



JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate, Mumbai - 400 020, India.

Affiliated to
University of Mumbai

Program: B.Sc.

Proposed Course: Botany

Semester IV

**Credit Based Semester and Grading System (CBGS) with effect from
the academic year 2020-21**

S.Y.B.Sc. Botany Syllabus

Academic year 2020-2021

Semester IV			
Course Code	Course Title	Credits	Lectures /Week
SBOT401	BRYOPHYTA, PTERIDOPHYTA; GYMNOSPERMS AND ANGIOSPERMS	2	3
SBOT402	ANATOMY, PLANT PHYSIOLOGY AND ENVIRONMENTAL BOTANY	2	3
SBOT403	PLANT TISSUE CULTURE, MOLECULAR BIOLOGY AND RESEARCH METHODOLOGY	2	3

PREAMBLE

Today plant science is a fusion of the traditional components with the modern aspects of biochemistry, molecular biology and biotechnology. Over the years, Botany has shown enormous gain in information and applications owing to tremendous inputs from research in all its aspects. With global recognition of the need for conservation, ecologists have contributed significantly in assessing plant diversity. Taxonomists have explored newer dimensions for the classification of plants. New insights have been gained in functional and structural aspects of plant development by utilizing novel tools and techniques for botanical research. Challenging areas of teaching and research have emerged in ecology and reproductive biology. Concern for ever increasing pollution and climate change is at its highest than ever before. Keeping these advancements in view, the vision of the curriculum at the undergraduate level is perfectly timed. From the beginning of 2019-2020 session; the Botany students of Jai Hind College shall have the benefit of a balanced, carefully-crafted course structure taking care of different aspects of plant science, namely plant diversity, physiology, biochemistry, molecular biology, reproduction, anatomy, taxonomy, ecology, economic botany and the impact of environment on the growth and development of plants. All these aspects have been given due weightage over the six semesters. It is essential for the undergraduate students to acquaint themselves with various tools and techniques for exploring the world of plants up to the sub-cellular level. A unit on instrumentation is proposed to provide such an opportunity to the students before they engage themselves with the learning of modern tools and techniques in plant science. Keeping the employment entrepreneurship in mind, applied component has been designed. On the whole, the curriculum is a source of lot of information and is supported by rich resource materials. It is hoped that a student graduating in Botany with the new curriculum will be a complete botanist. Students are encouraged to opt for AAA courses in other subjects like Microbiology, Life Sciences, Chemistry, etc.

Semester IV – Theory

<p>Course code: SBOT401</p>	<p>PAPER I: BRYOPHYTA & PTERIDOPHYTA; GYMNOSPERMS & ANGIOSPERMS (Credits:2 Lectures/Week: 3)</p>	
	<p>Learning Objectives: Students will continue to learn another important class in Bryophyta i.e Anthocerotae. They will study the lifecycle of an important genera <i>Anthoceros</i>. Students will learn the general characters of 2 Classes of Pteridophytes i.e. Sphenopsida & Pteropsida and also study the economic importance for the same. They will study 2 important genera belonging to these classes i.e. <i>Equisetum</i> and <i>Ophioglossum</i> respectively. Students will understand the general characters of Class Cycadophyta of Gymnosperms and study the economic importance for the same. They will study 2 important genera belonging to this class i.e. <i>Cycas</i> and <i>Zamia</i>. Students will learn the morphology and modifications of different floral members. They will have a detailed study of a few Angiosperm families prescribed in their syllabus and study examples of economically important plant species of the same.</p>	
	<p>Learning outcomes: Students will be able to differentiate between plant groups belonging to Bryophytes, Pteridophytes, Gymnosperms and Angiosperms. Learning economic importance for these plant groups will help students understand the potential use of each group. Basic study of parts of the flower and types variations in floral morphology along with study of a few families classified as per Bentham and Hooker's system will help students to understand the branch of taxonomy.</p>	
<p>Unit I</p>	<p>Bryophyta & Pteridophyta: General characters and economic importance of Anthocerotae Structure, life cycle and systematic position of <i>Anthoceros</i> General characters and economic importance of Sphenopsida & Pteropsida Structure life cycle, systematic position and alternation of generations in <i>Equisetum</i> and <i>Ophioglossum</i></p>	<p>15 L</p>
<p>Unit II</p>	<p>Gymnosperms: Salient features, classification up to orders (with examples of each) and economic importance of Cycadophyta (Chamberlain's system of</p>	<p>15 L</p>

	classification to be followed) Structure life cycle and systematic position of <i>Cycas</i> and <i>Zamia</i>	
Unit III	<p>Angiosperms:</p> <p>Morphology of Inflorescence: Racemose: Raceme; Spike; catkin; corymb; umbel; capitulum Cymose: Cyme; Uniparous cyme; Biparous cyme; Multiparous cyme Special: Hypanthodium; Cyathium & Verticillaster</p> <p>Modifications of calyx: pappus, spurred Forms of polypetalous and gamopetalous corolla: cruciform, caryophyllaceous, rosaceous, campanulate, infundibuliform, salver shaped, rotate, tubular, bilabiate, ligulate</p> <p>Classification of the following families as per Bentham and Hooker's system of classification: Sterculiaceae, Rutaceae, Myrtaceae, Asteraceae, Verbenaceae, Amaranthaceae and Areaceae.</p> <p>Economic importance of plants belonging to the above mentioned families.</p>	15 L
<p>Additional References:</p> <p>Vashishta B.R., Sinha, A.K. & Kumar A., Botany for degree students Fungi, S. Chand, 1st Edition, 2010</p> <p>Vashishta P.C., Sinha, A. K. & Kumar A., Botany for degree students Pteridophyta, S. Chand, 1st Edition, 2005</p> <p>Rashid A., An introduction to Pteridophyta: Diversity, Development and Differentiation, Vikas Publishing House, 1999</p> <p>Vashishta P.C., Sinha, A. K. & Kumar A., Botany for degree students Gymnosperms, S. Chand, 1st Edition, 2005</p> <p>Gangulee, Das & Datta, College Botany, Volume II, New Central Book Agency, 2006</p> <p>Chopra G.L., Angiosperms, S. Nagin & Co., 1969</p> <p>Sharma O. P., Plant Taxonomy, Tata Mc Graw – Hill Publishing Co. Ltd., 1993</p> <p>Gurucharan S., Plant systematic, Oxford & IBH publishing Co. Pvt. Ltd., 3rd edition, 2012</p> <p>Davis P.H. & Heywood V.H., Principles of Angiosperm Taxonomy, Scientific Publishers, 2011</p>		

Course code: SBOT402	PAPER II: ANATOMY, PLANT PHYSIOLOGY AND ENVIRONMENTAL BOTANY (Credits:2 Lectures/Week:3)	
	Learning objectives: <p>Students learn the concept of normal and secondary growth in dicot plants. They also learn about the defence mechanism and conducting tissue system in the plants.</p> <p>The topic on the structures of carbohydrates deals with understanding the structures of molecules or products finally formed after photosynthesis (which was covered in sem II) .The topic of respiration then continues to explain how these energy rich carbohydrates are broken down to release energy in the life forms. The student will learn the concept of photorespiration and its significance with respect to reduction in crop plant yield.</p> <p>The study of soil and its profile will help students understand the ecosystems in soil. Community ecology studies will make the student aware of the various methods used in conservation.</p> <p>The students will be introduced to the different types of pollutions and pollutants harming the environment.</p>	
	Learning Outcomes: <p>The students will understand importance of defence mechanism in the plants. The students will also be able to identify the different types of wood/timber with the help of wood anatomy.</p> <p>With the study of this unit of physiology students will understand all basic interconnecting links between photosynthesis, respiration and photorespiration. They will also have in-depth knowledge of structures of molecules (carbohydrates) which are the photosynthetic products and respiratory substrates.</p> <p>Students will be able to grasp the basic concepts in ecology of soil formation and its related factors and they will understand the concept of community ecology</p> <p>Students will be sensitized about the types of pollution and their impact on environment. Case studies will help them relate to environmental issues across the globe.</p>	
Unit I	Anatomy <ul style="list-style-type: none"> • Normal Secondary Growth in Dicotyledonous stem and root. • Mechanical Tissue system <ul style="list-style-type: none"> ➤ Tissues providing mechanical strength and support and their disposition 	15L

	<ul style="list-style-type: none"> ➤ I-girders in aerial and undergroundorgans • Conducting tissuesystem: <ul style="list-style-type: none"> ➤ Xylem and itselements ➤ Phloem and itselements ➤ Types of VascularBundles. • Defence mechanism inplants: <ul style="list-style-type: none"> ➤ Morphologicalarmatures ➤ Anatomical (tylosis, gall, periderm, abscission) • Wood anatomy: Axial parenchyma &Rays • Secretory and glandular tissue system -Glands, Digestive glands, Nectaries, Resin ducts and oils ducts. 	
Unit II	<p>Plant Physiology : Structure of biomolecules Lipids: Structure and classification of lipids. Nomenclature of fatty acids and role of lipidic compounds present in plants. Ultra-structure and functions of Glyoxysomes and Peroxisomes. Respiration:Ultra-Structure and functions of Mitochondrion (membranes, cristae, F1 particles and matrix). Aerobic: Glycolysis, TCA Cycle, ETS & Energetics of respiration; Anaerobicrespiration Comparison of respiration and Photorespiration.</p>	15L
Unit III	<p>Environmental Botany</p> <ul style="list-style-type: none"> • Ecology of Mangroves: Growth, Maintenanceand significance. Ecological factors: Concept of environmental factors. Soil as an edaphic factor, Soil composition, types of soil, soil formation, soil profile. Community ecology- Characters of community - Quantitative characters(Pyramids,Quadrats, Line-transect) and Qualitative characters (Whittaker’s Classification, Raunkier’s Classification, Braun-Blanquet Classification) Pollution: Definition and its types – Air pollution and its effect on plants, Water pollution and its effect on plants and Soil pollution and its effect on plants.Current&ImportantPollutionepisodesof the world & Metro cities of India (Mumbai; Delhi; Kolkata & Chennai) etc. 	15L
<p>Additional References: Fahn A., Plant anatomy, PergamonPress,1967 Pandey B. P., Plant anatomy, S. Chand,2007 EsauK.,Plantanatomy,JohnWiley&Sons,1953 Roy P., Plant anatomy, New Central Book Agency,2006 Lehninger, Principles of Biochemistry, D. Nelson & M. Cox, W.H.</p>		

Freeman & Co., 4th edition,2005
Taiz L.and Zeiger E., Plant Physiology, Sinauer Associates inc.
Publishers,2010
Odum E.P., Fundamentals of Ecology, Thomson Brooks/Cole,2005
Kormandy E.J., Concepts of Ecology, Prentice Hall,1996
Santra S.C., Fundamentals of Ecology and Environmental Biology,
New Central Book agency,2010
Reimold R.J and Queen W.H., Ecology of Halophytes, Academic Press,
INC,1974
Shukla R.S. & Chandel P.S., A textbook of Plant Ecology, S. Chand &
Co. Ltd.,2019



Course code: SBOT 403	PAPER III: PLANT TISSUE CULTURE, MOLECULAR BIOLOGY AND RESEARCH METHODOLOGY (Credits: 2 Lectures/Week:3)	
	Learning objectives: <p>The topic of plant tissue culture has been introduced as a separate unit to study basic techniques in PTC. The students will be learning everything from layout of a lab to actually growing cultures via Micropropagation. They will also study the commercial usage of tissue culture especially in cropimprovement.</p> <p>Study the basic aspects and strategies involved in gene cloning.</p> <p>The research methodology unit will make the students understand the concept of research, its types and a detailed account of the researchdesign.</p> <p>The publication basics will make the student understand the structured writing of a report, referencingand plagiarism.</p>	
	Learning outcomes: <p>The PTC unit will make the students aware of the various techniques followed in setting up a lab, making a medium, sterilising for aseptic conditions and various types of culturing techniques. After studying the topics, students will also be well versed with taking the plants from lab to land and how <i>in vitro</i> propagation can improve foodcrops.</p> <p>The gene cloning unit will introduce students to the fascinating topic on genetic engineering. They will understand the strategies involved in gene cloning using different types of vectors as well as the role played by some important enzymes involved in recombinant DNA technology.</p> <p>The student will use the basics studied about research in their academics for conducting projects andpresent them.</p>	
Unit I	Plant tissue Culture Historical aspect of PTC- contribution of major workers Layout of a PTCLab Aseptict echniques Nutritional components of tissue culturemedium Concept oft otipotency Stages ofMicropropagation Initiation and maintenance of callus, organogenesis and multiple shootculture Hardening Applications of PTC in cropimprovement	15L

<p>Unit II</p>	<p>Molecular Biology: Recombinant DNA technology</p> <p>General account of Enzymes involved in Gene cloning: Restriction enzymes: Types, Source, Mode of action and uses. Ligase enzyme: Source, Mode of action, uses and methods of ligation involving Homopolymer tailing, Linkers, Blunt end and sticky end ligation.) Source, Mode of action, uses of following enzymes in gene cloning: Polynucleotide kinase, Terminal transferase, Reverse Transcriptase, S1 Nuclease, Alkaline Phosphatase, different types of DNA Polymerases General account of vectors and Strategy of Gene cloning using following different types of Vectors: Plasmid vectors (PBR322, PUC19) Ti Plasmid based Vectors Bacteriophage Vectors Cosmid Vectors BAC and YAC vectors</p>	<p>15L</p>
<p>Unit III</p>	<p>Research Methodology</p> <ul style="list-style-type: none"> • Meaning of Research: need and general objectives of research, significance of research (emphasis on botany), criteria for good research • Types of research: Types of research, Research methods versus methodology • Research problem – definition, selection and technique involved in defining a problem. • Plagiarism- types and consequences 	<p>15L</p>
<p>Additional References:</p> <p>Glick, B. R., Pasternack J. and Patten, C., Molecular Biotechnology Principles and Applications of Recombinant DNA Technology 4th edition, American Society of Microbiology, CBS Publishers, 2007 Russell P., I-Genetics: A Molecular Approach, Pearson/Benjamin Cummings, 2nd Edition, 2006. Ramavat, K.G., Plant Biotechnology, S Chand & Company Ltd, 2004 Singh B.D., Plant biotechnology, Kalyani Pub. 2006 Ignacimuthu S., Plant Biotechnology, Oxford & Ibh Publishing Company Pvt Limited, 2005 Dodds J. and Roberts L., Experiments in Plant Tissue Culture, 2nd edition, Cambridge University Press, 1995 De, Kalyan, Plant Tissue Culture, S Chand & Company Ltd, 2008 Kothari, C.R., Research Methodology- Methods and Techniques, 2nd revised Edition, New Age international publishers, 2004 Roig M., Avoiding plagiarism, self-plagiarism, and other questionable writing practices: A guide to ethical writing. U.S. Department of Health & Human Services: Office of Research Integrity, 2011</p>		

Semester IV – Practical

Course Code: SBOT4PR	Practical Paper I, II & III (Credits:2.5 Practicals/Week:3)
	<p>Learning Objectives:</p> <p>The students will perform sectioning of fresh and preserved specimens of Bryophytes, Pteridophytes and Gymnosperms and observe microscopic details to understand their structural variations.</p> <p>The students will observe specimens to study floral morphology.</p> <p>The student will learn the technique of sectioning, staining and mounting of preserved and fresh plant materials to observe and study anatomical structures including mechanical tissue systems, conducting tissues and types of vascular bundles.</p> <p>Technique of respiration will be actually demonstrated in germinating seeds to understand the process.</p> <p>The students will study physico-chemical characters of soil to determine various characters.</p> <p>The students will study various aseptic techniques to be followed in PTC. They will also culture explants for callus and multiple shoot induction. Other culturing techniques will be studied via microphotographs.</p> <p>The students will learn to solve given statistical problems.</p>
	<p>Learning Outcomes:</p> <p>The students will now be able to study and interpret stages in life cycles of <i>Anthoceros</i>, <i>Cycas</i> and <i>Zamia</i>.</p> <p>Study of morphological characters will help them to easily identify the field plants.</p> <p>Students will understand the use of anatomical variations to classify plants.</p> <p>The study of soil parameters will help them to find solutions to problems encountered in cultivation of plants in different edaphic and climatic zones.</p> <p>They will be able to use their skill to construct gardens with necessary features and plants.</p> <p>The students will learn to use statistics and give statistically correct data of results that they interpret to solve actual problems.</p>
	<ol style="list-style-type: none"> 1. Study of stages in the life cycle of <i>Anthoceros</i> from fresh/ preserved material and permanent slides. 2. Study of stages in the life cycle of <i>Equisetum</i> from fresh/ preserved material and permanent slides. 3. Study of stages in the life cycle of <i>Ophioglossum</i> from fresh/ preserved material and permanent slides.

	<ol style="list-style-type: none"> 4. Study of stages in the life cycle of <i>Cycas</i> from fresh/preserved material and permanent slides. 5. Study of stages in the life cycle of <i>Zamia</i> from fresh/preserved material and permanent slides. 6. Economic importance of Anthocerotae/ Pteropsida/ Sphenopsida/Cycadophyta 7. Study of one plant from each of the following Angiosperm families <ul style="list-style-type: none"> Sterculiaceae Rutaceae Myrtaceae Asteraceae Verbenaceae Amaranthaceae Arecaceae <p>Morphological peculiarities and economic importance of the members of the above mentioned Angiosperm families</p>
	<ol style="list-style-type: none"> 8. Study of normal secondary growth in the stem and root of a Dicotyledonous plant 9. Types of mechanical tissues, mechanical tissue system in aerial, underground organs. 10. Study of morphological and anatomical structures involved in defence mechanism in plants 11. Study of conducting tissues- Xylem and phloem elements in Gymnosperms and Angiosperms as seen in L.S. and through maceration technique. 12. Study of different types of vascular bundles. 13. Application of wood anatomy in timber identification. 14. Study of digestive glands; oil glands; Resin ducts; with the help of temporary/ permanent preparations. 15. Q_{10}-germinating seeds using Phenol red indicator 16. Estimation of reducing sugars by Dinitrosalicylic acid method. 17. Determination of total carbohydrate by Anthrone method. 18. Study of the working of the following Ecological Instruments- Soil thermometer, Soil testing kit, Soil pH, Wind anemometer. 19. Mechanical analysis of soil by the sieve method & pH of soil. 20. Quantitative estimation of organic matter of the soil by Walkley and Black's Rapid titration method. 21. Study of vegetation by <ul style="list-style-type: none"> list quadrat method Garmin's method 22. Study of LD_{50} using heavy metals.

	<p>23. Comparative account of dust load from leaves in unpolluted and polluted areas.</p>
	<p>24. Preparation of MS Medium via stock making (Demonstration)</p> <p>25. Culturing of explants for multiple shoot induction</p> <p>26. Culturing of explants for callus induction</p> <p>27. Study of microphotographs of various types of cultures - anther, pollen, meristem, shoot, root and embryoculture.</p> <p>28. Identification of the cloning vectors - pBR322, pUC 19, Tiplasmid.</p> <p>29. Chi square test</p> <p>30. Calculation of coefficient of correlation</p> <p>31. Research Projects/Literature survey</p>



JAI HIND COLLEGE, CHURCHGATE

S.Y.B.Sc. Botany Practical Paper

Semester IV Paper I

Total Marks: 50

Time: 2 hrs 15 min

Q. 1 Identify, classify and describe specimen 'A' & 'B'. Sketch neat and labeled diagram. (14)

Q. 2 Identify, classify and describe specimen 'C'. Sketch neat and labeled diagram. (7)

Q. 3 Classify specimen 'D' upto its family giving reasons. Give floral formula. Sketch and label L.S. of Flower and T.S. of ovary. (9)

Q. 4 Identify and describe the specimen/ slide/ photomicrograph -, 'E' 'F' and 'G'. (15)

Q. 5 Journal (05)

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A – Bryophyta

B - Pteridophyta

C –Gymnosperms

D - Sterculiaceae / Rutaceae / Myrtaceae / Asteraceae / Verbenaceae / Amaranthaceae /Arecaceae

E, F & G – Economic importance of Anthocerotae/ Pteropsida/ Sphenopsida/ Cycadophyta;
Economic importance of families studied; any material not asked as table specimen.

JAI HIND COLLEGE, CHURCHGATE
S.Y.B.Sc. Botany Practical Paper
Semester IV Paper II

Total Marks: 50

Time: 2 hrs 30 min

Q. 1 (a) Make a temporary stained preparation of T.S. of specimen 'A' and comment on the secondary growth. (07)

Q. 1 (b) Make a temporary stained preparation of T.S. of specimen 'B' and comment on the mechanical tissue system. / Macerate the given material 'B' and describe the conducting tissues seen. (05)

Q. 1 (c) Take a TS/LS of the given material 'C' and describe the secretory tissue. (04)

Q. 1(d) Perform TS/RLS/TLS on the given material 'D' to characterise the wood type. (09)

Q. 2 Perform the Physiology experiment 'E' allotted to you. Write the principle, requirements. Record your observations and results. (08)

Q. 3 Perform the ecological experiment 'F' allotted to you. Write the principle, requirements. Record your observations and results. (08)

Q. 4 Identify and describe the specimen/ slide/ photograph – 'G', 'H' & 'I' (09)

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A – Dicot stem/ root

B – Mechanical tissue/ maceration of gymnosperms wood or angiosperms wood/ secretory tissues

C – wood anatomy

D – Q₁₀ with Phenol red indicator/ Estimation of reducing sugars by DNSA/ Estimation of carbohydrates by Anthrone method

E – Mechanical analysis of soil and pH of Soil/ Organic matter estimation/ list quadrat method

F, G & H – Ecological Instruments/ Types of Vascular bundles/ Garmin's instrument (in random order)

JAI HIND COLLEGE, CHURCHGATE

S.Y.B.Sc. Botany Practical Paper

Semester IV Paper III

Total Marks: 50

Time: 2 hrs 15 min

Q.1 Perform the culturing techniques allotted to you. (09)

Q. 2 Perform Chi-square test OR Co-efficient of correlation using the given data 'B' and analyse the results.

(10)

Q. 3 Identify and describe the specimen / photograph 'C' and 'D'

(06)

Q. 4 Project submission and presentation.

(25)

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A – Plant tissue culture experiment

B – Problems of Biostatistics

C – Artificial cloning vectors pBR 322/ pUC 18/ Ti – plasmid vector and microphotograph of PTC

Evaluation Scheme

[A] Evaluation scheme for Theory courses

I. Continuous Assessment (C.A.) - 40Marks

- (i) C.A.-I: Test – 20 Marks of 40 mins. duration
- (ii) C.A.-II: Test /Assignment/Project/ surprise class test – 20 marks

II. Semester End Examination (SEE)- 60Marks

[B] Evaluation scheme for Practical courses (SEE – 50 marks) NOTE:

1. A minimum of TWO field excursions (with at least one beyond the limits of Mumbai) for habitat studies are compulsory. Field work of not less than eight hours duration is equivalent to one period per week for a batch of fifteen students.

2. A candidate will be allowed to appear for the practical examinations only if he/she submits a certified journal of SYBSc Botany and the Field Report or a certificate from the Head of the Department/Institute to the effect that the candidate has completed the practical course of SYBSc Botany as per the minimum requirements. In case of loss of a journal, a candidate must produce a certificate from the Head of the Department/ Institute that the practical for the academic year was completed by the student. However, such a candidate will be allowed to appear for the practical examination but the marks allotted for the journal will not be granted.