



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

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

**Affiliated to  
University of Mumbai**

Program: S.Y.B.Sc.

Proposed Course: BOTANY

**Credit Based Semester and Grading System (CBCS) with effect from the  
academic year 2019-20**

**S.Y.B.Sc. Botany Syllabus**

**Academic year 2019-2020**

<b>Semester IV</b>			
<b>Course Code</b>	<b>Course Title</b>	<b>Credits</b>	<b>Lectures /Week</b>
<b>SBOT401</b>	<b>FUNGI, LICHENS, PTERIDOPHYTA AND GYMNOSPERMS</b>	<b>2</b>	<b>3</b>
<b>SBOT402</b>	<b>ANATOMY, PLANT PHYSIOLOGY AND ENVIRONMENTAL BOTANY</b>	<b>2</b>	<b>3</b>
<b>SBOT403</b>	<b>HORTICULTURE, MOLECULAR BIOLOGY AND RESEARCH METHODOLOGY</b>	<b>2</b>	<b>3</b>



## **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

<b>Course code: SBOT401</b>	<b>PAPER I: FUNGI; LICHENS, PTERIDOPHYTA AND GYMNOSPERMS (Credits:2 Lectures/Week: 3)</b>	
	<b>Learning Objectives:</b> <ul style="list-style-type: none"> <li>• The students continue to learn the characters of another important class of fungi i.e. the Ascomycetae . They will study this class of fungi by the study of lifecycles belonging to two important genera belonging to this class. Two important plant diseases caused by fungi also belonging to this class are studied in detail with respect to causal organism, symptoms, disease cycle and control measures.</li> <li>• The student will be able to appreciate the association between fungi and algae while studying lichens.</li> <li>• Student will appreciate the different orders of ferns and the classes Psilophyta and Lepidophyta.</li> <li>• Students will study the example of <i>Selaginella</i> – structure and life cycle.</li> <li>• Students will study the geological time scale, fossils and the example of <i>Rhynia</i>.</li> <li>• Students will understand the general characters of Coniferophyta and the structure life cycle and systematic position of <i>Pinus</i></li> </ul>	
	<b>Learning outcomes:</b> <ul style="list-style-type: none"> <li>• Students will get a detailed account and overall view of an important class of fungi (Ascomycetes) with respect to life cycle, disease cycle as well as control measures for fungi belonging to this class. They will be able to classify and identify the disease with the symptoms. The students will grasp the difference between beneficial and disease-causing fungi.</li> <li>• The students will understand and appreciate the general characters of Psilophytes, Lepidophytes and coniferophytes.</li> <li>• The life cycles and structures of the different groups will benefit in making the students understand the classes they are studying.</li> </ul>	
<b>Unit I</b>	<b>Thallophyta: Fungi, Plant Pathology and Lichens</b> <b>Fungi-</b> <ul style="list-style-type: none"> <li>• General characters of Ascomycetae</li> <li>• Structure, life cycle and systematic position of:               <ul style="list-style-type: none"> <li>○ <i>Erysiphe</i></li> <li>○ <i>Xylaria</i></li> </ul> </li> </ul> <b>Plant Pathology-</b> <ul style="list-style-type: none"> <li>• Symptoms, causative organism, disease cycle and control measures of :               <ul style="list-style-type: none"> <li>○ Powdery mildew</li> <li>○ Late blight of potato</li> </ul> </li> </ul> <b>Lichens-</b> Classification, Structure, Method of Reproduction, Economic Importance and Ecological Significance of Lichens.	<b>15 L</b>
<b>Unit II</b>	<b>Pteridophyta and Paleobotany</b> <b>Pteridophyta-</b> <ul style="list-style-type: none"> <li>• Salient features and classification upto orders (with examples of</li> </ul>	<b>15 L</b>

	<p>each) of Psilophyta and Lepidophyta (G M Smith's system of classification to be followed),</p> <ul style="list-style-type: none"> <li>• Structure, life cycle and systematic position of <i>Selaginella</i></li> </ul> <p><b>Palaeobotany-</b></p> <ul style="list-style-type: none"> <li>• The geological time scale;</li> <li>• Formation and types of fossils;</li> <li>• Structure and systematic position of form genus <i>Rhynia</i></li> </ul>	
<b>Unit III</b>	<p><b>Gymnosperms</b></p> <ul style="list-style-type: none"> <li>• Salient features, classification up to orders (with examples of each) and economic importance of Coniferophyta (Chamberlain's system of classification to be followed)</li> <li>• Structure life cycle and systematic position of <i>Pinus</i></li> <li>• Structure and systematic position of the form genus <i>Cordaites</i></li> </ul>	<b>15 L</b>
<p><b>References:</b></p> <ul style="list-style-type: none"> <li>• Vashishta B. R., Sinha, A. K. &amp; Kumar A., Botany for degree students Fungi, S. Chand, 1st Edition, 2010</li> <li>• Vashishta P.C., Sinha, A. K. &amp; Kumar A., Botany for degree students Pteridophyta, S. Chand, 1st Edition, 2005</li> <li>• Rashid A., An introduction to Pteridophyta: Diversity, Development and Differentiation, Vikas Publishing House, 1999</li> <li>• Vashishta P.C., Sinha, A. K. &amp; Kumar A., Botany for degree students Gymnosperms, S. Chand, 1st Edition, 2005</li> <li>• Gangulee, Das &amp; Datta, College Botany, Volume II, New Central Book Agency, 2006</li> </ul>		

<b>Course code: SBOT402</b>	<p><b>PAPER II: ANATOMY, PLANT PHYSIOLOGY AND ENVIRONMENTAL BOTANY</b> (Credits :2 Lectures/Week: 3)</p>	
	<p><b>Learning objectives:</b></p> <ul style="list-style-type: none"> <li>• Students are introduced to different tissue systems present in plants. Students learn the concept of normal and secondary growth in dicot plants.</li> <li>• 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 .</li> <li>• The students will learn the significance of biogeochemical cycles of carbon, nitrogen and water. 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.</li> </ul>	

	<p><b>Learning Outcomes:</b></p> <ul style="list-style-type: none"> <li>• The students will understand the anatomical aspects of higher plants and will grasp the differences between the different tissue systems and anatomical structures.</li> <li>• 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.</li> <li>• 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</li> </ul>	
<b>Unit I</b>	<p><b>Anatomy</b></p> <ul style="list-style-type: none"> <li>• Normal Secondary Growth in Dicotyledonous stem and root.</li> <li>• Mechanical Tissue system <ul style="list-style-type: none"> <li>○ Tissues providing mechanical strength and support and their disposition</li> <li>○ I-girders in aerial and underground organs</li> </ul> </li> <li>• Conducting tissue system: <ul style="list-style-type: none"> <li>○ Xylem and its elements</li> <li>○ Phloem and its elements</li> <li>○ Types of Vascular Bundles.</li> </ul> </li> <li>• Defence mechanism in plants: <ul style="list-style-type: none"> <li>○ Morphological armatures</li> <li>○ Anatomical ( tylosis , gall, periderm , abscission)</li> </ul> </li> </ul>	<b>15 L</b>
<b>Unit II</b>	<p><b>Plant Physiology :</b></p> <p><b><u>Structure of biomolecules</u></b></p> <ul style="list-style-type: none"> <li>• Carbohydrates: Basic Nomenclature, Classification, (Monosaccharides, Disaccharides, Oligosaccharides and Polysaccharides). Appropriate examples of class along with its use as Structural and storage Polysaccharides.</li> <li>• Lipids: Structure and classification of lipids. Nomenclature of fatty acids and role of lipidic compounds present in plants.</li> </ul> <p><b><u>Respiration:</u></b> Aerobic: Glycolysis, TCA Cycle, ETS &amp; Energetic of respiration; Anaerobic respiration; Photorespiration</p>	<b>15 L</b>
<b>Unit III</b>	<p><b>Environmental Botany</b></p> <ul style="list-style-type: none"> <li>• Ecology of Mangroves: Growth, Maintenance and significance.</li> <li>• Ecological factors: Concept of environmental factors. Soil as an edaphic factor, Soil composition, types of soil, soil formation, soil profile.</li> <li>• Community ecology- Characters of community - Quantitative characters and qualitative characters</li> </ul>	<b>15 L</b>
<p><b>Additional References:</b></p> <ul style="list-style-type: none"> <li>• Fahn A., Plant anatomy, Pergamon Press,1967</li> <li>• Pandey B.P., Plant anatomy, S. Chand, 2007</li> <li>• Taiz L.and Zeiger E., Plant Physiology, Sinauer Associates inc. Publishers, 2010</li> <li>• Odum E.P., Fundamentals of Ecology, Thomson Brooks/Cole, 2005</li> <li>• Kormandy E.J., Concepts of Ecology, Prentice Hall, 1996</li> <li>• Reimold R.J and Queen W.H., Ecology of Halophytes, Academic Press, INC, 1974</li> </ul>		

<b>Course code: SBOT 403</b>	<b>PAPER III: HORTICULTURE, MOLECULAR BIOLOGY AND RESEARCH METHODOLOGY</b> <b>(Credits : 2 Lectures/Week: 3)</b>	
	<b>Learning objectives:</b> <ul style="list-style-type: none"> <li>• Unit of horticulture aims at learning various branches of horticulture and its overall scope of gardening in present times. The topic on principles of landscape gardening is added to understand the basic principles and concepts involved in construction of various types of gardens. To understand all this better, a few examples of botanical gardens and national parks present in India and abroad are also added in the syllabus.</li> <li>• Study the basic aspects and strategies involved in gene cloning.</li> <li>• The research methodology unit will make the students understand the concept of research, its types and a detail account of the research design.</li> <li>• The publication basics will make the student understand the structured writing of a report, referencing and plagiarism.</li> </ul>	
	<b>Learning outcomes:</b> <ul style="list-style-type: none"> <li>• The unit of horticulture covers the applied aspects of various branches of horticulture. The study of gardens and national parks will enlighten the students about the practical application of their knowledge in actual designing gardens.</li> <li>• 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 role played by some important enzymes involved in recombinant DNA technology.</li> <li>• The student will use the basics studied about research in their academics for conducting projects and present them.</li> </ul>	<b>15 L</b>
<b>Unit I</b>	<b>Horticulture</b> <ul style="list-style-type: none"> <li>• Introduction to Horticulture: Branches of Horticulture</li> <li>• Gardening: <ul style="list-style-type: none"> <li>o Locations in the garden- edges, hedges, lawn, flower beds, avenue, water garden (with names of two plants for each category). Focal point.</li> </ul> </li> <li>• Types of gardens <ul style="list-style-type: none"> <li>o Formal and informal gardens,</li> <li>o National Park: Sanjay Gandhi National Park, Yellow Stone National park.</li> <li>o Botanical Garden: Veer Mata Jijabai Udaan (Victoria Garden), KEW gardens, Gardens by the Bay</li> </ul> </li> </ul>	
<b>Unit II</b>	<b>Molecular Biology: Recombinant DNA technology</b> <ul style="list-style-type: none"> <li>• <b>General account of Enzymes involved in Gene cloning:</b> <ul style="list-style-type: none"> <li>o Restriction enzymes: Types, Source, Mode of action and uses.</li> <li>o Ligase enzyme: Source, Mode of action, uses and methods of ligation involving Homopolymer tailing, Linkers, Blunt end and sticky end ligation.)</li> <li>o Source, Mode of action, uses of following enzymes in gene cloning: Polynucleotide kinase, Terminal transferase, Reverse Transcriptase, S1 Nuclease, Alkaline</li> </ul> </li> </ul>	

	<p>Phosphatase, different types of DNA Polymerases</p> <ul style="list-style-type: none"> <li>• <b>General account of vectors and Strategy of Gene cloning using following different types of Vectors:</b> <ul style="list-style-type: none"> <li>○ Plasmid vectors (PBr322, PUC 19)</li> <li>○ Ti Plasmid based Vectors</li> <li>○ Bacteriophage Vectors</li> <li>○ Cosmid Vectors</li> <li>○ BAC and YAC vectors</li> </ul> </li> </ul>	
<b>Unit III</b>	<p><b>Research Methodology</b></p> <ul style="list-style-type: none"> <li>• Meaning of Research: need and general objectives of research, significance of research (emphasis on botany), criteria for good research</li> <li>• Types of research: Types of research, Research methods versus methodology <ul style="list-style-type: none"> <li>○ Research problem – definition, selection and technique involved in defining a problem.</li> <li>○ Research Design – Meaning and need of research design, principles and features of a design, Concept of developing a research plan</li> </ul> </li> <li>• Publication basics – Meaning, Types, Referencing- offline and online. <ul style="list-style-type: none"> <li>○ Report writing and scientific paper writing –Mechanics of writing and Precautions</li> <li>○ Plagiarism- types and consequences</li> <li>○ Oral and poster presentations: Designing, colour combinations and use of videos and animations.</li> </ul> </li> </ul>	<b>15 L</b>
<p><b>Additional References:</b></p> <ul style="list-style-type: none"> <li>• Randhawa G.S &amp; Mukhopadhyay A., Floriculture in India, Allied Publishers, 1986</li> <li>• Molecular Biotechnology Principles and Applications of Recombinant DNA Technology By Bernard R Glick , Jack Pasternack and Cheryl Patten, 4<sup>th</sup> edition , American Society of Microbiology.</li> <li>• Russell P., I-Genetics: A Molecular Approach, Pearson/Benjamin Cummings, 2<sup>nd</sup> Edition, 2006.</li> <li>• Singh B.D., Plant biotechnology, Kalyani Pub. 2006</li> <li>• Ignacimuthu S., Plant Biotechnology, Oxford &amp;Ibh Publishing Company Pvt Limited, 2005</li> <li>• Mahajan B.K., Methods in Biostatistics: For medical students and research workers, Jaypee Brothers Medical publishers, 2008.</li> <li>• Kothari C.R., Research methodology – Methods and Techniques (Second Revised Edition), New Age International Publishers, 2004</li> <li>• Roig M., Avoiding plagiarism, self-plagiarism, and other questionable writing practices: A guide to ethical writing. U.S. Department of Health &amp; Human Services: Office of Research Integrity, 2011</li> </ul>		



## Semester IV – Practical

<p><b>Course Code:</b> <b>SBOT4PR</b></p>	<p><b>Practical Paper I, II &amp; III (Credits : 2.5                      3 Practicals/Week:1)</b></p> <p><b>Learning Objectives:</b></p> <ul style="list-style-type: none"> <li>• The student will study the technique of mounting or sectioning and mounting fresh and preserved plant materials of <i>Erisyphe</i>, <i>Xylaria</i>, <i>Rhynia</i>, <i>Selaginella</i> and <i>Pinus</i>.</li> <li>• Students will observe preserved specimens, permanent slides and photomicrographs to study of lichens, form genus <i>Cordaites</i> and fungal diseases.</li> <li>• The student 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.</li> <li>• Technique of respiration will be actually demonstrated in germinating seeds to understand the process.</li> <li>• The students will study physico-chemical characters of soil to determine various characters.</li> <li>• The students will study in detail the planning of a formal and informal garden. .</li> <li>• The students will learn to solve given statistical problems.</li> </ul> <p><b>Learning Outcomes:</b></p> <ul style="list-style-type: none"> <li>• The students will now be able to study and interpret stages in life cycles of <i>Erisyphe</i>, <i>Xylaria</i>, <i>Rhynia</i>, <i>Selaginella</i> and <i>Pinus</i>.</li> <li>• The students will be able to identify lichens and fungal diseases.</li> <li>• The study of soil parameters will help them to find solutions to problems encountered in cultivation of plants in different edaphic and climatic zones.</li> <li>• They will be able to use their skill to construct gardens with necessary features and plants.</li> <li>• The students will learn to use statistics and give statistically correct data of results that they interpret to solve actual problems .</li> </ul> <ol style="list-style-type: none"> <li>1. Study of stages in the life cycle of <i>Erysiphe</i> from fresh/ preserved material and permanent slides.</li> <li>2. Study of stages in the life cycle of <i>Xylaria</i> from fresh/ preserved material and permanent slides.</li> <li>3. Study of fungal diseases as prescribed for theory.</li> <li>4. Study of Lichens (crustose, foliose, &amp;fruiticose).</li> <li>5. Study of stages in the life cycle of <i>Selaginella</i> from fresh/ preserved material and permanent slides.</li> <li>6. Study of form genera <i>Rhynia</i> with the help of permanent slides/ photomicrographs.</li> <li>7. Study of stages in the life cycle of <i>Pinus</i> from fresh/ preserved material and permanent slides.</li> <li>8. Study of the form genus <i>Cordaites</i> with the help of permanent slide/ photomicrographs.</li> </ol>
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	<ol style="list-style-type: none"> <li>9. Study of normal secondary growth in the stem and root of a Dicotyledonous plant</li> <li>10. Types of mechanical tissues, mechanical tissue system in aerial, underground organs.</li> <li>11. Study of morphological and anatomical structures involved in defence mechanism in plants</li> <li>12. Study of conducting tissues- Xylem and phloem elements in Gymnosperms and Angiosperms as seen in LS and through maceration technique.</li> <li>13. Study of different types of vascular bundles.</li> <li>14. Q<sub>10</sub> – germinating seeds using Phenol red indicator</li> <li>15. Estimation of reducing sugars by Dinitrosalicylic acid method.</li> <li>16. Determination of total carbohydrate by Anthrone method.</li> <li>17. Study of the working of the following Ecological Instruments- Soil thermometer, Soil testing kit, Soil pH, Wind anemometer.</li> <li>18. Mechanical analysis of soil by the sieve method &amp; pH of soil.</li> <li>19. Quantitative estimation of organic matter of the soil by Walkley and Black's Rapid titration method.</li> <li>20. Study of vegetation by the list quadrat method</li> <li>21. Garmin's method</li> </ol>
	<ol style="list-style-type: none"> <li>22. Preparation of garden plans – formal and informal gardens: Identification of plants for different garden features.</li> <li>23. Identification of the cloning vectors – pBR322, pUC 18, Ti plasmid.</li> <li>24. Chi square test</li> <li>25. Calculation of coefficient of correlation</li> <li>26. Research Projects</li> </ol>

JAI HIND COLLEGE, CHURCHGATE

S.Y.B.Sc. Botany Practical Paper

Semester IV Paper I

Total Marks: 50

Time: 2 hrs 15min

- Q. 1 Identify, classify and describe specimen 'A'. sketch neat and labeled diagram. (10)
- Q. 2 Identify, classify and describe specimen 'B'. Sketch neat and labeled diagram. (10)
- Q. 3 Identify, classify and describe specimen 'C'. Sketch neat and labeled diagram. (10)
- Q. 4 Identify and describe the specimen/ slide/ photomicrograph –'D', 'E' and 'F'. (15)
- Q. 5 Journal (05)

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A – Fungi

B – Pteridophytes

C – Gymnosperms

D, E & F – Lichen/ Plant pathology/ *Cordaites/ Rhynia*

JAI HIND COLLEGE, CHURCHGATE

S.Y.B.Sc. Botany Practical Paper

Semester IV Paper II

Total Marks: 50

Time: 2 hrs 15min

Q. 1 (a) Make a temporary stained preparation of T.S. of specimen 'A' and comment on the secondary growth. (10)

Q. 1 (b) Make a temporary stained preparation of T.S. of specimen 'B' and comment on the mechanical tissue system. (05)

OR

Q. 1 (b) Macerate the given material 'B' and describe the conducting tissue seen. (05)

Q. 2 Perform the Physiology experiment 'C' allotted to you. Write the principle, requirements. Record your observations and results. (10)

Q. 3 Perform the ecological experiment 'D' allotted to you. Write the principle, requirements. Record your observations and results. (10)

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

Q. 5 Viva – voce (06)

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A – Dicot stem/ root

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

C – Q<sub>10</sub> with Phenol red indicator/Estimation of reducing sugars by DNSA/ Estimation of carbohydrates by Anthrone method

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

E, F & G – 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 15min

Q. 1 Prepare a garden plan 'A'. Mention any three garden locations with suitable plants (Botanical names). (07)

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' (03)

Q. 4 Project submission and presentation. (30)

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A – Formal and Informal garden

B – Problems of Biostatistics

C – Artificial cloning vectors pBR 322/ pUC 18/ Ti – plasmid vector

## Evaluation Scheme

### [A] Evaluation scheme for Theory courses

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

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

#### II. Semester End Examination (SEE)- 60 Marks

### [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 journal, a candidate must produce a certificate from the Head of the Department/ Institute that the practical for the academic year were 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.