types of stomata.
- 7) A case Study of patent filling.

Course: MS.BOT.4.03 Angiosperms

Unit I: Numerical Taxonomy (Phenetics Methods: Taxometrics) : Principles of Numerical Taxonomy, OUT, Taxonomic characters, coding of characters, Measuring resemblance, simple matching Coefficient, Taxonomic Distance, Cluster Analysis,

Unit II: Progressive taxonomy: a) Progressive taxonomy- Internet, Taxonomic databases (Kew, IPNI, the plantlist, tropicos, efloraindia, etc). **b)** Present status and future scope of Taxonomy in India- Vegetation survey, Floristics, Revisionary and monographic studies, Ethnobiological studies, Development and establishment of new herbaria, Role of taxonomists and job opportunities for taxonomists.

Unit III: Tools in taxonomy: Library – a. Literature: definition, origin, history and evolution of Literature of Taxonomy in India. b. Classification of Taxonomic Literature: Checklist, Catalogue, Floras, Monographs, Revisions, Encyclopedias, Indices, Dictionaries, Journal. Museum (Herbarium)- Definition, Steps involved in development of a herbarium, Maintenance of Herbarium, General account of Herbaria in India. Role of B.S.I in Herbaria, Private herbaria, Herbarium of KEW, Utility and importance of Herbaria in Taxonomy. Garden- a. Origin, History and Development of gardens in India. b. Types of Gardens, Kew Gardens. c. Role of gardens in taxonomic studies. d. Preservation of germ -plasm techniques and its importance in taxonomy. Naming of plants- Study of the International Code of Nomenclature for Algae, Fungi and Plants – Melbourne Code 2012. a. Principles, Articles, recommendations. b. Rules and exercises on plant nomenclature .

Unit IV: Applied Taxonomy: Remote Sensing- i. History, Principles and types of Remote sensing, ii. Advantages and limitations of remote sensing, iii. Applications of Remote Sensing in Vegetation Classification and Forest resource Management. iv. Remote sensing of soil and water. Plant quarantine- i. Purpose, ii. Historical account, iii. Plant protection organization, iv. Exclusive quarantine, v. Regular quarantine, vi. Domestic quarantine, vii. Certification of plant materials.

Practicals MS.BOT.PR.4.03 : No practicals.

Course: MS.BOT.4.04 Angiosperm

Unit I: Families III: Approaches to Angiosperm Taxonomy- Study the following families with reference to its systematic position, distribution, salient features, floral formula, floral diagram, morphological peculiarities .Enlist economic important plants and their uses. Oleaceae, Plumbaginaceae, Sapotaceae, Bignoniaceae, Caryophyllaceae, Loranthaceae, Urticaceae, Araceae and Orchidaceae. A detailed study of the present status, affinities, phylogeny and interrelationships of the above families.

Unit II: Taxonomic evidence : Taxonomic Evidences in relation with Cytology; Chromosome morphology, Chromosome behavior, Heterochromatin, Use of Cytological data at Family level, Use of Cytological data at genus and species level,. Chemotaxonomy.

Unit III: Plant Geography : Historical Development, Physical geography of earth, Static and Descriptive Plant geography, Botanical Provinces of India, Dynamic or interpretive plant geography, Major Theories, Ranges, Migration and barriers, center of origin. Endemism- role of Indian endemic flora in plant based discoveries.

Unit IV : Ethnobotany : a. Ethnobotany- Introduction; a brief history of ethnobotanical studies in the world and in India; scope of ethnobotany. Subdisciplines of ethnobotany. Interdisciplinary approaches. Knowledge of sociological and anthropological terms. b. Distribution of tribes in India. Knowledge of tribes of Maharashtra; Ethnobotanical works on these tribes. c. Methods in ethnobotanical research. Research design and cautions in data collections, Practical and field skills; Prior Informed Consent, PRA techniques, interviews and questionnaire methods, choice of resource persons. d. Ethnobotanical knowledge and communities: Ethnobotanical classification; Folk Taxonomy of Plants. e. Bioprospecting and commercial use of traditional knowledge. Medical ethnobotany, ethnopharmacology and the search of plant based drugs. Developing research partnerships: Ethics and research guidelines in ethnobotany, equitable research relationships. f. Traditional knowledge (TK) in relation to Intellectual Property Rights and Biopiracy. Equitable Benefit sharing models of the world.

Practicals MS.BOT.PR.4.04 :

- 1) Study of Angiosperm families mentioned for theory with reference to morphological peculiarities and economic importance of its members with the help of locally available plants.
- 2) Study of floral diagrams with respect to the families prescribed.
- 3) Study of pollen aperture types and pollinia types of Asclepiadaceae and Orchidaceae.
- 4) Karyotype Study.
- 5) Study of pericarp structure of Indehiscent fruit- Lotus, *Physalis* and *Zea mays*.
- 6) Study of seed coat structure in cotton, *Ludwigia*, *Bauhinea*, *Ricinus*, *Cucurbita*, *Canna*.
- 7) Visit to a Plant Quarantine centre and make a report of it.

Course: MS.BOT.4.05 Plant Physiology-II

Unit I: Mineral nutrition I: Assimilation of mineral nutrients in plants. Phosphate, sulphate, cations and molecular oxygen assimilation in plants. The energetics of nutrient assimilation of mineral nutrients in plants.

Unit II: Mineral nutrition II : Chemical fertilizers in crop production, Plant analysis as a guide to the nutritional status of plants, Foliar nutrition, Phytoremediation, Responses of plants to mineral toxicity, Heterotrophic nutrition in higher plants.

Unit III: Stress Physiology – I: Abiotic stresses, Plant responses to- Water deficit, Heat stress, and heat shock-adaptation, Chilling and freezing – adaptation/acclimation, Flooding and oxygen deficit. Oxidative stress, Salinity stress, Oxygen deficiency.

Unit IV: Stress Physiology – II: Biotic stresses, Plant responses to pathogens.

Practicals MS.BOT.PR.4.05 :

- 1) Determination of iron (Fe) in plant digest.
- 2) Ash preparation.
- 3) Determination of phosphorus (P) from ash .
- 4) Estimation of proline in water stressed plants.
- 5) Estimation of proline in salt stressed plants.
- 6) Estimation of total chlorophyll in water and salt stressed plants.

Course: MS.BOT.4.06 Plant Biochemistry-III

Unit I: Control of metabolism : Coarse metabolic controls, fine metabolic controls, regulation by variation in substrate and pH, pacemaker enzymes. Allosteric regulation-covalent modification, subunit association and dissociation, calmodulins, and calcium.

Unit II: Mitochondrial Metabolism : Control of glycolysis and oxidative pentose phosphate pathway; Catabolic role of the TCA, anabolic role of the TCA cycle, anaplerotic reactions; Cyanide resistant respiration; Control of mitochondrial respiration; Significance of respiratory pathways; Role of the nonphosphorylating mechanisms and their possible usefulness in the life of the plant ; Respiration in intact plants.

Unit III: Secondary Metabolites : Cutins, waxes and suberin; Role of secondary metabolites; Classes of secondary metabolites – terpenes, phenolics and alkaloids and other nitrogen containing compounds; Overview of the major pathways of secondary-metabolite biosynthesis and their inter-relationship with primary metabolism; Biosynthesis and role of terpenes, phenolics and alkaloids and other nitrogen containing compounds.

Unit IV: Signal transduction in plants : Second messengers - Cyclic-AMP, Cyclic-GMP, cyclic-ADP-ribose, 1,2 – diacylglycerol, inositol1,4,5-triphosphate, nitric oxide and Calcium ion and their role, structure of calmodulin MAPK cascade.

Practicals MS.BOT.PR.4.06 :

- 1) Study the activity of malate dehydrogenase.
- 2) Study of peroxidase activity.
- 3) Study of enzyme acid phosphatase.
- 4) Study of inhibition of acid phosphatase.
- 5) Detection of tannins, saponins, alkaloids, flavonoids, steroids and triterpenoids, wax, cutin etc.
- 6) Estimation of total alkaloids in tobacco leaves.

Course: MS.BOT.4.07 Plant Physiology-III

Unit I: Plant Growth Regulators : Modulation of plant genomes by natural and synthetic PGRs; Post Harvest Technology – Fruit ripening and Fruit preservation.

Unit II: Phytochrome and Photomorphogenesis : a) Photochemical and biochemical properties of phytochrome, phytochrome induced whole plant response, ecological roles of phytochrome, functional domains of phytochromes, cellular and molecular mode of action and factors involved in phytochrome regulated gene expression. b) Photophysiology of blue light responses, blue light photoreceptors, signal transduction.

Unit III: Control of flowering: Floral organs, genes regulating the floral development –floral organ identity genes - MADS box genes, a model for floral evocation; Initiation and regulation of developmental pathways.

Unit IV: Senescence and Programmed Cell Death: Programmed cell death (PCD) an overview; Overview of Senescence- Pigment Metabolism during Protein metabolism, Oxidative metabolism during senescence, Degradation of nucleic acids during senescence, Regulation of metabolic activity during senescence, Endogenous PGRs and senescence.

Practicals MS.BOT.PR.4.07

- 1) Study of photomorphogenetic effect of lights on the development of seedlings i) Length of hypocotyls, Size and fresh weight of cotyledons, Differentiation of stomata in the lower epidermis, ii) Estimation of total chlorophyll, iii) Extraction and estimation of anthocyanin,
- 2) Study the light-induced chloroplast movement.
- 3) Effect of cytokinin on chlorophyll retention.
- 4) Effect of GA on α -amylase induction in cereal grains.