



# SCHOOL OF SCIENCES

(FORMERLY, SCHOOL OF ARCHITECTURE, SCIENCE AND TECHNOLOGY)

**YASHWANTRAO CHAVAN MAHARASHTRA OPEN UNIVERSITY**



## Syllabus:

### **V156: M.Sc. (Botany){2023 Pattern}**

**(Semester 01 to 04)**

**(Incorporating  
NEP2020  
Recommendations,  
PG Credit and  
Curriculum  
Framework GR  
dated 16-05-2023)**

With effect from Academic  
Year 2023-24, vide G.R. No.  
NEP-2022/CR No. 09/VISHI-  
3/शिकाना, dated 16 May,  
2023.

**2023**

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**NEP2020: Programme Structure with Syllabus of all Courses at Semester 01 to 04 were finalized in the meeting held on 24 July 2023**

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Revised on 31 Aug 2023, 25 Nov 2023 for Evaluation Pattern

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# V156: M.Sc. (BOTANY) {2023 PATTERN}

## ABOUT THE PROGRAMME

PROGRAMME CODE: V156

PROGRAMME NAME: M.Sc. (BOTANY)

This M.Sc. programme is uniquely designed to impart essential knowledge in all major areas of Botany. This programme offers an exciting opportunity for specialization in Botany. The programme contents of total 04 semesters are a carefully selected blend of theory, practical and field project/ research project which prepare students for specialist professional employment, research in academia, and various industries for broader applications. Learner centric curriculum is designed in adherence to the principles of National Education Policy (NEP 2020) to acquire knowledge and skills with valuable experiences through hands-on activities, projects and internships.

## OBJECTIVES, OUTCOMES AND SCOPE OF THE PROGRAMME

**Objectives:** The 'M.Sc. (Botany)' program will

- Inculcate critical thinking and analytical skills to enable students to pursue higher studies and research in Life Sciences or related fields of Botany.
- Provide a strong foundation for a better understanding of current advances in Botany and its practical significance.
- Expose students to current trends in research about Botany.
- Gain comprehensive overview about the various courses included in the programme.
- To provide students with a comprehensive understanding of the principles of botany.
- To develop students' research skills in botany.
- To prepare students for careers in botany, research, or related fields.

**Outcomes:** After successful completion of this programme, students will be able to –

- Define the terms "botany", "plant", and "plant science" and explain their relationship to each other.
- Understand the basic principles of plant anatomy, physiology, and ecology.
- Conduct research in botany using a variety of methods.
- Communicate effectively about botany through written reports, presentations, and other media.
- Apply the principles of botany to solve real-world problems.

**Scope of the programmes:** After successful completion of this programme, students may get opportunities in various fields/sectors to work as

- Career opportunities in both private and government sector/ in India and abroad
- Job opportunities in sectors like agricultural industries, NMCs, Pest Control, botanical gardens, applied business etc.
- Inculcation of research attitude
- Inculcation of entrepreneurship
- Perceive higher education and research in the same or allied fields

## MODE OF EDUCATION

This Programme will be offered in Open and Distance Learning (ODL) Mode as defined in “UGC Open and Distance Learning Programmes and Online Programmes Regulations, 2020” published in the gazette notification by dated 4<sup>th</sup> Sept 2020 by the UGC as specified below.

*“Open and Distance Learning Mode means a mode of providing flexible learning opportunities by overcoming separation of teacher and learner using a variety of media, including print, electronic, online and occasional interactive face-to-face meetings with the learners or Learner Support Services to deliver teaching-learning experiences, including practical or work experiences”*

## BASIC INFORMATION

- 1. Mode of Education:** Open and Distance Learning (ODL) Mode
- 2. Minimum Programme Duration:** 2 years/ 4 semesters after Candidates with B.Sc. with Botany at FY and SY/ B.Sc. (Agri) or Equivalent pass
- 3. Maximum Programme Duration:** 4 years from the date of admission to the PG programme, also referred as Valid Registration Period
- 4. Learner Support Centers/ Study Centers:** University approved/ recognized Senior Science Colleges/ Institutes offering PG Botany programme
- 5. Medium of Instruction:** English
- 6. Attendance:** Minimum 80% attendance for all type of courses.
- 7. Profile of Prospective Students:** In Service Science Teachers from Schools/ Junior College & Equivalent Pass Students.
- 8. Teaching-Learning:** Total 12 + 3 = 15 working weeks in each semester, where 3-weeks’ time duration in each semester for clearing face-to-face counseling session’s backlog (if any).
- 9. Total Teaching-Learning Support:** Total 2640 Hours including Self-Study during all 4 semesters. 660 Hours (including Self-Study) **during** each semester.
- 10. Total Courses:** **23** courses (subjects) distributed over Semesters) 01 to 04.
- 11. Total Credits:** 88 Credits. { As per UGC norms 1 Credit means 30 hours of study efforts required to gain learning of particular content of each credit}.
- 12. Total Courses and Credit Points:**

Sem	Mandatory Courses (DSC)			Elective Courses (DSE) (4 Credits)	Other Courses (4 Credits)/ (6 Credits)	Total Courses (Credits)
	Theory		Practical (4 Credits)			
	(4 Credits)	(2 Credits)				
1	2	1	1	1	1 – Research Methodology (4 Credits)	<b>6</b> (22 Credits)
2	2	1	1	1	Any one - OJT/ Field Projects(4 Credits)	<b>6</b> (22 Credits)
3	2	1	1	1	1- Research Project (4 Credits)	<b>6</b> (22 Credits)
4	2	-	1	1	1- Research Project (6 Credits)	<b>5</b> (22 Credits)
Total	8 x 4 = 32 (38 Credits)	3 x 2 = 06	4 x 4 = (16 Credits)	4 x 4 = (16 Credits)	3 x 4 + 1 x 6 = (18 Credits)	<b>23</b> (88 Credits)

**13. Multiple Entry and Multiple Exit:** The multiple entry and multiple exit features open up new opportunities for learners, even if they have stopped or discontinued their study in the middle for a variety of reasons. This feature provides entry options in order to promote flexible learning within the valid registration period (04 years from the date of admission to the PG programme). Learners only have the choice to leave the program at the end of even semester 02, and they have the option to reenter at the start of odd semester 03. Only one exit option and reentry is permissible for MSc programme during stipulated time period.

**14. Exit Option- PG Diploma Certificate:** The learner who passes all registered courses of first year (two semesters) of the programme successfully in the examinations and obtains required credits (44 Credits), shall be awarded with **Post Graduate Diploma PGD 14-BOT** if learner shall opt for exit. The aggregate performance (SGPA of Semester 01 and Semester 02) and Class in the programme shall be reported on the basis of performance.

**15. PG Degree Certificate:** After successful completion of all courses (semesters 01 to 04) at two year of the programme and obtaining required credits (88 Credits), learner shall be awarded with **Post Graduate Degree**. The aggregate performance (CGPA of Semester 01 to Semester 04) and Class in the programme shall be reported on the basis of performance.

**16. Approval/Equivalence Status:** UGC and DEB recognized and approved [AY 2023 and onwards] with UGC/DEB letter F.No. 1-2/2021 (DEB-I), Dated: 02.08.2021, available at [https://www.ugc.ac.in/pdfnews/4204139\\_HEI-Recognition-list-02-08-2021.pdf](https://www.ugc.ac.in/pdfnews/4204139_HEI-Recognition-list-02-08-2021.pdf)

## ELIGIBILITY AND FEES

Admission Eligibility	Certification Eligibility	Fees per Year Annual Admission Form Amount (AAFA) is payable to university along with admission form at the start of each year.			
Candidates with B.Sc. with Botany at FY and SY/ B.Sc. (Agri) or Equivalent pass	<b>V156:</b> Min 40% or better marks in total 23 courses (subjects) of total 88 credits at Semesters 01 to 04.  CGPA: Aggregate performance and Class in the programme shall be reported on the basis of semesters 01 to 04.  For exit option <b>PGD 14- BOT</b> Min 40% or better marks in total 12 courses (subjects) of total 44 credits at Semesters 01 to 02.	<b>Description</b>		<b>INR ₹</b>	
				<b>1<sup>st</sup> Year</b>	<b>2<sup>nd</sup> Year</b>
		<b>Mandatory Fees</b>		608	858
		<b>Tuition Fee</b>	<b>USF</b>	8000	8000
			<b>LSCF</b>	12000	12000
		<b>End Exam Fees</b>		2480	2370
<b>AAFA</b>		23088	23228		

## PROGRAMME STRUCTURE

### V156: M.Sc (BOTANY) {2023 PATTERN} AS PER NEP 2020

Year (2 Yr. PG)	Level	Se m.	Major				RM	OJT/FP	RP	Cum. Cr.	
			Mandatory	CR	Elective	CR					
I	6.0	I	<b>BOT501:</b> Diversity of Non-Vascular Plants- I( <b>T</b> )	4	<b>BOT506:</b> Applied Phycology( <b>T</b> ) <b>OR</b> <b>BOT507:</b> Tools and Techniques in plant Science ( <b>T</b> )	4	<b>RES505:</b> Research Methodology ( <b>T</b> )(4 Cr)	-	-	<b>22</b>	
			<b>BOT502:</b> DiversityofNon-VascularPlants-II( <b>T</b> )	4							
			<b>BOT503:</b> DiversityofVascular Plants and Paleobotany – I ( <b>T</b> )	2							
			<b>BOT504:</b> Lab Activities on BOT501, BOT502 & BOT503 ( <b>P</b> )	4							
		II	<b>BOT509:</b> PlantPhysiology( <b>T</b> )	4	<b>BOT515:</b> Biotechnology and Molecular Biology( <b>T</b> ) <b>OR</b> <b>BOT516:</b> Ecology and Phytogeography ( <b>T</b> )	4	-	-	<b>BOT513:</b> OJT (4Cr) <b>OR</b> <b>BOT514:</b> FP (4Cr)	-	<b>22</b>
			<b>BOT510:</b> HerbalWealth ( <b>T</b> )	4							
			<b>BOT511:</b> Diversity of Vascular Plants and Paleobotany –II ( <b>T</b> )	2							
			<b>BOT512:</b> Lab Activities on BOT509, BOT510 & BOT511 ( <b>P</b> )	4							
<b>Cum. Cr. For 1 Year PG Diploma</b>			<b>28</b>	<b>8</b>	<b>4</b>	<b>4</b>	<b>-</b>	<b>44</b>			
<b>Exit option: PG Diploma (44Credits) after Three Year UG Degree PGD14-BOT:Post Graduate Diploma in Botany</b>											

Year (2 Yr. PG)	Level	Se m	Major				RM	OJT/ FP	RP	Cum. Cr.
			Mandatory	CR	Elective	CR				
II	6.5	III	<b>BOT601:</b> Cytogenetics & Plant Breeding (T)	4	<b>BOT606:</b> Biostatistics(T) <b>OR</b> <b>BOT607:</b> Mycology and Plant Pathology(T) <b>OR</b> <b>BOT608:</b> Renewable Energy Studies (T)	4	-	-	<b>BOT605:</b> Research Project (4 Cr)	<b>22</b>
			<b>BOT602:</b> Advanced Plant Physiology (T)	4						
			<b>BOT603:</b> Pharmacognosy(T)	2						
			<b>BOT604:</b> Lab Activities on BOT601, BOT602 & BOT603 (P)	4						
		IV	<b>BOT609:</b> Taxonomy of Angiosperms (T)	4	<b>BOT613:</b> Anatomy and Embryology (T) <b>OR</b> <b>BOT614:</b> Hydroponic Technology (T) <b>OR</b> <b>BOT615:</b> Medicinal plants and their applications(T)	4	-	-	<b>BOT612:</b> Research Project (6Cr)	<b>22</b>
			<b>BOT610:</b> Seed Technology(T)	4						
<b>BOT611:</b> Lab Activities on BOT609 & BOT610 (P)	4									
<b>Cum. Cr. For 2 Years PG Degree</b>			<b>54</b>	<b>16</b>	<b>4</b>	<b>4</b>	<b>10</b>	<b>88</b>		
<b>2 Years- 4 Semester PG Degree in Environmental Science (88 credits) after Three Year UG Degree</b>										

Abbreviations: Yr.: Year; Sem.: Semester; Cumulative Credits: Cum. Cr. ; T- Theory Course; P- Practical course; TW-Term Work; PW- Project Work

## SEMESTER AND COURSES

### Abbreviations of the courses

<b>Mandatory DSC</b>	Discipline Specific Core Course	<b>Elective DSE</b>	Discipline Specific Elective Course
<b>RM</b>	Research Methodology	<b>OJT</b>	On Job Training: Internship/ Apprenticeship
<b>FP</b>	Field projects	<b>RP</b>	Research Project
<b>OE</b>	Open Elective (May be taken from MOOC or may be chosen from other domain of learning to get exposure to interdisciplinary domain) [OE will be offered in phase manner]		

SN	Course Category	Code	Course Name	CA	EE	TM	Type	CR	Min %
<b>[Level 6.0] Semester 01: 22 Credits</b>									
01	Mandatory (DSC)	BOT501	Diversity of Non-vascular Plants-I	30	70	100	T	4	40%
02	Mandatory (DSC)	BOT502	Diversity of Non-Vascular Plants-II	30	70	100	T	4	40%
03	Mandatory (DSC)	BOT503	Diversity of Vascular Plants & Paleobotany-I	15	35	50	T	2	40%
04	Mandatory (DSC)	BOT504	Lab Activities on BOT501, BOT502 & BOT503	50	50	100	P	4	40%
05	RM	RES505	Research Methodology	30	70	100	T	4	40%
<b>Elective (DSE) Courses (Select Any One)</b>									
06	Elective (DSE)	BOT506	Applied Phycology	30	70	100	T	4	40%
07	Elective (DSE)	BOT507	Tools and Techniques in plant Science	30	70	100	T	4	40%
<b>[Level 6.0] Semester 02 : 22 Credits</b>									
08	Mandatory (DSC)	BOT509	Plant Physiology	30	70	100	T	4	40%
09	Mandatory (DSC)	BOT510	Herbal Wealth	30	70	100	T	4	40%
10	Mandatory (DSC)	BOT511	Diversity of Vascular Plants and Paleobotany-II	15	35	50	T	2	40%
11	Mandatory (DSC)	BOT512	Lab Activities on BOT509, BOT510 & BOT511	50	50	100	P	4	40%
12	OJT/FP	BOT513 BOT514	Any one OJT or FP	50	50	100	TW	4	40%
<b>Elective (DSE) Courses (Select Any One)</b>									
13	Elective (DSE)	BOT515	Biotechnology and Molecular Biology	30	70	100	T	4	40%
14	Elective (DSE)	BOT516	Ecology and Phytogeography	30	70	100	T	4	40%
<b>Exit option: PG Diploma {PGD 14 –BOT (44 Credits)} after Three Year UG Degree</b>									

<b>[Level 6.5] Semester 03 : 22 Credits</b>									
15	Mandatory (DSC)	BOT601	Cytogenetics and Plant Breeding	30	70	100	T	4	40%
16	Mandatory (DSC)	BOT602	Advanced Plant Physiology	30	70	100	T	4	40%
17	Mandatory (DSC)	BOT603	Pharmacognosy	15	35	70	T	2	40%
18	Mandatory (DSC)	BOT604	Lab Activities on BOT601, BOT602 & BOT603	50	50	100	P	4	40%
19	RP	BOT605	Research Project	50	50	100	PW	4	40%
<b>Elective (DSE) Courses (Select Any One)</b>									
20	Elective (DSE)	BOT606	Biostatistics	30	70	100	T	4	40%
21	Elective (DSE)	BOT607	Mycology and Plant Pathology	30	70	100	T	4	40%
22	Elective (DSE)	BOT608	Renewable Energy Studies	30	70	100	T	4	40%
<b>[Level 6.5] Semester 04 : 22 Credits</b>									
23	Mandatory (DSC)	BOT609	Taxonomy of Angiosperms	30	70	100	T	4	40%
24	Mandatory (DSC)	BOT610	Seed Technology	30	70	100	T	4	40%
25	Mandatory (DSC)	BOT611	Lab Activities on BOT609 & BOT610	50	50	100	P	4	40%
26	RP	BOT612	Research Project	75	75	150	PW	6	40%
<b>Elective (DSE) Courses (Select Any One)</b>									
27	Elective (DSE)	BOT613	Anatomy and Embryology	30	70	100	T	4	40%
28	Elective (DSE)	BOT614	Hydroponic Technology	30	70	100	T	4	40%
29	Elective (DSE)	BOT615	Medicinal Plants and their Applications	30	70	100	T	4	40%
<b>2 Years- 4 Semester PG Degree in Botany (88 Credits) after Three Year UG Degree</b>									



## Grading system

1. **“Absolute Grading”**: the marks are converted to grades based on pre-determined class intervals.
2. **“Letter Grade”**: It is an index of the performance of students in a said programme. Grades are denoted by letters O, A+, A, B+, B, C, P and F.
3. **“Grade Point”**: It is a numerical weight allotted to each letter grade on a 10-point scale. Grade Point shall be “o (Zero)” for Letter Grade “Ab” and “F”. The marks scored by the examinee shall be converted into grade points by dividing the marks scored in the aggregate and dividing the resulting number by maximum marks, multiplying the result by ten, retaining the integer part (ignore the fractional part). Thus, if a person has secured 56 marks out of 100 marks in aggregate for a course, we get  $(56/100) \times 10$  which is 5.6. Ignoring the fraction, we get 5 as the grade point.

Marks Obtained out of 100	Grade Point	Semester GPA / Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign / Letter Grade Result
90 – 100	10	9.00 – 10.00	90.0 - 100	O (Outstanding)
80 – 89.99	9	8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)
70 – 79.99	8	7.00 - < 8.00	70.0 - < 80.0	A (Very Good)
60 – 69.99	7	6.00 - < 7.00	60.0 - < 70.0	B+ (Good)
55 – 59.99	6	5.50 - < 6.00	55.0 - < 60.0	B (Above Average)
50 – 54.99	5	5.00 - < 5.50	50.0 - < 55.0	C (Average)
40 – 49.99	4	4.00 - < 5.00	40.0 - < 50.0	<b>P (Pass)</b>
0 – 39.99	0	Below 4.00	<b>Below 40</b>	<b>F (Fail)</b>
		<b>Ab (Absent)</b>	-	<b>Absent</b>

4. **“Credit Point”**: It is the product of grade point and number of credits for a course.
5. **“Semester Grade Point Average (SGPA)”**: It is a measure of performance of work done in a semester. It is the ratio of sum of the product of the number of credits with the grade points scored by a student in all courses taken by a student and the sum of number of credits of all the courses undergone by a student:

$$SGPA (S_i) = \frac{\sum C_i G_i}{\sum C_i}$$

It shall be expressed up to two decimal places.

6. **“Cumulative Grade Point Average (CGPA)”**: It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme.

$$CGPA = \frac{\sum C_i S_i}{\sum C_i}$$

Where,  $S_i$  is the SGPA of the  $i^{\text{th}}$  semester &  $C_i$  is the total number of credits in that semester. It

shall be expressed up to two decimal places.

7. **“Transcript or Grade Card or Certificate”**: Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade secured) along with SGPA of that semester and CGPA **earned till that semester**.
8. **“Evaluation Pattern”**: As per NEP2020, the ‘Evaluation Pattern’ of the Post graduate Programme consists of the following components:

<b>Course Type</b>	<b>Number of Credits</b>	<b>Continuous Assessment (CA)</b>	<b>End Examination (EE)</b>	<b>Total Marks ‘TM’ = (CA+EE)</b>	<b>Minimum Passing %</b>
Theory(T)	4	30	70	100	minimum 40% in CA, EE and (CA + EE) shall be essential for each course to pass
Theory (T)	2	15	35	50	
Practical (P)	4	50	50	100	
OJT/Field Project (FP)	4	50	50	100	
Research Project (RP)	4	50	50	100	
Research Project(RP)	6	75	75	150	

## EVALUATION PATTERN

[CA and EE Evaluation Pattern as per the Minutes of the Meeting of the NEP Cell Dated 21.11.2023]

SN	Type of Course	Continuous Assessment (CA)	End Examination (EE)
1	Theory (T) 4 Credit 100 Marks  CA: 30% EE: 70%	<p>Each student is required to attempt <b>total 02</b> (Two) “Continuous Assessments (CAs)” for <b>each</b> course of <b>each</b> Semester, as per the following details:</p> <ol style="list-style-type: none"> <li><b>CA01:</b> ‘Continuous Assessment 01 (CA01)’ on <b>Credit 01 to Credit 04</b> of <b>each</b> course, consists of <ul style="list-style-type: none"> <li>2 (Two) ‘Short Answer Questions (SAQs)’, each carrying <b>05</b> Marks, on Credit 01 and Credit 02</li> </ul> <p style="text-align: center;"><b>and</b></p> <ul style="list-style-type: none"> <li>1 (One) ‘Long Answer Question (LAQ)’ of 10 Marks, on Credit 03 and Credit 04. LAQ may consist of sub-questions.</li> </ul> <p><b>CA01:</b> On Credit 01 to Credit 04, of Marks = <math>(5 \times 2 + 10) = \mathbf{20 \text{ Marks}}</math></p> </li> <li><b>CA02:</b> ‘Continuous Assessment 02 (CA02)’ on <b>Credit 01 to Credit 04</b> of <b>each</b> course, consists of <ul style="list-style-type: none"> <li>A test containing total <b>10</b> (Ten) ‘Objective Type Questions,’ <b>05 (Five)</b> on <b>Credit 01</b> and <b>Credit 02</b>, <b>and 05 (Five)</b> on <b>Credit 03</b> and <b>Credit 04</b>. Each ‘Objective Type Question’ of 1 Mark.</li> </ul> <p><b>CA02:</b> On Credit 01 to Credit 04, of Marks = <b>10 Marks</b></p> </li> <li>Maximum number of attempts for <b>CA</b>, during <b>each</b> semester : <b>Single</b> attempt only</li> <li><b>Total Marks: 30</b> Marks</li> </ol>	<ol style="list-style-type: none"> <li>Student is required to answer <b>05 ‘VSAQs’ out of 06 ‘VSAQs’</b>, each carrying <b>03</b> Marks, on <b>Credit 01 to 04</b>, for total <b>15 Marks</b>. <b>One VSAQ will be on each Credit</b>.</li> <li>Student is required to answer <b>05 ‘SAQs’ out of 06 ‘SAQs’</b>, each carrying <b>05</b> Marks, on <b>Credit 01 to 04</b>, for total <b>25 Marks</b>. <b>One SAQ will be on each Credit</b>.</li> <li>Student is required to answer <b>01 ‘LAQ’ out of 2 LAQs</b>, of <b>10</b> Marks on <b>Credit 01</b> and <b>Credit 02</b>, for total <b>10 Marks</b>. <b>LAQ may consist of sub-questions</b>.</li> <li>Student is required to answer <b>01 ‘LAQ’ out of 2 LAQs</b>, of <b>10</b> Marks on <b>Credit 03</b> and <b>Credit 04</b>, for total <b>10 Marks</b>. <b>LAQ may consist of sub-questions</b>.</li> <li>Student is required to answer <b>01 ‘LAQ’ out of 2 LAQs</b>, of <b>10</b> Marks on <b>Credit 01 to Credit 04</b>, for total <b>10 Marks</b>. <b>LAQ may consist of sub-questions</b>.</li> <li>Number of attempts: <b>Till Valid Registration Period (VRP) only</b></li> <li><b>Marks: 70</b> Marks</li> <li><b>Duration: 150</b> minutes</li> </ol>

SN	Type of Course	Continuous Assessment (CA)	End Examination (EE)																
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2	Theory (T) <b>2 Credit</b> 50 Marks CA: 30% EE: 70%	Each student is required to attempt <b>total 01</b> (One) "Continuous Assessment (CA)" for <b>each</b> course of <b>each</b> Semester, as per the following details: <ol style="list-style-type: none"> <li><b>CA01:</b> 1 (One) 'Continuous Assessment 01 (CA01)' on <b>Credit 01</b> and <b>Credit 02</b> of <b>each</b> course, consists of               <ul style="list-style-type: none"> <li>1 (One) 'Short Answer Question (SAQ)' of 5 Marks</li> <li><b>and</b></li> <li>1 (One) 'Long Answer Question (LAQ)' of 10 Marks, LAQ may consist of sub-questions.</li> </ul> <b>CA01:</b> On <b>Credit 01</b> and <b>Credit 02</b>, of Marks = (5 + 10) = <b>15 Marks</b> </li> <li>Maximum number of attempts for <b>CA</b>, during <b>each</b> semester: <b>Single</b> attempt only</li> <li><b>Total Marks:</b> <b>15</b> Marks</li> </ol>	<ol style="list-style-type: none"> <li>Student is required to answer <b>05 'VSAQs' out of 06 'VSAQs'</b>, each carrying <b>03</b> Marks, on <b>Credit 01 to 02</b>, for total <b>15 Marks</b>. <b>One VSAQ will be on each Credit.</b></li> <li>Student is required to answer <b>02 'SAQs' out of 03 'SAQs'</b>, each carrying <b>05</b> Marks, on <b>Credit 01 to 02</b>, for total <b>10 Marks</b>. <b>One SAQ will be on each Credit.</b></li> <li>Student is required to answer <b>01 'LAQ' out of 2 LAQs</b>, of <b>10</b> Marks on <b>Credit 01</b> and <b>Credit 02</b>, for total <b>10 Marks</b>. <b>LAQ may consist of sub-questions.</b></li> <li>Number of attempts: <b>Till Valid Registration Period (VRP) only</b></li> <li><b>Marks:</b> <b>35</b> Marks</li> <li><b>Duration:</b> 75 minutes</li> </ol>																

SN	Type of Course	Continuous Assessment (CA)		End Examination (EE)	
		SN	Description	Evaluation of End Examination (EE)	Marks
		1	Question Types	Very Short Answer Question (VSAQ) on each Credit	03 Marks
				Short Answer Question (SAQ) on each Credit	05 Marks
				On each Credit, either Single Long Answer Question (LAQ) <b>or</b> LAQ contains sub-questions (a), (b) and so on.	10 Marks
		2	Grand Total Marks	Total <b>three</b> Questions in EE Question paper based on: Credit 01 to 02 : 05 VSAQs out of 06 VSAQs (15 Marks) Credit 01 to 02 : 02 SAQs out of 03 SAQs (10 Marks) Credit 01 to 02 : 01 LAQ out of 02 LAQs (10 Marks) <b>LAQ may contain sub-questions</b>	35 Marks

SN	Type of Course	Continuous Assessment (CA)				End Examination (EE)
3	Practical (P) 4 Credit 100 Marks CA: 50% EE: 50%	1. Student is required to submit "Activity Report in Work-Book Format" for <b>each</b> Credit in the prescribed format. 2. Maximum number of attempts for <b>each</b> CA, during <b>each</b> semester : <b>Single</b> attempt only 3. <b>Marks: 50</b> Marks 4. Grading Criteria:				External and internal examiners shall assess each student based on: 1. Workbook/Activity Report submission by the student (Only by <b>External Examiner</b> ) [05 Marks] 2. Practical Activity performed by the student [12 Marks] 3. Result and Conclusion of the Practical Activity [13 Marks] 4. Viva-Voce on Practical Activities [20 Marks] 5. Number of attempts: <b>Till Valid Registration Period (VRP) only</b> 6. <b>Marks: 50</b> Marks 7. <b>Duration: 180</b> minutes
	<b>Lab Punctuality, Preparedness &amp; Ethics</b>	Irregular in lab. Copies the experiment from others <b>(0 Points)</b>	Consistently regular but unable to explain the concepts <b>(06 Points)</b>	Punctuality in lab. Follows the procedure and responds to questions asked <b>(10 Points)</b>		
	<b>Activity Report and Performance</b>  (Experiment No, Date, Objectives, Apparatus with specification, Observations, Graphs, software used if any)	Poor Documentation and copied the experiment from others. Couldn't perform the Activity /poor observation made <b>(04 Points)</b>	Average Documentation : Report is in format but some of the formatting guidelines are missed. Performed the Activity but observations made with some mistakes <b>(12 Points)</b>	Good Documentation: Lab activity writing is in proper format with all references, Grammar. Performed the Activity on time observations made with no mistakes <b>(20 Points)</b>		
	<b>Results and Conclusion</b>	Unable to achieve the desired results but makes attempts to relate data to theory. Poor concluding statements <b>(08 Points)</b>	Average graphical and tabulated representation with misinterpret physical significance of theory. Achieve the desired results and but insufficient conclusion statement. <b>(14 Points)</b>	Analyses and interpret observed data carefully with good graphical and tabulated representation using appropriate theory/evidence. Achieve the results and reach to appropriate Conclusion <b>(20 Points)</b>		

<b>SN</b>	<b>Type of Course</b>	<b>Continuous Assessment (CA)</b>	<b>End Examination (EE)</b>		
			<b>Evaluation of Practical End Examination</b>		
		SN	Description	Internal Examiner	External Examiner
		1	Workbook/Activity Report	-	05 Marks
		2	Actual Conduct of one randomly selected Practical Activity	02 Marks	10 Marks
		3	Diagram, Synoptic Answers, Graph/Observation and Conclusion	03 Marks	10 Marks
		4	Viva-Voce/Oral	05 Marks	15 Marks
		5	Total	10 Marks	40 Marks

SN	Type of Course	Continuous Assessment (CA)	End Examination (EE)																					
4	Field Project (TW) 4 Credit 100 Marks CA: 50% EE: 50%	<p>Students need to complete one month Field Project (Total Study hours <b>120 hrs</b> including Activity Report). After completion of the field project, learners shall submit a report to the LSC - Programme Coordinator (PC) and Mentor/Guide.</p> <ol style="list-style-type: none"> <li>Maximum number of attempts for <b>each</b> CA, during <b>each</b> semester: <b>Single</b> attempt only</li> <li>Duration: 1 Month or 4 Weeks duration –i) After end examination of semester 02 and before beginning of semester 03 <b>or</b></li> </ol> <p>ii) Any one month during semester 02 duration</p> <ol style="list-style-type: none"> <li><b>Marks: 50</b> Marks</li> <li>Grading Criteria for Evaluation of FP (<b>only by Mentor/Guide</b>):</li> </ol>	<ol style="list-style-type: none"> <li><b>External</b> and Internal examiners (Internal examiner - <b>Programme Coordinator (PC) / Supervisor of LSC</b>) shall assess each student based on: <ol style="list-style-type: none"> <li>Activity Report submission by the student (Only by <b>External Examiner</b>) [10 Marks]</li> <li>Viva-Voce on Activity Report [40 Marks]</li> </ol> </li> <li>Number of attempts: <b>Till Valid Registration Period (VRP) only</b></li> <li><b>Marks: 50</b> Marks</li> <li><b>Duration: 180</b> minutes</li> </ol>																					
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SN	Type of Course	Continuous Assessment (CA)	End Examination (EE)																							
5	OJT or Internship (TW)  4 Credit 100 Marks  CA: 50% EE: 50%	<ol style="list-style-type: none"> <li>Students need to complete one month On Job Training (OJT) or Internship (Total Study hours 120 hrs including Internship Report) in any Industry/ Organization/Institute/R&amp;D Division /Any Micro/ Small/Medium/Enterprise/ Govt/NGO/PSU/Online Internship related to major course.</li> <li>Maximum number of attempts for each CA, during each semester: <b>Single</b> attempt only</li> <li><b>Marks: 50</b> Marks</li> <li>Duration: 1 Month or 4 Weeks –               <ol style="list-style-type: none"> <li>After end examination of semester 02 and before beginning of semester 03.</li> <li>Any one month during semester 02 duration</li> </ol> </li> <li>Grading Criteria for Evaluation of OJT (or Intern) <b>only by Mentor where the Internship is proposed to be imparted:</b></li> </ol>	At the end of <b>second</b> semester, <b>Programme Coordinator (PC)/ Supervisor of LSC and 1 (one) External Examiner</b> will complete 'End Exam (EE)' for <b>all</b> allotted students as follows: <ol style="list-style-type: none"> <li>Duration of EE: After Theory EE of second Semester</li> <li>Programme Coordinator (PC)/ <b>Supervisor of LSC</b> and <b>External Expert</b> will have 20% and 80% weightage respectively in EE.</li> <li>Number of attempts: <b>Till Valid Registration Period (VRP) only</b></li> <li><b>Marks</b> for EE: <b>50</b> Marks</li> </ol>																							
			Parameter	<b>PC /Supervisor of LSC</b>	External Expert																					
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			Maintenance of Daily Diary	-	10 Marks																					
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		<b>Document as Evidence:</b> Activity report along with Certificate or Declaration, duly issued and signed by the concerned authority [ <b>To be assessed during EE</b> ] should be submitted during End Examination to the parent Learner support Centre (LSC).																								

SN	Type of Course	Continuous Assessment (CA)	End Examination (EE)																							
6	Project Work (PW)  RP-I <b>4 Credit</b> 100 Marks  CA: 50% EE: 50%	1. Student is required to submit “Activity Report” based on Grading Criteria of the course in the prescribed format. 2. Maximum number of attempts for each CA, during each semester: <b>Single</b> attempt only 3. <b>Marks: 50</b> Marks 4. Grading Criteria: <table border="1"> <thead> <tr> <th>SN</th> <th>Desc</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Seminar*</td> <td>25</td> </tr> <tr> <td>2</td> <td>Research Proposal</td> <td>25</td> </tr> </tbody> </table>	SN	Desc	Marks	1	Seminar*	25	2	Research Proposal	25	1. <b>External</b> and internal examiners shall assess each student based on: <ol style="list-style-type: none"> <li>Project Report submission by the student (Only by <b>External Examiner</b>) [10 Marks]</li> <li>Project Presentation by the student [20 Marks]</li> <li>Viva-Voce on Project Report [20 Marks]</li> </ol> 2. Number of attempts: <b>Till Valid Registration Period (VRP) only</b> 3. <b>Marks: 50</b> Marks 4. <b>Duration: 180</b> minutes														
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		<table border="1"> <thead> <tr> <th rowspan="2">SN</th> <th colspan="3">Evaluation of Project Work End Examination</th> </tr> <tr> <th>Description</th> <th>Internal Examiner</th> <th>External Examiner</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Project Report</td> <td>-</td> <td>10 Marks</td> </tr> <tr> <td>2</td> <td>Project Presentation</td> <td>05 Marks</td> <td>15 Marks</td> </tr> <tr> <td>3</td> <td>Viva-Voce /Oral</td> <td>05 Marks</td> <td>15 Marks</td> </tr> <tr> <td>4</td> <td>Total</td> <td>10 Marks</td> <td>40 Marks</td> </tr> </tbody> </table>		SN	Evaluation of Project Work End Examination			Description	Internal Examiner	External Examiner	1	Project Report	-	10 Marks	2	Project Presentation	05 Marks	15 Marks	3	Viva-Voce /Oral	05 Marks	15 Marks	4	Total	10 Marks	40 Marks
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2	Project Presentation	05 Marks	15 Marks																							
3	Viva-Voce /Oral	05 Marks	15 Marks																							
4	Total	10 Marks	40 Marks																							

SN	Type of Course	Continuous Assessment (CA)	End Examination (EE)																							
7	Project Work (PW) RP-II  <b>6 Credit</b> 150 Marks  CA: 50% EE: 50%	1. Student is required to submit “Activity Report” based on Grading Criteria of the course in the prescribed format. 2. Maximum number of attempts for <b>each</b> CA, during <b>each</b> semester: <b>Single</b> attempt only 3. <b>Marks: 75</b> Marks 4. Grading Criteria: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>SN</th> <th>Desc</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Seminar*</td> <td>30</td> </tr> <tr> <td>2</td> <td>Research Paper Presentation**</td> <td>30</td> </tr> <tr> <td>3</td> <td>Project Report</td> <td>15</td> </tr> </tbody> </table> <p>*To be conducted in Online/Off line mode at LSC.            ** Journals/Conferences/ at LSC, in Online/Offline mode [This activity shall be organized by respective LSC in Online/Offline mode in case student didn't get an opportunity for presentation at Journals/Conferences]</p>	SN	Desc	Marks	1	Seminar*	30	2	Research Paper Presentation**	30	3	Project Report	15	1. <b>External</b> and internal examiners shall assess each student based on: <ol style="list-style-type: none"> <li>Project Report submission by the student (Only by <b>External Examiner</b>) [20 Marks]</li> <li>Project Presentation by the student [25 Marks]</li> <li>Viva-Voce on Project Report [30 Marks]</li> </ol> 2. Number of attempts: <b>Till Valid Registration Period (VRP) only</b> 3. <b>Marks: 75</b> Marks 4. <b>Duration: 180</b> minutes											
SN	Desc	Marks																								
1	Seminar*	30																								
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	<b>Total</b>	<b>15 Marks</b>	<b>60 Marks</b>																							

1. **Separate and independent passing @ 40% in CA, EE and (CA+EE) shall be essential for each course - Theory, Practical, OJT/FP and RP.** “CA, EE and Total marks” shall be separately reported for **each** course in the transcript or mark-statement. The minimum and maximum marks for “CA, EE and Total Marks” are shown in the table below. If student does not score a minimum of 40% marks in CA or in EE of a course then the result of such a course will be reported as FAIL.

Course Type	Number of Credits	Continuous Assessment (CA)		End Examination(EE)		Total Marks ‘TM’ = (CA +EE)	
		Min	Max	Min	Max	Min	Max
Theory	2	6	15	14	35	20	50
	4	12	30	28	70	40	100

Course Type	Number of Credits	Continuous Assessment (CA)		End Examination (EE)		Total Marks 'TM' = (CA + EE)	
		20	50	20	50	40	100
Practical/ OJT/FP/RP	4	20	50	20	50	40	100
	6	30	75	30	75	60	150

2. In **each** semester, **only 1 attempt**, for CA for **each** course and for EE for **each** course shall be allowed. Only **during valid registration period (VRP)**, students are allowed to appear for CA and EE for **each** course against the payment of the specified 'Examination Fee' for each attempt, for each course where he/she is admitted by the university. The 'CA and/or EE' attempts are counted for each examination option offered by the university to the student, irrespective of whether student actually chooses to appear in end exam or not.
3. If a student does not successfully complete the continuous assessment (CA) or pass the End Examination of Practical/Term work/OJT/Field Project/Research Project courses, they may complete these requirements with the next semester at the respective Learning Support Center (LSC) **only** during the valid registration period (VRP).
4. **Duration for Practical/Term work/OJT/Field Project/Research Project type of Courses:** 180 Minutes for a batch of typically 15 ± 3 students
5. **Only best of past performance shall be reported in transcript or mark statement.**
6. **Total student evaluation for**
  - a. **Each** semester shall be for **550** marks
  - b. **Each** year shall be for **1100** marks
  - c. **Each** regular PG degree shall be for **2200** marks
7. **Reporting Semesters** for certification:
  - Min 40% or better marks in total 23 courses (subjects) of total 88 credit points at Semesters 01-04.

## SUCCESSFUL COMPLETION OF COURSE OR PROGRAMME

1. "Successful Completion of the Course" means - either course is exempted or student gets minimum specified or better grade, either in end examination of that course or by credit transfer. A student obtaining grade "F" shall be considered failed and will be required to reappear in the examination. The student obtained minimum "P" (Pass) letter grade required for successful completion of each course.
2. "Successful Completion of the Programme" means – all courses at all semesters are successfully completed and the student obtained "P" (Pass) letter grade for all courses at all semesters along with minimum specified SGPA and CGPA.

## SEMESTER 01

### BOT501: DIVERSITY OF NON-VASCULAR PLANTS-I

#### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} & V144: M.Sc. (Botany) [2022 Pattern]

#### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSC	BOT501	Diversity of Non –Vascular Plants -I	4	12	120	30	70	100	T

#### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"><li>B.Sc with Botany or equivalent from a recognized University/Board.</li></ul>	Objectives of this course are to <ul style="list-style-type: none"><li>Understand the micro-organisms</li><li>Analyze differences in lower plants.</li><li>Identify the three main divisions of nonvascular plants: liverworts, hornworts, and mosses.</li><li>Describe the key characteristics of nonvascular plants, including their lack of vascular tissue, their reliance on water for reproduction, and their simple body plans.</li><li>Explain the ecological importance of nonvascular plants, such as their role in soil formation and water retention.</li></ul>

#### UNITS

UN	Name of the Unit	CSs	Questions
01-01	<b>Introduction and classification</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"><li>Very Short Answer Question (VSAQ), of 03 marks</li><li>Short Answer Question (SAQ), of 05 marks</li><li>Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)</li></ul>
01-02	<b>Study of viruses</b>		
01-03	<b>Techniques for study of viruses</b>		
01-04	<b>A brief account of Viroids, Prions and Interferons</b>		
02-01	<b>Study of bacteria.</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
02-02	<b>Structure of bacteria</b>		
02-03	<b>Bacterial genomics</b>		
02-04	<b>Uses of bacteria</b>		
03-01	<b>Study of fungi</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
03-02	<b>Sexuality in fungi</b>		
03-03	<b>Study of examples of fungi</b>		
03-04	<b>Study of examples of fungi</b>		
04-01	<b>Fungal association and its application</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	
04-02	<b>Fungal diseases</b>		
04-03	<b>Plant pathology</b>		
04-04	<b>Plant disease management</b>		

## DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Introduction and classification:</b> General characters of the five kingdoms of living organisms with emphasis on Kingdom Plantae (Whittaker); merits and demerits.	<b>CR 01</b>
1-2	<b>Study of viruses:</b> General account, Classification, structure, types of viruses	
1-3	<b>Techniques for study of viruses:</b> Cell cultivation (plant and animal cell types), purification (centrifugation), effect of physical and chemical agents on viruses	
1-4	<b>A brief account of Viroids, Prions and Interferons:</b> Definition, structure, diseases caused, transmission etc.	
2-1	<b>Study of bacteria:</b> General characteristics of Archaeobacteria (Mycoplasmas, Rickettsiae, Chlamydia, Spirochaetes, Actinomycetes) and Eubacteria.	<b>CR 02</b>
2-2	<b>Structure of bacteria:</b> Ultra - structure of bacterial cell - cell wall (biosynthesis of peptidoglycan), cell membrane, capsule, external appendages, cytoplasmic inclusions, extranuclear genetic elements, endospore and cysts;	
2-3	<b>Bacterial genomics:</b> Bacterial nutrition; Genetic recombination; Drug resistance;	
2-4	<b>Uses of bacteria:</b> Economic importance of bacteria, various fields of bacterial use	
3-1	<b>Study of fungi:</b> Classification of Fungi (Alexopoulos and Mims; Ainsworth); Structure including reproduction, phylogeny and interrelationships of various groups;	<b>CR 03</b>
3-2	<b>Sexuality in fungi:</b> Heterothallism in fungi – sexuality in fungi; parasexuality – sex hormones in fungi; economic importance of fungi.	
3-3	<b>Study of examples of fungi:</b> General characters, structure and life cycle of Myxomycotina (Plasmodiophora), Mastigomycotina (Saprolegnia), Zygomycotina (Rhizopus)	
3-4	<b>Study of examples of fungi:</b> General characters, structure and life cycle of Ascomycotina ( <i>Peziza</i> , <i>Erysiphe</i> ), Basidiomycotina ( <i>Puccinia</i> , <i>Polyporus</i> , <i>Ustilago</i> ) and Deuteromycotina ( <i>Alternaria</i> , <i>Fusarium</i> )	
4-1	<b>Fungal association and its application:</b> Lichens - classification, structure, reproduction and economic importance; Mycorrhiza- structure and applications; Cultivation of mushrooms – <i>Pleurotus</i> .	<b>CR 04</b>
4-2	<b>Fungal diseases:</b> General account; Symptoms, etiology, epidemiology and control Major of Late blight of Potato, Ergot of Bajra, Smut of Sorghum, Rice blast and White rust of Crucifer.	
4-3	<b>Plant pathology:</b> Host-pathogen interaction, defense mechanism in host, plant disease epidemiology	
4-4	<b>Plant disease management</b> - physical, chemical and biological control; Plant quarantine.	

## LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT501	Diversity of Non –Vascular Plants –I – Dr. Ashok M. Bhosale	2022	978-93-95855-49-5 YCMOU, Nashik

<b>Reference-Books:</b>			
BOT501:RB1	General Microbiology Volume – I – Hans G.	1993	Cambridge University, Press Cambridge.
	The Mycoplasmas – III Plant and insect Mycoplasmas – F. Whitcomb and J.G Turil	1978	
BOT501:RB2	Introduction to plant Viruses – C.L. Mandar	1978	
BOT501:RB3	Plant Viruses – Mathews	1981	
BOT501:RB4	Plant Viruses – K.M. Smith	1977	
BOT501:RB5	Microbiology and Plant Pathology – P.D. Sharma,		Rastogi publications, Shivaji Road, Meerut.
BOT501:RB6	Botany for Degree Students - B.R Vashista, Sinha,		S. Chand and Company Ltd, Ram Nagar, New Delhi.
BOT501:RB7	College Botany Vol – I - B.P. Pandey,		S. Chand and Company Ltd, Ram Nagar, New Delhi.
BOT501:RB8	Algal Biotechnology - L.V. Venkataraman		
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT501:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT501:WL1			

<b>COURSE OUTCOMES</b>
<p>After successful completion of this course, student should be able to</p> <ul style="list-style-type: none"> <li>• Identify and describe the different types of nonvascular plants.</li> <li>• Explain the key features of nonvascular plants and their life cycles.</li> <li>• Discuss the ecological importance of nonvascular plants.</li> <li>• Apply their knowledge of nonvascular plants to real-world problems, such as conservation and restoration.</li> </ul>



## BOT502: DIVERSITY OF NON-VASCULAR PLANTS- II

### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} & V144: M.Sc. (Botany) [2022 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSC	BOT502	Diversity of Non-Vascular Plants -II	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>B.Sc with Botany or equivalent from a recognized University/Board.</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Distinguish non-vascular plants</li> <li>Identify the different types of nonvascular plants, including algae, liverworts, hornworts, and mosses.</li> <li>Describe the key characteristics of nonvascular plants, including their lack of vascular tissue, their reliance on water for reproduction, and their simple body plans.</li> <li>Explain the ecological importance of nonvascular plants, such as their role in soil formation and water retention.</li> <li>Discuss the potential of nonvascular plants as biofertilizers and bioagents.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	<b>Study of cyanobacteria</b> <b>Phycology</b> <b>Examples of algae</b> <b>Economic importance of algae</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	<p>As per evaluation pattern, on <b>Each Credit</b>, Student is required to answer</p> <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks</li> </ul> <p>(LAQ may contain sub-questions (a), (b) and so on.)</p>
02-01 02-02 02-03 02-04	<b>Bryophytes.</b> <b>Examples of bryophytes</b> <b>Economic and ecological importance of bryophytes</b> <b>Phylogeny of bryophytes</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
03-01 03-02 03-03 03-04	<b>Bio fertilizers</b> <b>Applications of biofertilizers</b> <b>Biopesticides</b> <b>Applications of biopesticides</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
04-01 04-02 04-03 04-04	<b>Bioagents.</b> <b>Strategies of marking and Registration with CIB of bioagents</b> <b>Quality parameters</b> <b>Important bioagents</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	



## DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Study of cyanobacteria:</b> Distribution, cell structure, heterocyst and akinetes and their significance, chromatic adaptations and reproduction. <i>Spirulina</i> , <i>Microcystis</i> and <i>Oscillatoria</i> .	<b>CR 01</b>
1-2	<b>Phycology:</b> Classification and general account of algae (according to Fritsch); Distribution and diversity in vegetative structure (Thallus organization). Algal cell structure - Pigmentation, plastids, flagellation, storage products and cell wall composition of various divisions of algae	
1-3	<b>Examples of algae:</b> Distribution, thallus organization, cell structure, reproduction and life cycle pattern with reference to Chlorophyceae ( <i>Hydrodictyon</i> ), Charophyceae ( <i>Chara</i> ), Bacillariophyceae ( <i>Diatoms</i> ), Xanthophyceae ( <i>Vaucheria</i> ), Phaeophyceae ( <i>Dictyota</i> , <i>Sargassum</i> ) and Rhodophyceae ( <i>Gracilaria</i> ).	
1-4	<b>Economic importance of algae:</b> Algae as environmental indicators, algae in agriculture, algae as sources of food, animal feed and pharmaceuticals; algal blooms, fossil algae.	
2-1	<b>Bryophytes:</b> History and classification (Proskauer, 1957); Diversity in structure of gametophytes and sporophytes, reproduction – asexual & sexual and life cycle.	<b>CR 02</b>
2-2	<b>Examples of bryophytes:</b> Structure, reproduction, sporophytes, spore dispersal mechanism and life history of Hepaticopsida – Marchantiales ( <i>Riccia</i> ), Sphaerocarpaceae, Jungermanniales ( <i>Porella</i> ), Calobryales; Anthocerotopsida – Anthocerotales ( <i>Anthoceros</i> ); Bryopsida – Sphagnales ( <i>Sphagnum</i> ), Funariales ( <i>Funaria</i> ), Polytrichales ( <i>Polytrichum</i> ).	
2-3	<b>Economic and ecological importance of bryophytes:</b> Economic importance of bryophytes – direct and indirect uses (ethnomedicinal uses, phytoindicators and other uses); recent experimental work on bryophytes (ultrastructure, chemical constituents and regeneration studies).	
2-4	<b>Phylogeny of bryophytes:</b> Origin, evolution and interrelationship of bryophytes, evolution of sporophytes of bryophytes, fossil bryophytes.	
3-1	<b>Bio fertilizers:</b> Definition, types and manufacturing process	<b>CR 03</b>
3-2	<b>Applications of biofertilizers:</b> Various examples of biofertilizers used in agricultural sector	
3-3	<b>Biopesticides:</b> Definition, types and manufacturing process	
3-4	<b>Applications of biopesticides:</b> Various examples of biopesticides used in agricultural sector	
4-1	<b>Bioagents:</b> Definition, history and applications	<b>CR 04</b>
4-2	<b>Strategies of marking and Registration with CIB of bioagents:</b> Flowsheet for Registration with CIB of bioagents, list of various agencies/institutes responsible for strategies of marking of bioagents	
4-3	<b>Quality parameters:</b> Quality parameters as per CIB specifications for bioagents	
4-4	<b>Important bioagents:</b> Importance of <i>Trichogramma</i> , <i>Cryptolaemus</i> , <i>Chrysoperla</i> , NPV and entomofungal pathogens. Establishing insectary for host insects and natural enemies	

## LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT502	Diversity of Non –Vascular Plants –II – Prof. Ramesh Kashetti, Dr. Ganesh Nikalje	2022	978-93-95855-65-5 YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning			

resource!			
BOT502:RB1	General Microbiology Volume – I – Hans G.	1993	Cambridge University, Press Cambridge.
BOT502:RB2	The Mycoplasmas – III Plant and insect Mycoplasmas – F. Whitcomb and J.G Turil	1978	
BOT502:RB3	Introduction to plant Viruses – C.L. Mandar	1978	
BOT502:RB4	Plant Viruses – Mathews	1981	
BOT502:RB5	Plant Viruses – K.M. Smith	1977	
BOT502:RB6	Microbiology and Plant Pathology – P.D. Sharma,		Rastogi publications, Shivaji Road, Meerut.
BOT502:RB7	Botany for Degree Students - B.R Vashista, Sinha,		S. Chand and Company Ltd, Ram Nagar, New Delhi.
BOT502:RB8	College Botany Vol – I - B.P. Pandey,		S. Chand and Company Ltd, Ram Nagar, New Delhi.
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT502:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT502:WL1			

## COURSE OUTCOMES

After successful completion of this course, student should be able to

- Identify and describe the different types of nonvascular plants.
- Explain the key features of nonvascular plants and their life cycles.
- Discuss the ecological importance of nonvascular plants.
- Apply their knowledge of nonvascular plants to real-world problems, such as conservation and restoration.
- Evaluate the potential of nonvascular plants as biofertilizers and bioagents.

# BOT503: DIVERSITY OF VASCULAR PLANTS AND PALEOBOTANY-I

## PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} & V144: M.Sc. (Botany) [2022 Pattern]

## COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSC	BOT503	Diversity of Vascular Plants and Paleobotany-I	2	6	60	15	35	50	T

## PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Understand vascular plants</li> <li>Differentiate between the vascular plants at higher level</li> <li>Explain paleobotany</li> <li>Understand the basic morphology, anatomy, and physiology of vascular plants.</li> <li>Be able to identify the major groups of vascular plants, both living and extinct.</li> <li>Understand the evolutionary history of vascular plants.</li> <li>Be able to apply paleobotanical data to understand the history of the Earth's climate and environment.</li> <li>Appreciate the diversity of vascular plants and their importance in the world today.</li> </ul>

## UNITS

UN	Name of the Unit	CSs	Questions
01-01	<b>Pteridophytes I</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)</li> </ul>
01-02	<b>Evolution in Pteridophytes</b>		
01-03	<b>Pteridophytes II</b>		
01-04	<b>Fossil pteridophytes</b>		
02-01	<b>Gymnosperms I</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
02-02	<b>Gymnosperms II</b>		
02-03	<b>Fossil gymnosperms</b>		
02-04	<b>Reproduction in gymnosperms</b>		

## DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Pteridophytes I</b> - General characteristics and classification of Pteridophytes (Reimer, 1954); Origin of Pteridophytes and Relationship of Pteridophytes with Bryophytes and Gymnosperms	<b>CR 01</b>
1-2	<b>Evolution in Pteridophytes:</b> Stellar evolution in pteridophytes; Heterospory and seed	

	habit.	
1-3	<b>Pteridophytes II:</b> Diversity in morphology, reproduction and life history of the following: Psilotopsida – Psilotales; Lycopsida – Lycopodiales, Isoetales, Selaginellales; Sphenopsida – Equisetales; Pteropsida – Eusporangiate - Ophioglossales, Marattiales, Osmudidae – Osmundales; Leptosporangiate - Filicales (Schizaeaceae, Polypodiaceae, Adiantaceae, Gleicheniaceae, Cyatheaceae, Hymenophyllaceae, Aspleniaceae and Dryopteridaceae), Marsileales and Salviniaceae.	
1-4	<b>Fossil pteridophytes:</b> Systematic position, structure of the sporophyte and gametophyte of Psilophytales – Rhynia; Lepidodendrales – Lepidodendron, Lepidostrobus, Lepidocarpon; Calamitales – Calamites	
2-1	<b>Gymnosperms I</b> – General Structure, reproduction, evolution, relationship with Pteridophytes and Angiosperms and classification of gymnosperms (K. R. Sporne, 1954); Phylogeny of Gymnosperms, Origin and evolution of ovule; Economic importance of gymnosperms	<b>CR 02</b>
2-2	<b>Gymnosperms II</b> - Diversity in the structure, anatomy, reproduction, of the orders Cycadales, Coniferales, Ginkgoales, Taxales and Gnetales.	
2-3	<b>Fossil gymnosperms:</b> Systematic position and structure of the sporophyte Pteridospermales – <i>Medullosa</i> , Bennettitales – <i>Willamsioinii</i> , Pentoxylales– <i>Pentoxylon</i> , Cordaitales – <i>Cordaites</i>	
2-4	<b>Reproduction in gymnosperms:</b> Pteridospermales – <i>Medullosa</i> , Bennettitales – <i>Willamsioinii</i> , Pentoxylales– <i>Pentoxylon</i> , Cordaitales – <i>Cordaites</i> .	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT503-T01	Diversity of Vascular Plants and Paleobotany-I – Dr. Satish Deore, Dr. Amanulla Khan N. Pathan	2022	978-93-95855-04-4 YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT503:RB1	Pteridophyta, Gymnosperm and Paleobotany – Singh, Panday and Jain,		Rastogi publication, Meerut.
BOT503:RB2	College Botany, Vol II - S. Sundarajan,		Himalaya publishing House, New Delhi.
BOT503:RB3	College Botany (For degree students) – A. C. Datta		Manzar Khan Oxford University, Press Kolkatta.
BOT503:RB4	College Botany Vol- I – Gangulee Das and Dutta		New central Book Agency, Kolkatta.
BOT503:RB5	Text Book of Botany Vol II. – Pandey and Ajanta Chaddha		Vikas Publication Pvt. Ltd, New Delhi.
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT503:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT503:WL1			

## **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- The student will be able to identify the major groups of vascular plants, both living and extinct, with 80% accuracy.
- The student will be able to explain the evolutionary relationships between the major groups of vascular plants.
- The student will be able to use paleobotanical data to reconstruct the history of the Earth's climate and environment.
- The student will be able to write a research paper on a topic related to the diversity of vascular plants.

## BOT504: LAB ACTIVITIES ON BOT501, BOT502, BOT503

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} & V144: M.Sc. (Botany) [2022 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSC	BOT504	Lab Activities on BOT501, BOT502 & BOT503	4	12	120	50	50	100	P

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Prepare slides</li> <li>Prepare herbarium</li> <li>Observe specimen</li> <li>Understand the basic morphology, anatomy, and physiology of non-vascular plants.</li> <li>Be able to identify the major groups of non-vascular plants, both living and extinct.</li> <li>Understand the evolutionary history of non-vascular plants.</li> <li>Be able to apply non-vascular plant data to understand the history of the Earth's climate and environment.</li> <li>Appreciate the diversity of non-vascular plants and their importance in the world today.</li> </ul>

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
	<b>Diversity of Non-Vascular plants</b>	
1-1	To prepare herbarium of-Viruses and Cyanobacteria - TMV – Tobacco and Papaya (Herbarium).	<b>CR 01</b>
1-2	To study microbes (Bacteria and fungi) in Soil, water and air – solid- serial dilution	
1-3	To study Fungi – Plasmodiophora, Saprolegnia, Rhizopus;	
1-4	To study Lichens – types and reproductive body; Cultivation of mushrooms – <i>Pleurotus</i>	
1-5	To study Pathology – late blight of Potato, Ergot of Bhajra, Smut of Sorghum, Rice blast and white rust of Crucifer.	
1-6	To study Peziza – External, L.S. of Apothecia (Slide); <i>Erysiphae</i>	
2-1	To study Cyanobacteria – <i>Spirulina</i> , <i>Microcystis</i> and <i>Oscillatoria</i> .	<b>CR 02</b>
2-2	To study Algae – <i>Volvox</i> , <i>Hydrodictyon</i> , <i>Chara</i> .	
2-3	To study Diatoms, <i>Vaucheria</i> ,	
2-4	To study <i>Dictyota</i> , <i>Sargassum</i> .	
2-5	To study <i>Gracilaria</i> (Mounting/sectioning of algal material)	

2-6	To study Bryophytes – <i>Porella, Riccia</i>	
<b>Diversity of Vascular Plants</b>		
3-1	Study of Pteridophytes – Diversity of forms upto order level - Psilotum, Lycopodium, – Thallus, T.S. rhizome, cones - L.S. and T.S.	<b>CR 03</b>
3-2	Study of Equisetum, Ophioglossum	
3-3	Study of Osmunda, Salvinia	
3-4	Study of Marsilea (Thallus T.S., Cones – T.S. and L.S) and other forms	
3-5	Study of Gymnosperms – Diversity of forms upto order level – Cycas.	
3-6	Study of Cupressus.	
<b>Diversity of Algae</b>		
4-1	Collection, isolation and culture of algae (fresh water and industrial waste) and Study of algae	<b>CR 04</b>
4-2	Majorment of growth (algal biomass)	
4-3	Estimation of chlorophyll in different algae	
4-4	Estimation of Carotenoid and phycobilin protein in different algae	
4-5	Estimation of total soluble proteins and total lipids	
4-6	Analysis of water quality – phosphate estimation.	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT504-P01	Lab Activities on BOT 501, BOT502 – Dr. D. M. Survase	2022	Publication 2505 YCMOU, Nashik
BOT504-P02	Lab Activities on BOT503 – Dr. Satish Deore, Dr. Amanulla Khan N. Pathan	2022	Publication 2505 YCMOU, Nashik
BOT501-T01	Diversity of Non –Vascular Plants –I – Dr. Ashok M. Bhosale	2022	978-93-95855-49-5 YCMOU, Nashik
BOT502-T02	Diversity of Non –Vascular Plants –II – Prof. Ramesh Kashetti, Dr. Ganesh Nikalje	2022	978-93-95855-65-5 YCMOU, Nashik
BOT503-T03	Diversity of Vascular Plants and Paleobotany-I – Dr. Satish Deore, Dr. Amanulla Khan N. Pathan	2022	978-93-95855-04-4 YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT504:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT504:WL1			

### COURSE OUTCOMES

After successful completion of this course, student should be able to

- Identify the major groups of non-vascular plants, both living and extinct, with 80% accuracy.
- Explain the evolutionary relationships between the major groups of non-vascular plants.
- Use non-vascular plant data to reconstruct the history of the Earth's climate and environment.
- write a research paper on a topic related to the diversity of non-vascular plants



## RES505: RESEARCH METHODOLOGY

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V151: M.Sc.(Mathematics) {2023 Pattern}, V152: M.Sc.(Environmental Science) {2023 Pattern}, V153: M.Sc.(Physics) {2023 Pattern}, V154: M.Sc.(Chemistry) {2023 Pattern}, V155: M.Sc.(Zoolgy) {2023 Pattern}, V156: M.Sc.(Botany) {2023 Pattern}, V141: M.Sc.(Physics) {2022 Pattern}, V142: M.Sc.(Chemistry) {2022 Pattern}, V143: M.Sc.(Zoolgy) {2022 Pattern}, V144: M.Sc.(Botany) {2022 Pattern}

### COURSE INFORMATION

Sem	Other	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	RM	RES505	Research Methodology	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	Objectives of this course are to <ul style="list-style-type: none"> <li>Gain experience with ethics proposals</li> <li>Gain experience with instruments development and data collection methods.</li> <li>Understand the different types of research methods used in botany.</li> <li>Be able to design and conduct a research study in botany.</li> <li>Be able to analyze and interpret data from a research study in botany.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01	<b>Research</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question</li> </ul>
01-02	<b>Methods in biological research</b>		
01-03	<b>Experimental design</b>		
01-04	<b>Sampling methods</b>		
02-01	<b>Data collection</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
02-02	<b>Representation of data</b>		
02-03	<b>Graphical representation</b>		
02-04	<b>Analysis of data</b>		



03-01	<b>Use of inferential statistical tools in research</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	(LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)
03-02	<b>Biostatistical Test</b>		
03-03	<b>Use of ANOVA</b>		
03-04	<b>Application of correlation of data</b>		
04-01	<b>Literature collection</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	
04-02	<b>Intellectual Property Rights</b>		
04-03	<b>Research Databases</b>		
04-04	<b>Research Metrics</b>		

**Important Note:** This course is common across all Postgraduate Programmes in the ‘School of Sciences’, the content within the Research Methodology course should incorporate illustrations and examples relevant to their respective domains or disciplines.

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Research:</b> basic and applied research, essential steps in research, Research – definition, importance and application.	<b>CR 01</b>
1-2	<b>Methods in research:</b> General methods in research – natural observation, field study, and experimentations.	
1-3	<b>Experimental design</b> – basic principles, hypothesis, one & two group experimental design. Matched pair data analysis, factorial design, randomized block design.	
1-4	<b>Sampling method</b> - Concept of population, random sampling and non random sampling, variables – random, independent and intervening variables.	
2-1	<b>Data collections:</b> methods for primary data- observation, interview, questionnaire methods, and experiments, Methods for secondary data – scientific journals, books, reports, databases.	<b>CR 02</b>
2-2	<b>Representation of data:</b> Tabular representations of quantitative data, frequency table – one way and two way.	
2-3	<b>Graphical representation:</b> Graphical representation of quantitative data – line graph, histogram, frequency polygon, frequency curve, Ogive, bar diagrams and pie diagrams.	
2-4	<b>Analysis of data</b> – Tools of statistics and software applications.	
3-1	<b>Use of inferential statistical tools in research:</b> Use of different statistical estimations depending on the type of data, hypothesis testing, and test of significance.	<b>CR 03</b>
3-2	<b>Biostatistical Test:</b> Student’s ‘t’ test – applications and importance in research data And Application of Chi-square test for the experimental data	
3-3	<b>Use of ANOVA :</b> (one-way and two-way ANOVA) for the research data analysis.	
3-4	<b>Application of correlation of data:</b> Application of correlation and regression analysis for the data.	
4-1	<b>Literature collection:</b> Need, review process, consulting source material, literature citation; Components of research report – Text, tables, figures, bibliography, Writing of dissertations, project proposals, project reports, research papers.	<b>CR 04</b>
4-2	<b>Intellectual Property Rights:</b> Basics of patent, Types of Patents (patents, copyrights, trademarks, Geographical Indications, Industrial Designs, and traditional knowledge, Patent application process (Searching a patent, Drafting a patent, Filing of patent, Types of patent applications), Patent documents (Specifications and Claims).	
4-3	<b>Research Databases:</b> Types of Databases- Indexing Databases and benefits of Indexing, Citation Index Database; Major Citation Indexing Services - Web of Science /Web of Knowledge (WoS/WoK), Scopus/Science Direct, Google Scholar, CiteSeerX,	

	World Wide Science (WWS), IEEE Xplore, PubMed Central (PMC) Database, Directory of Open Access Journals (DOAJ), Indian Citation Index (ICI) Database, E-Theses Online Service (EThOS), Preprint site arXiv [Refer <a href="#">Chapter 13</a> of <a href="#">Academic Integrity and Research Quality</a> ]	
4-4	<b>Research Metrics:</b> Journal Metrics- Impact Factor (IF) or Journal Impact Factor(JIF), List of Impact Factor of Various Journals, Problems of the Impact Factor and the Editorial Ethics, Cite Score, Difference between Cite Score and Impact Factor, Impact Per Publication (IPP); Newly Emerged Indicators - Source Normalised Impact Per Paper (SNIP), Scimago Journal Rank (SJR), Eigenfactor, Article Influence, SCImago Journal; Author level Metrics- H-Index with its Advantages and limitations, G-Index, i10/20 Index; Altmetrics with its Advantages and limitations; Unique ID for Research Contributors/Author . [Refer <a href="#">Chapter 13 and 14</a> of <a href="#">Academic Integrity and Research Quality</a> ]	
Self-Study	<b>Laboratory safety:</b> Biohazardous agents, biosafety levels, lab acquired infections, other hazards; Laboratory good practices. Animal model systems: animal ethics- animal welfare guidelines for care and use of animals.	No Marks

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>CourseWebsiteLinkfor(1)MobileandOnlineLectures,(2)DiscussionForumforonlineinteractionand(3)Self-TestforeachCRBlock,ContinuousAssessmentTestandEndExamination</b>			
<b>Text-Books</b>			
RES505-T01	Research Methodology – Dr. Anant J. Dhembare (Unit 01 to 14 only), Available <a href="#">here</a>	2022	978-9395855624 YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
RES505:RB1	Research Methods in Environmental Studies: A Social Science Approach, – Ismael Vaccaro, Eric Alden Smith, and Shankar Aswani	1st Edition, 2010	978-0813344113 Routledge
RES505:RB2	Environmental Social Science: Human-Environment Interactions and Sustainability, – Emilio F. Moran, Edward A. Rosa, and Anantha K. Duraipappah	1st Edition, 2010	978-1402090346 Springer
RES505:RB3	Handbook of Research Methods and Applications in Environmental Studies, – Matthias Ruth and Brynhildur Davidsdottir	1st Edition, 2018	978-1785364327 Edward Elgar Publishing
RES505:RB4	Research Methods for Environmental Studies: A Social Science Approach, – Mark L. Nichter and Mimi Nichter	1st Edition, 1991	978-0306438297 Springer
RES505- RB5	<a href="#">Academic Integrity and Research Quality</a> (Chapter 13 and 14)	Dec 2021	e-Books , <a href="#">UGC web site</a>
<b>CD/DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
RES505:CD1			
<b>WebLinks:</b> Explore additional details and reinforce learning, with this optional learning resource!			

RES505-WL1	<a href="#">Academic Integrity and Research Quality</a>	Dec 2021	UGC
RES505-WL2	<a href="#">Guidance Document: Good Academic Research Practices</a>	Sept 2020	UGC
<b>OER:</b> Explore additional details and reinforce learning, with this optional learning resource!			
RES505-OER1			

### **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Design a research study to investigate the effects of climate change on the distribution of a particular species of plant.
- Collect data on the abundance of different species of plants in a particular ecosystem.
- Analyze data to determine the factors that limit the growth of a particular species of plant.
- Write a research paper that summarizes the results of their research study and discusses the implications of their findings.
- Give a presentation to a lay audience about their research study and its findings.

## BOT506: APPLIED PHYCOLOGY (ELECTIVE)

### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} & V144: M.Sc. (Botany) [2022 Pattern]

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSE	BOT506	Applied Phycology	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	Objectives of this course are to <ul style="list-style-type: none"> <li>Explain meristems, wood diversity, vascular tissues</li> <li>Enlist applications of fertilization, apomixes, embryogenesis</li> <li>A comprehensive understanding of phycology (the study of algae) and its practical applications in various fields of botany.</li> <li>The knowledge and skills required to apply phycological principles in real-world scenarios, including environmental management, agriculture, biotechnology, and industry.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	<b>Algal distribution</b> <b>Algae as bio-fertilizer and green manure</b> <b>Application of algae</b> <b>Algae as nutrient supplement and in pharmacy</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks</li> </ul> (LAQ may contain sub-questions (a), (b) and so on.)
02-01 02-02 02-03 02-04	<b>Value added products from microalgae and processes</b> <b>Algae and heavy metals toxicity</b> <b>Algae and its role in assessment of water quality</b> <b>Tests for algae</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
03-01 03-02 03-03 03-04	<b>Growth control of algae</b> <b>Cultivation of algae</b> <b>Cultivation of agarophytes</b> <b>Algal biotechnology and tissue culture of seaweeds</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
04-01 04-02 04-03 04-04	<b>Toxins and biochemicals from algae</b> <b>Problems and prospects</b> <b>Biochemicals from algae</b> <b>Regulators from algae</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	

## DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Algal distribution:</b> Distribution and ecology of fresh water, marine, terrestrial algae and unusual habitats.	<b>CR 01</b>
1-2	<b>Algae as bio-fertilizer and green manure:</b> Symbiotic and non-symbiotic algae in soil fertility and crop production, role of <i>Anabaena</i> and <i>Nostoc</i> in nitrogen fixation (aerobic and anaerobic); Algae in agriculture (Reclamation of usar soil and algalization).	
1-3	<b>Application of algae:</b> Algae in agriculture (Reclamation of usar soil and algalization)	
1-4	<b>Algae as nutrient supplement and in pharmacy:</b> Nutrient supplements of <i>Spirulina</i> , <i>Chlorella</i> , <i>Scenedesmus</i> and <i>Porphyridium</i> ; Importance of <i>Botryococcusbraunii</i> and <i>Dunaliella</i> ;	
2-1	<b>Value added products from microalgae and processes:</b> Algae in pharmacy – iodine, carrageenan, agar, amino acids, vitamins, enzymes, antibiotics, vermifuge and sterols.	<b>CR 02</b>
2-2	<b>Algae and heavy metals toxicity:</b> Metabolism of heavy metals by algae, mechanism of metal toxicity, metal tolerance and biomass production; immobilization of algae	
2-3	<b>Algae and its role in assessment of water quality:</b> Algae as indicators of water quality in fresh and marine environment (including algal blooms); Effect of algae in water supplies - taste, odour, filter and screen clogging, slime formation, coloration, corrosion, coagulation, toxicity and parasitic algae;	
2-4	<b>Tests for algae:</b> Algal bioassay test - bottle test (Brief explanation of principles, planning, media, inoculums, procedure data analysis and interpretation of results) and PAM flurometry;	
3-1	<b>Growth control of algae:</b> Methods to control algae in water supplies, recreational waters and aquarium.	<b>CR 03</b>
3-2	<b>Cultivation of algae:</b> Mass cultivation of algae with examples <i>Spirulina</i> , <i>Chlorella</i> , <i>Dunaliella</i> ; Fermentation and its products from algae (methane and ethanol),	
3-3	<b>Cultivation of agarophytes-</b> methodology, requirements, harvest and processing of <i>Porphyra</i> , <i>Euclima</i> , <i>Gelidium</i> , <i>Gracilaria</i> and <i>Laminaria</i> .	
3-4	<b>Algal biotechnology and tissue culture of seaweeds:</b> General information about challenges in algal biotechnology; callus induction, protoplast culture and somatic hybridization; commercial application of seaweed biotechnology.	
4-1	<b>Toxins and biochemicals from algae:</b> Algal toxins – neurotoxins, hepatotoxins, effect of toxins, mode of action.	<b>CR 04</b>
4-2	<b>Problems and prospects:</b> Detailed description of various problems and prospects related to toxins and biochemical from algae.	
4-3	<b>Biochemicals from algae</b> – Pigments, essential fatty acids, polysaccharides, wax, hydrocarbons,	
4-4	<b>Regulators from algae</b> – Plant growth regulators, osmoregulators	

## LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT506-T01	Applied Phycology – Dr. Ashwini A. Aher	2022	978-93-95855-35-8 YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT506:RB1	General Microbiology Volume – I – Hans G.	1993	Cambridge University, Press Cambridge.
BOT506:RB2	The Mycoplasmas – III Plant and insect Mycoplasmas	1978	

	- F. Whitcomb and J.G Turil		
BOT506:RB3	Introduction to plant Viruses - C.L. Mandar	1978	
BOT506:RB4	A textbook of Botany ( Algae, Fungi, Virus, Microbiology, Plant pathology, Bryophytes, Pteridophytes and Gymnosperms) - V. Singh, Pandey and Jain		Rastogi Publications, Shivaji Road, Meerut.
BOT506:RB5	Botany for Degree Students - B.R Vashista, Sinha,		S. Chand and Company Ltd, Ramnagar, New Delhi.
BOT506:RB6	Algal Biotechnology - L.V. Venkataraman		
BOT506:RB6	Microbiology and Plant Pathology - P.D. Sharma,		Rastogi publications, Shivaji Road, Meerut
BOT506:RB7	Plant Viruses - K.M. Smith	1977	
BOT506:RB8	Plant Viruses - Mathews	1981	
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT506:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT506:WL1			

## COURSE OUTCOMES

After successful completion of this course, student should be able to

- Identify and classify different groups of algae, including their morphological and anatomical characteristics.
- Understand the ecological roles and contributions of algae in various ecosystems and their importance in the food chain.
- Analyze the physiological processes of algae, including photosynthesis and reproduction, and relate them to broader botanical principles.
- Evaluate the impact of algae on the environment, including harmful algal blooms and their management strategies.
- Apply phycological knowledge in the field of agriculture, including algae-based fertilizers, biofertilizers, and soil health improvement.

## BOT507: TOOLS AND TECHNIQUES IN PLANT SCIENCE (ELECTIVE)

### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} & V144: M.Sc. (Botany) [2022 Pattern]

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
01	DSE	BOT507	Tools and Techniques in Plant Science	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	Objectives of this course are to <ul style="list-style-type: none"> <li>Apply knowledge of different instruments to study plants</li> <li>Understand principles of different techniques.</li> <li>Understand the basic tools and techniques used in plant science.</li> <li>Apply these tools and techniques to the study of plants.</li> <li>Communicate effectively about tools and techniques in plant science.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	<b>Microscopy I</b> <b>Microscopy II</b> <b>Confocal Raman microscopy</b> <b>Microscopic Techniques</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks</li> </ul> (LAQ may contain sub-questions (a), (b) and so on.)
02-01 02-02 02-03 02-04	<b>Microtechnique</b> <b>Preparation of media for microorganism's growth (both bacteria and fungi)</b> <b>Anti-microbial activity</b> <b>Separation Technique I</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
03-01 03-02 03-03 03-04	<b>Chromatography</b> <b>Separation Technique II</b> <b>gel electrophoresis</b> <b>Spectroscopic Techniques</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
04-01 04-02 04-03 04-04	<b>Analysis of polymer structures</b> <b>Radiochemical Techniques</b> <b>Molecular Tools</b> <b>Statistical tools in marker analysis</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Microscopy I:</b> Introduction, principles and properties of light and laser light;	<b>CR</b>



	polarization of light, resolution power - numerical aperture; polarized and lambda filters.	<b>01</b>
1-2	<b>Microscopy II:</b> Principles and working of: Phase contrast microscopy; Fluorescent microscopy;.	
1-3	<b>Confocal Raman microscopy:</b> Introduction, Use and Application	
1-4	<b>Microscopic Techniques:</b> Atomic Force Microscopy and Electron microscopy (TEM & SEM)	
2-1	<b>Microtechnique:</b> Introduction; Principles and preparation of material for light and electron microscopy- a brief account of fixation and fixatives; stains and staining, double staining, shadow casting; sectioning methods – Microtome – types of microtome; freeze drying, freeze etching, cryosectioning.	
2-2	<b>Preparation of media for microorganism's growth (both bacteria and fungi):</b> isolation techniques – spread plate method, pour plate method and streak plate method	<b>CR 02</b>
2-3	<b>Anti-microbial activity-</b> disc and well diffusion method, Bioautography, Flow Cytometry	
2-4	<b>Separation Technique I:</b> Centrifugation – Principles, types, and theory of centrifugation;	
3-1	<b>Chromatography</b> – Introduction, principle, types of chromatography – paper chromatography, thin layer chromatography, HPTLC, column chromatography - HPLC, gas chromatography.	
3-2	<b>Separation Technique II:</b> Electrophoresis – Introduction, principle, buffers, detection and assay, recording and storage, safety and applications, factors affecting electrophoresis; types of electrophoresis – moving boundary electrophoresis, paper electrophoresis,	
3-3	<b>Gel electrophoresis:</b> polyacrylamide gel electrophoresis (PAGE), agarose electrophoresis; iso electric focusing electrophoresis, immuno electrophoresis, denaturing gradient gel electrophoresis, temperature gradient gel electrophoresis, capillary electrophoresis.	<b>CR 03</b>
3-4	<b>Spectroscopic Techniques:</b> Introduction, Principle of Spectroscopy - visible and UV; linear and circular dichroism, CD spectra of protein and nucleic acids, ionization, protein mass determination, atomic spectroscopy - Atomic absorption spectroscopy including Plasma emission, flame photometer, IR, Raman spectroscopy, Fourier Transform Infrared Spectroscopy.	
4-1	<b>Analysis of polymer structures:</b> NMR, ESR and X-ray crystallography - Methods of glowing crystals, theory of X - ray diffraction, Bragg's law.	
4-2	<b>Radiochemical Techniques:</b> Introduction to Radioactivity, Units of radioactivity, Stable and radioactive isotopes, half-life of radioisotopes, Specific activity, Isotopic dilution techniques, theory and construction of GM Counter, Liquid and Scintillation counter, autoradiography and applications of tracer techniques.	<b>CR 04</b>
4-3	<b>Molecular Tools:</b> Gene isolation and characterization through PCR, Microarrays, DNA based molecular markers - RAPD, AFLP, RFLP, STS; use of molecular markers in plant genetics; Molecular mapping and tagging of agronomically important traits.	
4-4	<b>Statistical tools in marker analysis:</b> Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants, Gene pyramiding	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT507-TO1	Tools and Techniques in Plant Science		
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT507:RB1	Bioinformatics: Principles and Applications – Ghosh Z. and Bibekanand M.	2008	Oxford University Press
BOT507:RB2	Bioinformatics and Functional Genomics. II Edition	2009	Wiley- Blackwell.



	– Pevsner J.		
BOT507:RB3	Discovering Genomics, Proteomics and Bioinformatics. _II Edition. – Campbell A. M., Heyer L. J.	2006	Benjamin Cummings
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT507:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT507:WL1			

### **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Understand the basic tools and techniques used in plant science, such as microscopes, cell culture techniques, and genetic engineering.
- Apply these tools and techniques to the study of plants, such as the identification of plant cells, the culture of plant cells, and the transformation of plant cells with genes.
- Communicate effectively about tools and techniques in plant science through written reports, presentations, and other media.

## SEMESTER 02

### BOT509: PLANT PHYSIOLOGY

#### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} & V144: M.Sc. (Botany) [2022 Pattern}

#### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	DSC	BOT509	Plant Physiology	4	12	120	30	70	100	T

#### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"><li>B.Sc. with Botany or equivalent from a recognized University/Board.</li></ul>	Objectives of this course are to <ul style="list-style-type: none"><li>Explain function of different biomolecules</li><li>Explain structure of different biomolecules</li><li>Analyze the biochemical basis of plant processes.</li></ul>

#### UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	<b>Carbohydrates</b> <b>Saccharides</b> <b>Structure of maltose, sucrose, starch and pectin.</b> <b>Carbohydrate Polymer Technologies and Application</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"><li>Very Short Answer Question (VSAQ), of 03 marks</li><li>Short Answer Question (SAQ), of 05 marks</li><li>Long Answer Question (LAQ) of 10 Marks</li></ul> (LAQ may contain sub-questions (a), (b) and so on.)
02-01 02-02 02-03 02-04	<b>Proteins and enzymes</b> <b>Enzymes</b> <b>Enzyme regulation</b> <b>Applications of recombinant proteins</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
03-01 03-02 03-03 03-04	<b>Water relations</b> <b>Loss of water</b> <b>Mineral nutrition</b> <b>Phloem transport</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
04-01 04-02 04-03 04-04	<b>Photosynthesis</b> <b>Respiration</b> <b>Plant growth regulators and movements</b> <b>Plant Movements</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	

## DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Carbohydrates:</b> Atomic structure, chemical bonds, ionic bond, covalent bond, coordination bond, hydrogen bond, hydrogen ion concentration (pH), buffers.	<b>CR 01</b>
1-2	<b>Saccharides:</b> Structure, function and properties of mono, oligo and polysaccharides.	
1-3	<b>Structure of maltose, sucrose, starch and pectin</b> - glycoside linkage, deoxy sugars, glycoproteins, aminosugars, isomerism and mutarotation.	
1-4	<b>Carbohydrate Polymer Technologies and Application:</b> Concept, methods and applications	
2-1	<b>Proteins and enzymes:</b> Structure of polypeptides - protein structure - the Ramachandran plot, $\alpha$ helix, $\beta$ sheet conformational map, tertiary and quaternary.	<b>CR 02</b>
2-2	<b>Enzymes</b> – Nomenclature, classification, structure (apoenzyme, cofactors, metallic activators and coenzymes) and properties (enzyme specificity), mode of action,	
2-3	<b>Enzyme regulation:</b> Factors affecting enzyme activity (regulation), enzyme kinetics and enzyme purification (electrophoresis- SDS PAGE).	
2-4	<b>Applications of recombinant proteins:</b> Concept, application in field of agriculture, biotechnology, research etc.	
3-1	<b>Water relations:</b> Diffusion, osmosis, osmotic potential, water potential and chemical potential. Mechanism of absorption of water. Mechanism of ascent of sap: Vital Theories, Root Pressure theory; Physical force theories-capillary theory, imbibitional theory, Atmospheric Pressure theory, transpiration pull theory; Factors affecting ascent of sap.	<b>CR 03</b>
3-2	<b>Loss of water:</b> Transpiration, types, structure of stomata, distribution of stomata, mechanism of stomatal transpiration, theories of stomatal movement (photosynthetic theory, glyoxylate theory, classical theory, Steward's theory and modern theory), significance of transpiration, adaptations to reduce transpiration, factors affecting transpiration, anti-transpirants; guttation.	
3-3	<b>Mineral nutrition:</b> Up-take of minerals- ion traffic into the root, nutrient's role and deficiency symptoms (mention any six major and four minor), active and passive absorption, Donnan's potential, chelating agents, factors affecting mineral salt uptake and ion antagonism.	
3-4	<b>Phloem transport:</b> Transport of organic solutes (using radioactive tracer autoradiography), vein loading and unloading, Transport mechanisms (Transcellular or streaming hypothesis, contractile protein hypothesis, mass flow, electro osmosis) source sink concept.	
4-1	<b>Photosynthesis:</b> Introduction, ultra-structure of Chloroplast, Red drop effect, Emerson's enhancement, Electron flow through cyclic and non-cyclic photophosphorylation, C <sub>3</sub> cycle, evidences, factors affecting photosynthesis, C <sub>4</sub> cycles, difference between C <sub>3</sub> and C <sub>4</sub> cycles, CAM pathway and its adaptive advantages.	<b>CR 04</b>
4-2	<b>Respiration:</b> Introduction, ultra-structure of Mitochondrion, Types – aerobic and anaerobic, RQ, Glycolytic and Krebs' cycle, ATP synthesis through oxidative electron transfer chain (Cytochrome system), chemi-osmotic regeneration of ATP, Pentose Phosphate Pathway. Photorespiration.	
4-3	<b>Plant growth regulators and movements:</b> Plant Growth Regulators – Discovery, structure, biosynthesis, bioassays, roles and mechanism of action of auxins, gibberellins, cytokinins, ethylene and abscisic acid.	
4-4	<b>Plant Movements:</b> Autonomic or spontaneous movements, locomotion movement, growth and curvature movement, movements of variation, paratonic or induced movements, tactic movements, tropic movements, nastic movements, haptonomic movements, seismonastic movements.	

## LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End</b>			

<b>Examination</b>			
<b>Text-Books</b>			
BOT509-T01	Plant Physiology – Dr. V. B. Kadam	2022	978-93-95855-77-8 YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT509:RB1	Introduction to Plant Physiology – Hopkins W. G.	1995	John Wiley and Sons, Inc., New York, USA
BOT509:RB2	Photosynthesis in C <sub>3</sub> and C <sub>4</sub> Pathway – Lawlor D.W.	2001	Viva. New Delhi.
BOT509:RB3	Biology of Plants. American Society of Plant Physiologists		Maryland, USA.
BOT509:RB4	Concept in Photobiology; Photosynthesis and Photomorphogenesis.		Narosa Publishing House, New Delhi.
BOT509:RB5	Plant Biochemistry – Heldt H. W.	2004	Academic Press, California
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT509:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT509:WL1			

### **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Describe the fundamental physiological processes in plants, such as photosynthesis, respiration, transpiration, and nutrient uptake.
- Explain the role of plant hormones in growth regulation, development, and responses to environmental cues.
- Understand the mechanisms of water and mineral transport in plants and their significance in maintaining plant health and homeostasis.
- Analyze the factors influencing plant growth, including light, temperature, humidity, and nutrient availability.
- Investigate the responses of plants to abiotic and biotic stress factors, such as drought, salinity, pathogens, and herbivores.
- Evaluate the impact of environmental factors on crop productivity and explore strategies for improving crop yield and stress tolerance.

## BOT510: HERBAL WEALTH

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V152: M.Sc.(Environmental Science) {2023 Pattern} , V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	DSC	BOT510	Herbal Wealth	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Explain importance herbs</li> <li>Apply concept of raw drug depository and ethnobotany.</li> <li>Understanding of the diverse array of medicinal and economically important plants, commonly referred to as "herbs."</li> <li>Identification, classification, and practical applications of these herbal resources.</li> <li>Appreciate the significance of herbal wealth in various cultural, medicinal, industrial, and economic contexts.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	<b>Conservation</b> <b>Conservation organizations</b> <b>Cultivation</b> <b>Adaptive planning and management for sustainable harvesting</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> </ul>
02-01 02-02 02-03 02-04	<b>Intellectual property rights (IPR)</b> <b>Food flavors and natural colours</b> <b>Natural colours</b> <b>Production technology</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	<ul style="list-style-type: none"> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks</li> </ul> (LAQ may contain sub-questions (a), (b) and so on.)
03-01 03-02 03-03 03-04	<b>Plant sweeteners (natural sweeteners)</b> <b>Raw drug repository</b> <b>Substitutes and Adulterants</b> <b>Basic concepts of Intellectual Property Rights (IPRs)</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	

04-01	<b>Ethnobotany</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	
04-02	<b>Ethnobotany in India</b>		
04-03	<b>Methods of research in Ethnobotany</b>		
04-04	<b>Indigenous systems of medicines in India</b>		

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Conservation:</b> Biodiversity and concepts of conservation: in-situ and ex-situ, Medicinal Plants Conservation Area (MPCA), Medicinal Plants Development Area (MPDA); Categories of assessment (seven categories)	<b>CR 01</b>
1-2	<b>Conservation organizations:</b> Red Data book, National and International Conservation organizations and their initiatives. CBD, FAO mandate, Project Tiger.	
1-3	<b>Cultivation:</b> Medicinal plant cultivation in India, Agro climatic zones of Maharashtra and India	
1-4	<b>Adaptive planning and management for sustainable harvesting:</b> <i>Garcinia</i> , <i>Decalepis</i> , <i>Cinnamomum</i> , <i>Vateria</i> , <i>Limonia</i> and <i>Dioscorea</i> ; sustainability factor - trade.	
2-1	<b>Intellectual property rights (IPR)</b> – Choice of IPR, Patents, Tradeseecrets, Trade mark, Copyrights, GATT (General Agreement on Tariff and Trade) and its relevance to international trade, TRIPS (Trade Related Intellectual Property Rights) and PGR (Plant Genetic Resource).	<b>CR 02</b>
2-2	<b>Food flavors and natural colours</b> – Study of some important plants used as sources and importance of food flavour's; Natural colours – introduction; classification; sources, examples – Juglansregia (walnut), Rubiatantrum and Rubiaperegrine (madder), Lithospermumerythrorhizon (Japanese shikone), Lawsoniainermis (henna), Alkannatinctoria (alkanna), Crocussativus (saffron),	
2-3	<b>Natural colours:</b> Introduction; classification; sources, examples -Tageteserecta (marigold), Capsicumannum (capsicum), Indigoferatinctoria and Indigoferasuffruticosa (indigo), Curcumalonga (turmeric), Haematoxyloncampechianum (logwood) and Monascuspurpurea (monascus, mould)	
2-4	<b>Production technology:</b> Study of highly used medicinal plants - their cultivation, extraction of active principle, and quality control. List of plants: Bacopamonniieri, Centellaasiatica, Tinosporacordifolia, Garcinia indica, Eclipta alba, Gymnemasylvestris, Cymbopogoncitratus, Vetiveriazizanioides, Piper longum, Phyllanthusamarus, Cassiaangustifolia (Tirunelvellisenna), Morindacitrifolia (Noni), Andrographispaniculata	
3-1	<b>Plant sweeteners (natural sweeteners):</b> Sweeteners - Introduction, sources of sweeteners, groups of sweeteners – nutritive and non-nutritive; examples - Stevia reboudiana, Glycyrrhizaglabra, Citrus aurantiumvaramara, Thaumtococcusdanielli, Dioscoreophyllummucminii; sucralose	<b>CR 03</b>
3-2	<b>Raw drug repository:</b> Collection, Preservation and Storage of raw drugs	
3-3	<b>Substitutes and Adulterants:</b> Substitutes and Adulterants in raw drugs	
3-4	<b>Basic concepts of Intellectual Property Rights (IPRs):</b> Intellectual Property Rights with particular reference to Traditional Knowledge and Biowealth	
4-1	<b>Ethnobotany:</b> Its Concept, Scope and Relevance.	<b>CR 04</b>
4-2	<b>Ethnobotany in India:</b> Retrospect and prospects.	
4-3	<b>Methods of research in Ethnobotany:</b> Introduction to research approaches in Applied Ethnobotany, different levels of participation; community involvement in definition of issues; collection and analysis of information and data; use of results. Attitudes and behavior of applied ethnobotanists. Identifying research sites and initial research questions. Preparation for field work: background reading; consultations with experts and agencies; finding resources for research. Composition of ethnobotanical teams. Introduction to communities. Stakeholder analysis. Participatory appraisals of plant resources: users and uses. Working with local specialists in plant resources. Data analysis and writing up results.	

	Using results: their return to communities; follow-up actions; community education and training. Identification of conflicts and resolution of disputes.	
4-4	<b>Indigenous systems of medicines in India:</b> Ayurveda, Unani, Siddha, Indigenous systems of medicine, Traditional systems of medicine	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT510 –T01	Herbal Wealth – Dr. Deepak Bhaskar Shelke, Dr.Hiralal Bhaskar Sonawane, Dr.Balkrishna Ankush Shinde, Dr.Mahadev Ramkisan Chambhare	2022	978-9395855518 YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT510:RB1	The Encyclopedia of Medicinal Plants – Andrew Chevallier	2nd edition, 2016	978-0241229446 DK
BOT510:RB2	The Complete Medicinal Herbal: A Practical Guide to the Healing Properties of Herbs – Penelope Ody	1st edition, 1993	978-1852307589 HarperCollins Publishers
BOT510:RB3	Herbal Medicine: Expanded Commission E Monographs – Mark Blumenthal, Alicia Goldberg, and Josef Brinckmann	1st edition, 2000	978-0965555507, American Botanical Council
BOT510:RB4	The Herbal Medicine-Maker's Handbook: A Home Manual – James Green	1st edition, 2000	978-0895949905, Crossing Press
BOT510:RB5	The Modern Herbal Dispensatory: A Medicine-Making Guide – Thomas Easley and Steven Horne	1st edition, 2016	978-1623170790, North Atlantic Books
BOT510:RB6	Rodale's Basic Herbal with Information on Essential Herbs and Where to Grow Them, How to Harvest, and How to Use Them-Plus, over 200 of the Most Commonly Used Medicinal Herbs – William H. Hylton	1st edition, 2000	978-1579542347, Rodale Books
BOT510:RB7	Herbal Medicine from the Heart of the Earth – Sharol Marie Tilgner	1st edition, 2009	978-1888483147, Wise Acres LLC
<b>CD/DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT510:CD1			
<b>WebLinks:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT510:WL1			
<b>OER:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT510:OER1			

## **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Identify and classify a wide range of medicinal and economically important plants and herbs based on their botanical characteristics.
- Describe the traditional and contemporary uses of herbs in different cultures for medicinal, culinary, cosmetic, and aromatic purposes.
- Understand the chemical constituents and active compounds present in medicinal herbs and their potential therapeutic benefits.
- Evaluate the scientific evidence supporting the medicinal properties and efficacy of herbal remedies.
- Discuss the importance of herbal wealth in the context of traditional medicine systems, such as Ayurveda, Traditional Chinese Medicine, and Indigenous knowledge.
- Analyze the ecological significance of herbal resources and their conservation in the context of sustainable practices and biodiversity conservation.



## BOT511: DIVERSITY OF VASCULAR PLANTS AND PALEOBOTANY-II

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern]

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	DSC	BOT511	Diversity of Vascular Plants and Paleobotany-II	2	6	60	15	35	50	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Understand vascular plants</li> <li>Differentiate between the vascular plants at higher level</li> <li>Explain paleobotany</li> <li>Understand the basic morphology, anatomy, and physiology of vascular plants.</li> <li>Be able to identify the major groups of vascular plants, both living and extinct.</li> <li>Understand the evolutionary history of vascular plants.</li> <li>Be able to apply paleobotanical data to understand the history of the Earth's climate and environment.</li> <li>Appreciate the diversity of vascular plants and their importance in the world today.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	<b>Paleobotany</b> <b>Time scale</b> <b>Fossilization</b> <b>Method of fossilization</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)</li> </ul>
02-01 02-02 02-03 02-04	<b>Brief account on techniques to study fossils</b> <b>Taxonomy of paleobotany</b> <b>Palynology</b> <b>Flora and application of paleobotany</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Paleobotany</b> - Introduction, definition, background, scope and objectives	<b>CR 01</b>
1-2	<b>Time scale:</b> Geological time scale and geological age determination	

1-3	<b>Fossilization</b> : Definition, Ideal environment for preservation of plants as fossils, factors affecting fossilization	
1-4	<b>Method of fossilization:</b> Various methods of fossilization, types of fossils – impression, petrification, compression, mould, cast, amber, coal balls, nodules and pseudo fossils.	
2-1	<b>Brief account on techniques to study fossils</b> - Ground thin section, Film or Peel technique, Maceration technique and Transfer technique	<b>CR 02</b>
2-2	<b>Taxonomy of paleobotany:</b> Paleobotanical nomenclature and provision made in ICBN for naming fossil plants.	
2-3	<b>Palynology:</b> Definition, methods of study and applications of palynology	
2-4	<b>Flora and application of paleobotany-</b> Flora of India; Contribution of BirbalSahni; Applications of Paleobotany - fossils for fuel (oil) and as industrial raw material (coal).	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT503-T01	Diversity of Vascular Plants and Paleobotany-I – Dr. Satish Deore, Dr. Amanulla Khan N. Pathan	2022	978-93-95855-04-4 YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT511:RB1	Pteridophyta, Gymnosperm and Paleobotany – Singh, Panday and Jain,		Rastogi publication, Meerut.
BOT511:RB2	College Botany, Vol II – S. Sundarajan,		Himalaya publishing House, New Delhi.
BOT511:RB3	College Botany (For degree students) – A. C. Datta		Manzar Khan Oxford University, Press Kolkatta.
BOT511:RB4	College Botany Vol- I, – Gangulee Das and Dutta		New central Book Agency, Kolkatta.
BOT511:RB5	Text Book of Botany Vol II. – Pandey and Ajanta ChaddhaA		Vikas Publication Pvt. Ltd, New Delhi.
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT511:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT511:WL1			

### COURSE OUTCOMES

After successful completion of this course, student should be able to

- The student will be able to identify the major groups of vascular plants, both living and extinct, with 80% accuracy.
- The student will be able to explain the evolutionary relationships between the major groups of vascular plants.
- The student will be able to use paleobotanical data to reconstruct the history of the Earth's climate and environment.
- The student will be able to write a research paper on a topic related to the diversity of vascular plants.

## BOT512: LAB ACTIVITIES ON BOT509, BOT510 & BOT511

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	DSC	BOT512	Lab Activities on BOT509, BOT510 & BOT511	4	12	120	50	50	100	P

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>B.Sc. With or equivalent from a recognized University/Board.</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Develop technical skill</li> <li>To empower our students with practical skills</li> <li>Identify and classify medicinal plants.</li> <li>Understand the chemical constituents of medicinal plants and their effects on humans.</li> <li>Describe the traditional and modern uses of medicinal plants.</li> <li>Evaluate the safety and efficacy of medicinal plants.</li> <li>Collect and prepare herbarium specimens.</li> <li>Conduct field studies of medicinal plants.</li> <li>Apply ethical principles to the study and use of medicinal plants.</li> </ul>

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
<b>Plant Physiology Practical</b>		
1-1	To Determine Chlorophyll a and Chlorophyll b Ratio in C3 & C4 Plants	<b>CR 01</b>
1-2	Quantitative Estimation of Proteins by Burette Method	
1-3	Estimation of Total Free Amino Acids	
1-4	Estimate Enzyme Activity at Different Temperature	
1-5	Detection of Amino Acids/ Sugar from The Phloem Sap By Paper Chromatography.	
1-6	Separation of Photosynthetic Pigments Using Separating Funnel and Measurement of Absorbance of The Pigments.	
<b>Herbal Wealth Practical</b>		
2-1	Study of Highly Used Medicinal Plant: Identification, General Characters and Economical Importance – <i>Bacopa monnieri</i> , <i>Centella asiatica</i> , <i>Tinospora cordifolia</i> , <i>Garcinia indica</i> , <i>Eclipta alba</i> , <i>Gymnema sylvestris</i> , <i>Cymbopogon citratus</i> , <i>Vetiveria zizanioides</i> , <i>Coleus forskohlii</i> , <i>Piper longum</i> , <i>Phyllanthus amarus</i> , <i>Cassia angustifolia</i> (Tiruvonnelli senna), <i>Morinda citrifolia</i> (Noni), <i>Andrographis paniculata</i> , <i>Stevia rebovidiana</i> [Any two]	<b>CR 02</b>

2-2	Study of Plant Sweeteners; Raw Drug Identification - Adulteration – Fruits, Bark, Seeds, Roots, Flowers, Resins (Guggulu)	
2-3	Herbal Preparation - Infusion (Tea) - Hot and Cold; Tulasi taila, Guduchi taila	
2-4	Study of Trikatu, Triphala, Ashtachurna and Sitopaladichurna; Vasavalehya	
2-5	Determination of Ash Value and Moisture Content of Crude Drugs	
2-6	Determination of the Alcohol Content of Asava and Arista.	
2-7	Preparation of any one Herbal Cosmetics	
<b>Medicinal Plants and their Application</b>		
3-1	Study of Ashwagandha Shatavarikalpam	<b>CR 03</b>
3-2	Study of Swarasa – Kumari, Vasa and Ginger	
3-3	Study of Bringamlaka taila; Siktha taila	
3-4	Study of Varna Lepa; Adrakakanda; Amlamru	
3-5	Study of Rasayana – Ghrita Kumara Rasayana; Kashaya for Common Fever	
3-6	Histochemical Studies of Drugs	
3-7	Extraction of Essential Oils from Suitable Medicinal Plants	
<b>Updated on 25 April 2024 (Given by Author Dr. Amanulla Khan N. Pathan)</b>		
<b>Diversity of Vascular Plants and Paleobotany- II</b>		
4-1	Techniques for The Study of Fossils	<b>CR 04</b>
4-2	Study Major Floral Distribution of Gondwana Land	
4-3	Study of Morphological, Anatomical and Reproductive Characters of <i>Rhynia</i>	
4-4	Study of Morphological, Anatomical and Reproductive Characters of <i>Sphenophyllum</i>	
4-5	Study of Morphological, Anatomical, and Reproductive Characters of <i>Medullosa</i>	
4-6	Study of the Morphological, Anatomical, and Reproductive Characters of <i>Glossopteris</i> .	

## LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT512-P01	Lab Activities on BOT509 – Dr. Kirankumar Khandare	2022	Publication 2618 YCMOU, Nashik
BOT512-P02	Lab Activities on BOT510 – Dr. M. B. Patil	2022	Publication 2647 YCMOU, Nashik
BOT512-P03	Lab Activities on BOT511 – Dr. Satish Deore, Dr. Amanulla Khan N. Pathan	2022	Publication 2505 YCMOU, Nashik
BOT512-T01	Plant Physiology – Dr. V. B. Kadam	2022	978-93-95855-77-8 YCMOU, Nashik
BOT512 –T02	Herbal Wealth – Dr. Deepak Bhaskar Shelke, Dr.Hiralal Bhaskar Sonawane, Dr.Balkrishna Ankush Shinde, Dr.Mahadev Ramkisan Chambhare	2022	978-9395855518 YCMOU, Nashik
BOT512-T03	Diversity of Vascular Plants and Paleobotany-I – Dr. Satish Deore, Dr. Amanulla Khan N. Pathan	2022	978-93-95855-04-4 YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			

<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT512:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT512:WL1			

<b>COURSE OUTCOMES</b>
<p>After successful completion of this course, student should be able to</p> <ul style="list-style-type: none"> <li>• Identify medicinal plants by their common and scientific names.</li> <li>• Describe the chemical constituents of medicinal plants and their effects on humans.</li> <li>• Discuss the traditional and modern uses of medicinal plants.</li> <li>• Evaluate the safety and efficacy of medicinal plants.</li> <li>• Collect and prepare herbarium specimens.</li> <li>• Conduct field studies of medicinal plants.</li> <li>• Apply ethical principles to the study and use of medicinal plants.</li> <li>• Write a research paper on a topic related to medicinal plants.</li> <li>• Give a presentation on a topic related to medicinal plants.</li> </ul>

## BOT513: ON JOB TRAINING (OJT)

### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern}

### COURSE INFORMATION

Sem	Other	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	OJT	BOT513	On Job Training (OJT)	4	12	120	50	50	100	TW

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"><li>B.Sc. With or equivalent from a recognized University/Board.</li></ul>	Objectives of this course are to <ul style="list-style-type: none"><li>Develop technical skill</li><li>To empower our students with practical skills</li><li>Gain hands-on experience in a professional setting.</li><li>Apply knowledge and skills learned in the classroom to real-world situations.</li><li>Develop professional relationships with employers and colleagues.</li><li>Learn about the expectations and culture of a particular industry or workplace.</li><li>Explore career options and develop a clearer sense of professional identity.</li></ul>

### DETAILS ABOUT ON JOB TRAINING (OJT)/INTERNSHIPS

Internships offer valuable opportunities for postgraduate students to bridge the gap between academia and the professional world, promote research and innovation.

By engaging in hands-on experiences and collaborating with experts, students can develop practical skills, expand their network, and gain insights into potential career paths.

#### Guidelines:

##### A. General:

- 1) It is mandatory for a student to successfully complete the OJT (Internship) to be eligible for the PG Diploma and/or PG Degree. This internship could be the research internship or any normal industry, Organization/Institute, Start-up/ ATAL Innovation/Incubation centers, Micro/Small/Medium/Enterprise, Govt/NGO/PSU/, Online/offline academic activities at School/Regional Centers/ University Head Quarters, Online Internship related to major courses.
- 2) In case of working students and his/her job nature is related to major courses of the studies, he/she will be permitted for the internship at workplace provided; a declaration by an employer is submitted directly to the LSC head and University. Both, declaration by an employer and the training completion certificate will be attached along with Internship report.
- 3) Internship is of four credits with a period of 4 weeks and carries a weightage of 50-50% in 'Continuous Assessment (CA)' and 'End examination (EE)'. The internship time period does not extend beyond 30<sup>th</sup> June.

- Total Study efforts (including Self-Study) in Hours: Total 120 Hours
  - On-Job-Training/Internship (@ during each of 22 days) in a month: 110Hours
  - InternshipReport:10 Hours
  - Duration– i) After end examination of semester 02 and before beginning of semester 03  
or ii) Any one month within semester 02 of the programme
- 4) At the end of the internship, each student is required to provide a printed copy of their consolidated diary/journal and internship report for end of internship evaluation. The report must express exactly what was learned and accomplished during the internship.
  - 5) The Intern will be assessed by
    - a) Continuous Assessment (CA) - Mentor of the Industry/NGO/organization/Institute etc. where student is selected for Internship
    - b) End Examination (EE) - LSC Supervisor/PC and External Examiner.

## B. Monitoring and Evaluation:

**Monitoring:** During internship period as part of ‘Continuous assessment (CA)’, the mentor should evaluate the interns using the following points and should issue a recommendation letter that whether Intern/student meets the expectations of the internship or not:

1	Behaviors, Shows interest in assigned work, Willingness to learn
2	Accepts responsibility, Cooperates with co-workers and supervisors, Demonstrates organizational skills
3	Uses time, knowledge and expertise effectively, Analyzes problems effectively
4	Demonstrates creativity/ originality / any innovative contribution, Professional ethics and accountability
5	Writes effectively, Produces high quality work/Skill Proficiency

**Evaluation:** At internship, the intern will be evaluated in the end examination (EE), by duly constituted expert committee of internal and external, on the following suggestive aspects:

- Professional Attitude
- Maintenance of Daily Diary
- Internship Report
- Viva voce/Oral

<b>Reference-Link:</b> Explore additional details!	
BOT513–RB1	UGC Internship Guidelines <a href="https://www.ugc.gov.in/pdfnews/1887287_Rsearch-Internship-Guidelines-120522.pdf">https://www.ugc.gov.in/pdfnews/1887287_Rsearch-Internship-Guidelines-120522.pdf</a>
BOT513–RB2	AICTE Internship Portal <a href="https://internship.aicte-india.org/">https://internship.aicte-india.org/</a>
BOT513–RB3	NITI Aayog Internship Scheme <a href="https://www.niti.gov.in/internship">https://www.niti.gov.in/internship</a>

## **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Demonstrate proficiency in the skills and knowledge required for the job.
- Communicate effectively with colleagues and supervisors.
- Work independently and as part of a team.
- Solve problems and make decisions.
- Demonstrate professional behavior and ethics.
- Reflect on their experiences and identify areas for further learning and development.



## BOT514: FIELD PROJECT (FP)

### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern}

### COURSE INFORMATION

Sem	Other	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	FP	BOT514	Field Project	4	12	120	50	50	100	TW

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"><li>B.Sc. With or equivalent from a recognized University/Board.</li></ul>	Objectives of this course are to <ul style="list-style-type: none"><li>Develop technical skill</li><li>To empower our students with practical skills</li><li>Identify and classify plant specimens in the field.</li><li>Collect and prepare plant specimens for herbarium.</li><li>Conduct field studies of plant communities.</li><li>Apply ecological principles to the study of plant communities.</li><li>Communicate effectively about botanical research.</li></ul>

#### Domain:

Maharashtra is a diverse state with various ecosystems, botanical challenges, and research opportunities. Choose a domain that aligns with your interests, the expertise of your faculty, and the resources available in your region. Field projects offer an opportunity to apply theoretical knowledge to real-world situations and contribute to addressing botanical challenges in the region. Some potential domains of field work for Botany students are listed as follows. Learner may find this helpful while choosing topic of the field work, but not limited to -

- Ethnobotany and Medicinal Plant Conservation:** Document traditional knowledge of medicinal plants used by local communities in Maharashtra and explore ways to conserve and sustainably manage these resources.
- Moss and Lichen Diversity in Western Ghats:** Study the diversity and distribution of mosses and lichens in the Western Ghats, assessing their ecological roles and sensitivity to environmental changes.
- Molecular Phylogenetics of Endemic Plants:** Use molecular techniques to investigate the phylogenetic relationships and evolutionary history of endemic plant species in Maharashtra.

- **Plant-Insect Interactions:** Explore the ecological relationships between plants and insects, focusing on herbivory, pollination, and plant defenses within specific ecosystems in Maharashtra.
- **Aquatic Plant Ecology:** Study the distribution, diversity, and adaptations of aquatic plants in Maharashtra's lakes, rivers, and wetlands, and their importance in maintaining aquatic ecosystems.
- **Restoration Ecology:** Design and implement a restoration project for a degraded ecosystem in Maharashtra, involving the reintroduction of native plant species and monitoring their establishment.
- **Phytoremediation of Contaminated Soils:** Investigate the potential of native plant species to remediate contaminated soils, addressing environmental pollution issues in Maharashtra.
- **Plant-Microbe Interactions in Rhizosphere:** Study the interactions between plants and soil microbes in the rhizosphere, focusing on nutrient cycling, disease suppression, and plant growth promotion.
- **Fern and Fern Ally Diversity:** Explore the diversity and ecological significance of ferns and fern allies in Maharashtra's diverse ecosystems.
- **Palynology and Climate Change:** Analyze pollen grains preserved in sediment cores from Maharashtra to reconstruct past vegetation and climate changes.
- **Seed Bank Dynamics:** Investigate the composition and dynamics of seed banks in different habitats within Maharashtra, and their role in plant community dynamics.
- **Carnivorous Plants:** Study the carnivorous plant species found in Maharashtra, examining their unique adaptations and nutrient acquisition strategies.
- **Algal Blooms in Freshwater Systems:** Research the factors contributing to algal blooms in freshwater bodies of Maharashtra and their impact on water quality.
- **Plant Genetics and Crop Improvement:** Focus on improving crop varieties relevant to Maharashtra's agricultural practices through genetic selection and breeding techniques.
- **Forest Canopy Ecology:** Study the plant diversity and ecological interactions within the canopy of Maharashtra's forests, including epiphytic plants and their associations.
- **Climate-Induced Shifts in Plant Distribution:** Investigate how changing climate patterns are influencing shifts in plant distribution and diversity across different elevational gradients in Maharashtra.
- **Plant-Soil Feedbacks:** Examine the feedback mechanisms between plants and soil microorganisms, and their implications for plant community composition and ecosystem functioning.
- **Floral Morphology and Pollination Syndromes:** Analyze the floral morphology of plant species in Maharashtra and correlate it with their respective pollination syndromes.
- **Pharmacological Screening of Plant Extracts:** Conduct bioassays to assess the pharmacological properties of plant extracts from Maharashtra, potentially leading to the discovery of new bioactive compounds.
- **Plant Invasion Dynamics:** Investigate the spread and impact of invasive plant species in different habitats within Maharashtra and propose management strategies.

**Guidelines:** [In process]

### **Topic Selection and Proposal:**

- Choose a well-defined and feasible topic that aligns with your interests, available resources, and the expertise of your mentors.
- Develop a clear and comprehensive project proposal that outlines the research objectives, significance, methodology, and expected outcomes.

### **Research Planning:**

- Define your research question and objectives precisely. Identify the scope of your study, study area within Maharashtra, and the timeline for fieldwork.
- Conduct a thorough literature review to understand the existing knowledge and identify gaps in the chosen area of study.

### **Methodology:**

- Determine the appropriate research methods and techniques based on your research objectives. These might include field surveys, sample collection, laboratory analysis, interviews, or experiments.
- Detail the step-by-step procedures you will follow during fieldwork, ensuring they are well-structured and repeatable.

### **Ethics and Permissions:**

- If your research involves human subjects, ensure you obtain necessary ethical approvals from your academic institution.
- If conducting research in protected areas or involving sensitive species, obtain required permits or approvals from relevant authorities.

### **Data Collection:**

- Collect data systematically and accurately according to your defined methodology. Maintain organized records of observations, samples, measurements, and any other relevant information.

### **Data Analysis:**

- Organize and manage your collected data in a format suitable for analysis.
- Apply appropriate statistical or analytical techniques to interpret your data and draw meaningful conclusions.

### **Results and Interpretation:**

- Present your findings using tables, graphs, charts, and descriptive text.
- Interpret your results in the context of your research question and compare them with existing literature.

### **Discussion and Conclusion:**

- Discuss the implications of your findings, considering how they contribute to the existing knowledge in your field and address the research gaps you identified.
- Reflect on any limitations of your study and suggest potential avenues for further research.

### Reporting and Documentation:

- Create a well-structured report that includes an introduction, objectives, methods, results, discussion, and conclusion sections.
- Include proper citations for references to literature.
- Visual aids such as photographs, maps, and diagrams can enhance the clarity of your report.

### Presentation and Communication:

- Present your findings to your academic institution, peers, and mentors through a seminar, presentation, or poster session.
- Practice clear and concise communication to effectively convey your research process and outcomes.

### Time Management:

- Plan your fieldwork, data collection, and analysis schedule to ensure efficient use of time and resources.

### Mentorship and Feedback:

- Collaborate closely with mentors or advisors who can provide guidance, feedback, and support throughout the project.

### Flexibility and Adaptability:

- Be prepared to adjust your plans if you encounter unexpected challenges during fieldwork or analysis.

### Reflective Learning:

- Reflect on the process and outcomes of your project, considering what you've learned, the skills you've gained, and potential future directions.

### LEARNING RESOURCE DETAILS

LRCode	TitleAuthor	EditionYear	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
	–		
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
	–		

<b>CD/DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
EVS514:CD1			
<b>WebLinks:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT514:WL1	<a href="https://sdgs.un.org/goals">https://sdgs.un.org/goals</a>		
BOT514:WL2	<a href="https://cpcb.nic.in/standards/">https://cpcb.nic.in/standards/</a>		
BOT514:WL3	<a href="http://www.ipcc.org">www.ipcc.org</a> ; <a href="https://www.ipcc.ch/report/sixth-assessment-report-cycle/">https://www.ipcc.ch/report/sixth-assessment-report-cycle/</a>		
<b>OER:</b> Explore additional details and reinforce learning, with this optional learning resource!			

## COURSE OUTCOMES

After successful completion of this course, student should be able to –

- Students will demonstrate the ability to apply theoretical knowledge and concepts to real-world situations, effectively bridging the gap between academia and practical applications.
- Students will develop advanced research and investigative skills, including the ability to design and execute research projects, collect and analyze data, and draw well-founded conclusions.
- Students will conduct independent research, demonstrating the ability to formulate research questions, design appropriate methodologies, and independently execute fieldwork or data collection.
- Students will exhibit effective collaboration and communication skills, demonstrating the ability to work collaboratively with others, engage in professional dialogue, and effectively communicate their research findings to diverse audiences.
- Students will showcase advanced problem-solving and critical thinking abilities, demonstrating the capacity to identify and address challenges encountered during fieldwork, analyze complex data, and propose innovative solutions.
- Students will demonstrate a thorough understanding of ethical considerations, field safety protocols, and best practices in their chosen field of study.

## BOT515: BIOTECHNOLOGY AND MOLECULAR BIOLOGY(ELECTIVE)

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	DSE	BOT515	Biotechnology and Molecular Biology	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	Objectives of this course are to <ul style="list-style-type: none"> <li>Explain plant tissue culture</li> <li>Apply techniques in biotechnology.</li> <li>Understand the principles of biotechnology and molecular biology.</li> <li>Apply these principles to the study of plants.</li> <li>Communicate effectively about biotechnology and molecular biology.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	<b>Morphogenesis</b> <b>Morphogenetic factors</b> <b>Plant Tissue Culture</b> <b>Organogenesis</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks</li> </ul> (LAQ may contain sub-questions (a), (b) and so on.)
02-01 02-02 02-03 02-04	<b>In Vitro Propagation.</b> <b>Application of tissue culture</b> <b>Technique Of Transformation</b> <b>Application of transgenic plants</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
03-01 03-02 03-03 03-04	<b>Applications and hazards of biotechnology</b> <b>Industrial Biotechnology</b> <b>Enzyme biotechnology</b> <b>DNA</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
04-01 04-02 04-03 04-04	<b>DNA Repair Mechanism</b> <b>Bioinformatics</b> <b>Information sources</b> <b>Use of Bioinformatic</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	

## DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Morphogenesis:</b> Morphogenesis at cellular level – differentiation, dedifferentiation, redifferentiation of vascular tissues in-vitro. Role of cytoplasm and nucleus in morphogenesis, <i>Acetabularia</i> ; Asymmetric division and its significance.	<b>CR 01</b>
1-2	<b>Morphogenetic factors</b> – water, temperature, light, chemical factors and growth regulators; Polarity – general account; Plant galls and their importance in morphogenesis	
1-3	<b>Plant Tissue Culture:</b> Brief history and applications of PTC, Requirements of PTC and aseptic maintenance.	
1-4	<b>Organogenesis</b> - Single cell culture, suspension culture, pollen culture (haploid cell culture), meristem culture and embryo culture.	
2-1	<b>In Vitro Propagation:</b> Somatic embryogenesis, synthetic seed production. Somatic hybridization, somaclonal variation and cryopreservation; production of high value secondary metabolites through cell and tissue culture in plants like <i>Andrographis</i> , <i>Bacopa</i> and <i>Stevia</i>	<b>CR 02</b>
2-2	<b>Application of tissue culture:</b> Application of tissue culture in agriculture, industry, forestry and medicine.	
2-3	<b>Technique Of Transformation:</b> Physical methods - microprojectile, electroporation, Organelle transformation; Chemical method - PEG mediated DNA uptake and Biological method - Agrobacterium mediated	
2-4	<b>Application of transgenic plants;</b> general account of vaccines from plants – banana;	
3-1	<b>Applications and hazards of biotechnology;</b> GM foods – golden rice, Bt brinjal and Bt cotton; Biosafety of GM foods.	<b>CR 03</b>
3-2	<b>Industrial Biotechnology:</b> Microbial Biotechnology - production of organic compounds by fermentation, basic principles of fermentation technology, types of fermenters, Production of Acetone and Butanol.	
3-3	<b>Enzyme biotechnology:</b> Extraction and purification of enzymes, immobilization of enzymes, uses of enzymes (amylase, protease, invertase). Brief account on Biosensors and Biochips.	
3-4	<b>DNA:</b> DNA chemistry and structure, polymorphism in DNA structure, DNA replication – enzymes, mechanism of DNA replication in Prokaryotes and Eukaryotes.	
4-1	<b>Dna Repair Mechanism:</b> Photoreactivation, excision repair, recombination repair and mismatch repair.	<b>CR 04</b>
4-2	<b>Bioinformatics:</b> History, Databases - Types of databases, Database structure, Models, Sequences and Nomenclature, IUPAC symbols, Nomenclature of DNA sequences, Protein sequences, types of sequence used in bioinformatics;	
4-3	<b>Information sources-</b> NCBI, PubMed, Taxonomy browsers, BLAST, FASTA;	
4-4	<b>Use of Bioinformatic:</b> Use of Bioinformatic tools in analysis.	

## LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT515-T01	Biotechnology and Molecular Biology	2022	
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT515:RB1	Intellectual property rights in the WTO and developing countries – Jayashree Watal		Oxford University Press, Oxford.
BOT515:RB2	Intellectual Property: Patents, Trademarks and Copyright	2000	West Group

	in a Nutshell, – Arthur Raphael Miller, MichealH.Davis;		Publishers.
BOT515:RB3	Intellectual Property Rights: Unleashing the Knowledge Economy – P. Ganguli,	2001	Tata McGraw-Hill.
BOT515:RB4	Understanding Trips: Managing Knowledge in Developing Countries. – Manjula Guru & M.B. Rao,	2003	Sage Publications.
BOT515:RB5	Textbook on intellectual property rights, – N.K. Acharya	2001	Asia Law House
BOT515:RB6			
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT515:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT515:WL1			

### **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Define the terms "biotechnology", "molecular biology", and explain their relationship to each other.
- Understand the basic principles of biotechnology and molecular biology, such as DNA cloning, gene expression, and protein synthesis.
- Apply these principles to the study of plants, such as the development of new cultivars, the improvement of crop yields, and the development of new drugs.
- Communicate effectively about biotechnology and molecular biology through written reports, presentations, and other media.



## BOT516: ECOLOGY AND PHYTOGEOGRAPHY (ELECTIVE)

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
02	DSE	BOT516	Ecology and Phytogeography	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	Objectives of this course are to <ul style="list-style-type: none"> <li>Explain ecological concepts</li> <li>Explain phytogeographical concepts.</li> <li>Understand the principles of ecology and phytogeography.</li> <li>Apply these principles to the study of plant communities.</li> <li>Communicate effectively about ecology and phytogeography.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01	<b>Ecology And Ecosystem</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks</li> </ul> (LAQ may contain sub-questions (a), (b) and so on.)
01-02	<b>Ecological niche And Concept</b>		
01-03	<b>Productivity In Ecosystem</b>		
01-04	<b>Nonconventional sources of energy</b>		
02-01	<b>Ecological Succession</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
02-02	<b>Ecological Factors</b>		
02-03	<b>Biotic</b>		
02-04	<b>Pollution</b>		
03-01	<b>Climate Change</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
03-02	<b>Climatic Variations</b>		
03-03	<b>Remote Sensing And GIS</b>		
03-04	<b>Phytogeography</b>		
04-01	<b>Plant Distribution</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	
04-02	<b>Plant migration and barriers on plant migration</b>		
04-03	<b>Botanical provinces of India</b>		
04-04	<b>Theories Of Present And Past</b>		

## DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Ecology And Ecosystem:</b> Origin, scope, definition, homeostasis; Ecosystem - Definition, Composition, structure, function, kinds of ecosystem (one terrestrial and one aquatic), Trophic levels and energy flow, food chain, food webs, ecological pyramid, biological magnification, bio-geochemical cycle, resilience of ecosystem, ecosystem management.	<b>CR 01</b>
1-2	<b>Ecological niche And Concept:</b> Ecological niche, ecocline, ecotone and edge effect. Limiting Factors: Concept of limiting factors-Liebig's law of the minimum, Shelford's law of Tolerance	
1-3	<b>Productivity In Ecosystem</b> – Introduction, Types - primary productivity, secondary productivity, turn over, grass land, shrub land and forest ecosystem;	
1-4	<b>Nonconventional sources of energy</b> – wind, tidal, geothermal, biomass based energy.	
2-1	<b>Ecological Succession:</b> types, general trends, causes and processes of succession – hydrosere and xerosere.	<b>CR 02</b>
2-2	<b>Ecological Factors:</b> Abiotic – Climatic (Global climatic pattern - global warming, atmospheric ozone, acid and nitrogen deposition), Topographic, edaphic; heavy metals and radionuclide in soil, erosion and conservation;	
2-3	<b>Biotic</b> - Competition, Mermecophily, Amensalism, Symbiosis, Parasitism and Epiphytism.	
2-4	<b>Pollution</b> - Kinds (Air, water and soil pollution) and sources of pollution; Plant indicators of pollution – bioindicators, biomonitoring, bioremediation, biofuelling, biofilm and bio corrosion, current environmental problems-e-waste and its management, bioterrorism, case studies – Kaiga, Kolar mining, Narmada river valley project and Silent valley project and current environmental problems - Rehabilitation of lakes.	
3-1	<b>Climate Change:</b> Integrated strategies for Conservation; Climate change prediction, REDD+, Synergies between Sustainable use of Biodiversity and Climate change, consequence of climate, Ozon layer depletion.	<b>CR 03</b>
3-2	<b>Climatic Variations:</b> Coping with climatic variations, El-Nino effect & greenhouse effect.	
3-3	<b>Remote Sensing And GIS:</b> scope, methodology and importance, Application of Remote sensing and GIS in Ecological science	
3-4	<b>Phytogeography:</b> Phytogeography - Introduction, definition, aims, principles and methods to study plant geography.	
4-1	<b>Plant Distribution:</b> Vestor's classification based on shapes of area; types and patterns of distribution - continuous distribution, discontinuous distribution – types and theoretical explanation; endemic distribution;	<b>CR 04</b>
4-2	<b>Plant migration and barriers on plant migration:</b> vicarious and relict species – types and examples; centers of origin; insular flora, Mangrove vegetation.	
4-3	<b>Botanical provinces of India;</b> Vegetation of India. Floristic regions of India; Endemism-centre of origin, vicariance, theories of endemism, factors for endemism, endemic plants;	
4-4	<b>Theories Of Present And Past</b> – Continental drift hypothesis; Age and Area hypothesis and Land, Bridge hypothesis.	

## LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT516-T01	Ecology and Phytogeography – Dr. Sachin B. Patil	2022	978-93-95855-34-1 YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			

BOT516:RB1	Biodiversity - Agarwal K.C.		Agro Botanical Publishers
BOT516:RB2	Text Book of Plant Ecology - Ambasht R.S.		Students Friends Company, Varanasi
BOT516:RB3	. Introduction to Plant Ecology - Ashby M		McMilla Co, Ltd, New York
BOT516:RB4	A Text Of Plant Geography - Bharycha F.R.,		Oxford University Press, India
BOT516:RB5	Methods In Environmental Analysis, Water, Soil and Air. - P.K. Gupta		Agro Bios, Jodhpur
BOT516:RB6	Air, Environment and Pollution - S.S. Purohit,		Agro Bios, Jodhpur
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT516:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT516:WL1			

### **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Understand the basic principles of ecology and phytogeography, such as the distribution of plants, the interactions between plants and their environment, and the effects of human activities on plant communities.
- Apply these principles to the study of plant communities, such as the identification of plant communities, the study of the factors that influence the distribution of plants, and the assessment of the impact of human activities on plant communities.
- Communicate effectively about ecology and phytogeography through written reports, presentations, and other media.

## SEMESTER 3

### BOT601: CYTOGENETICS AND PLANT BREEDING

#### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern}

#### COURSE INFORMATION

Sem.	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSC	BOT601	Cytogenetics and Plant Breeding	4	12	120	30	70	100	T

#### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"><li>B.Sc. with Botany or equivalent from a recognized University/Board.</li></ul>	Objectives of this course are to <ul style="list-style-type: none"><li>Explain techniques in plant breeding</li><li>Study cytogenetics.</li><li>Understand the principles of genetics and cytology.</li><li>Identify and interpret chromosomal abnormalities.</li><li>Apply cytogenetics to plant breeding.</li><li>Design and execute breeding experiments.</li><li>Evaluate the results of breeding experiments.</li></ul>

#### UNITS

UN	Name of the Unit	CSs	Questions
01-01	<b>Chromosome structure</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"><li>Very Short Answer Question (VSAQ), of 03 marks</li><li>Short Answer Question (SAQ), of 05 marks</li><li>Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)</li></ul>
01-02	<b>Types of chromatin</b>		
01-03	<b>Specialized types of chromosomes</b>		
01-04	<b>Structural and numerical alterations in chromosomes</b>		
02-01	<b>Genetics of prokaryotes and eukaryotic organisms</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
02-02	<b>Gene structure and expression</b>		
02-03	<b>Regulation of gene expression</b>		
02-04	<b>Genetic recombination and gene mapping</b>		
03-01	<b>Mutation</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
03-02	<b>Cytogenetics of aneuploids and structural heterozygotes</b>		
03-03	<b>Molecular Cytogenetics</b>		
03-04	<b>Multigene families, in situ hybridization</b>		

04-01	<b>Principles and Methods of Plant breeding.</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	
04-02	<b>Genetic basis of breeding self-pollinated crops.</b>		
04-03	<b>Mutations and polyploidy breeding.</b>		
04-04	<b>Pre-breeding and genetic enhancement.</b>		

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Chromosome structure:</b> Chromatin organization and packaging of DNA; molecular organization of centromere and telomere; nucleolus and ribosomal RNA genes;	CR 01
1-2	<b>Types of chromatin:</b> Euchromatin and heterochromatin; karyotype analysis; banding patterns	
1-3	<b>Specialized types of chromosomes:</b> Ploidy, lampbrush, B-chromosomes and sex chromosomes	
1-4	<b>Structural and numerical alterations in chromosomes:</b> Origin, meiotic behaviour and consequences of duplication, deficiency, inversion and translocation, heterozygotes characteristics and types of aneuploids, role of polyploidy in crop evolution, evolution of major crop plants (wheat and rice).	
2-1	<b>Genetics of prokaryotes and eukaryotic organisms:</b> Phage phenotypes; genetic recombination in bacteria; genetic transformation, conjugation and transduction in bacteria; cytoplasmic male sterility, genetic basis of inbreeding depression and heterosis; exploitation of hybrid vigour.	CR 02
2-2	<b>Gene structure and expression:</b> Genetic fine structure; cistrons test; fine structure analysis of eukaryotes; introns and exons RNA splicing.	
2-3	<b>Regulation of gene expression:</b> Regulation of gene expression in prokaryotes and eukaryotes; split genes, overlapping genes and pseudogenes.	
2-4	<b>Genetic recombination and gene mapping:</b> Recombination, independent assortment and crossing over; molecular mechanism of recombination; chromosome mapping; genetic and physical maps, linkage groups.	
3-1	<b>Mutation:</b> Spontaneous and induced mutations; physical and chemical mutagens; molecular basis of mutation; transposable elements in prokaryotes and eukaryotes; inherited human diseases; cancer at cellular level; proto-oncogenes and oncogenes.	CR 03
3-2	<b>Cytogenetics of aneuploids and structural heterozygotes:</b> Effect of aneuploidy on phenotypes in plants; transmission of monosomics and trisomics and their use in chromosome mapping of diploid and polyploidy species; Robertsonian translocation.	
3-3	<b>Molecular Cytogenetics:</b> Nuclear DNA content; C-value paradox; cot-curves and their significance; restriction mapping-concept and techniques	
3-4	Multigene families, in situ hybridization: Concept and applications	
4-1	<b>Principles and Methods of Plant breeding:</b> Historical perspectives: Past progress and future needs, green revolution, evergreen revolution. Mating Systems: Self-fertilization, full sib mating, half sib mating, back crossing; inbreeding and backcrossing; random mating, assortative and disassortative matings, sister line crosses, convergent crosses, complex crosses, diallel selective mating, mating designs for components of variation.	CR 04
4-2	<b>Genetic basis of breeding self-pollinated crops:</b> selection; pure line theory and its genetic basis; sources of genetic variation, genetic consequences of hybridization (segregation and recombination of genes); composition of populations derived from hybrids; role of genotype and environment in continuous variation; heritability; genetic advance under selection. Breeding methods for self-pollinated crops: A brief outline of the following: pure line and mass selection; pedigree method and its modification, bulk population method and its	

	modifications. Backcross method; testing and evaluation of purelines, hybrid breeding. Genetic basis of breeding cross pollinated crops: Genetic basis of self-incompatibility and male sterility and their use in hybrid seed production; genetic basis of inbreeding depression and heterosis; exploitation and fixation of heterosis; genetic basis of population improvement Breeding methods for cross-pollinated crops: selection, recurrent selection; development of hybrids, synthetics and composites.
4-3	<b>Mutations and polyploidy breeding:</b> Mutation breeding, distant hybridization and polyploidy breeding including analytical breeding, mutant variety data(MVD)-IAEA. Breeding methods for vegetatively propagated crops: Somatic mutations, examples of sugarcane and potato crops.
4-4	<b>Pre-breeding and genetic enhancement:</b> Wide hybridization and alien gene transfer. Crop varieties: Identification, release and notification of crop varieties, institutions involved in release of varieties.

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT601:RB1	Plant Breeding – Singh B. D.	2007	Kalyani Publishers. Ludhiana
BOT601:RB2	Principles of Crop Improvement - Simmonds, N.W.	1979	Longman Groups Ltd. London
BOT601:RB3	Analysis and Exploitation of Variation – Roy D.		Narosa Publishing, New Delhi
BOT601:RB4	Breeding Field Crops – Poehlman J. M. and Sleper D. A.	1995 4th Ed	Panima Publishing Corporation, New Delhi
BOT601:RB5	Breeding Field Crops, – Poehlman, J.M.	1987 3rd Ed.	AVI Publishing Co. Inc., Westport, Connecticut
BOT601:RB6	Fundamentals of Plant Genetics and Breeding – Welsh, J. R.	1981	John Wiley and Sons, New York.
BOT601:RB7	Plant Breeding II – Frey, K. J.	1982	Kalyani Publishers, New Delhi.
BOT601:RB8	Plant Breeding: Theory and Practice – Chopra, V.L.	2000 2nd Ed.	Oxford & IBH, New Delhi.
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT601:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT601:WL1			

### COURSE OUTCOMES

After successful completion of this course, student should be able to

- Identify and interpret chromosomal abnormalities in plant cells.
- Apply cytogenetics to plant breeding by selecting parents with desirable traits and using various breeding methods.

- Design and execute breeding experiments using proper techniques.
- Evaluate the results of breeding experiments and draw conclusions about the effectiveness of the breeding methods used.



## BOT602: ADVANCED PLANT PHYSIOLOGY

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSC	BOT602	Advanced Plant Physiology	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Explain biochemical basis of plant metabolism</li> <li>Explain flowering and seed.</li> <li>Understand the basic principles of plant physiology.</li> <li>Apply these principles to the study of plant growth, development, and responses to the environment.</li> <li>Conduct research on plant physiology.</li> <li>Communicate effectively about plant physiology.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	<b>Nitrogen Metabolism</b> <b>Mechanism Of Nitrogen Fixation</b> <b>Lipid Metabolism</b> <b>Glyoxylate Pathway</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	<p>As per evaluation pattern, on <b>Each Credit</b>, Student is required to answer</p> <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks</li> </ul> <p>(LAQ may contain sub-questions (a), (b) and so on.)</p>
02-01 02-02 02-03 02-04	<b>Flowering</b> <b>Floral Induction And Development</b> <b>Seed Structure And Biology</b> <b>Types Of Seeds</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
03-01 03-02 03-03 03-04	<b>Principles Of Seed Processing</b> <b>Seed Dormancy And Germination</b> <b>Plant Secondary Metaboli and It's Defense</b> <b>Importance Of Secondary Metabolites</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
04-01 04-02 04-03 04-04	<b>Signal Transduction In Plants</b> <b>Protein Degradation</b> <b>Stress Physiology</b> <b>Genetic Engineering</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Nitrogen Metabolism:</b> Nitrogen fixation (Nif gene complex), host microbe specificity,	<b>CR 01</b>
1-2	<b>Mechanism Of Nitrogen Fixation:</b> Assimilation of nitrates, synthesis of amino acids – reductive and transamination and GS –GOGAT system	



1-3	<b>Lipid Metabolism:</b> Structure and function of Lipids and its derivatives; Synthesis of fatty acids. Breakdown of fatty acids ( $\beta$ and $\gamma$ Oxidatives), Synthesis of Triacyl Glyceride (Kennedy pathway).	
1-4	<b>Glyoxylate Pathway:</b> Glyoxylate pathway and Gluconeogenesis, Synthesis of Phospholipids and Glycolipids.	
2-1	<b>Flowering:</b> The flowering process, Photoperiodism and its significance, Phytochrome, role of Vernalization, endogenous clock and its regulation, biochemical signaling involved in flowering.	<b>CR 02</b>
2-2	<b>Floral Induction And Development:</b> Introduction to genetic and molecular basis or mechanism of flowering.	
2-3	<b>Seed Structure And Biology:</b> Structure of dicot and monocot seeds,	
2-4	<b>Types Of Seeds:</b> Apomictic seeds, Polyembryonic seeds, Orthodox and recalcitrant seeds, Heirloom varieties, seed treatments, seed protectants, priming, coating, pelleting.	
3-1	<b>Principles Of Seed Processing:</b> Seed sampling, classes of seeds – breeder's seed, nuclear seeds, certified seeds, cultivar seeds; seed certification and submission procedure for seed certification.	<b>CR 03</b>
3-2	<b>Seed Dormancy And Germination:</b> Introduction, types, induction and mechanism to break dormancy (seed and bud), seed germination and seed viability, Germination enhancers, Factors affecting germination.	
3-3	<b>Plant Secondary Metabolites And It's Defense:</b> Biosynthesis, function and role of the following as defense molecules: flavonoids, terpenoids, alkaloids, steroids, anthocyanin and lignin; role of secondary metabolites in plant-microbe interaction; plant-plant interaction.	
3-4	<b>Importance Of Secondary Metabolites:</b> Importance of secondary metabolites to humans (Pharmaceuticals); brassinosteroids; jasmonic acids; Antinutritional factors (ANF).	
4-1	<b>Signal Transduction In Plants:</b> Introduction, Phytochrome signaling pathway-Ion fluxes, gene expression, Phytochrome signaling, Phytochrome associated protein Kinases and Phosphatases.	<b>CR 04</b>
4-2	<b>Protein Degradation:</b> ABA signal transduction pathways; Brassinosteroid signaling pathway; Brief account on G-proteins, Cyclic nucleotides and calcium- calmodulin cascade.	
4-3	<b>Stress Physiology:</b> Drought, soil salinity, light and temperature stresses and their physiological effects on plants	
4-4	<b>Genetic Engineering:</b> Molecular mechanism of drought tolerance in plants; engineering plants for stress tolerance.	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT602-T01	Advanced Plant Physiology - Dr. V. B. Kadam	2023	YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT602:RB1	Indoor Gardening		G. V. Publication House
BOT602:RB2	Nursery Management - Kulkarni		
BOT602:RB3	Elements of Biostatistics - Sadguru Prasad.		Rastogi Publications, Meerut.
BOT602:RB4	A Text book of Cell and Molecular Biology - P. K. Gupta		Rastogi Publications, Meerut
BOT602:RB5	Cell Biology - Singh and Tomeir		Rastogi Publications, Meerut

BOT602:RB6	Cytology, genetics and evolution – P. K. Gupta		Rastogi Publications, Meerut
BOT602:RB7	Cytogenetics – P. K. Gupta		Rastogi Publications, Meerut.
BOT602:RB8	College Botany Vol 04 – S. Sundarajan		Himalaya Publishing House, Mumbai
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT602:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT602:WL1			

### **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Describe the basic principles of plant physiology, such as photosynthesis, respiration, transpiration, and the role of hormones in plant growth and development.
- Apply these principles to the study of plant growth, development, and responses to the environment.
- Conduct research on plant physiology using proper techniques and equipment.
- Communicate effectively about plant physiology through written reports, presentations, and other media.

## BOT603: PHARMACOGNOSY

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSC	BOT603	Pharmacognosy	2	6	60	15	35	50	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	Objectives of this course are to <ul style="list-style-type: none"> <li>Prepare herbal cognition</li> <li>Extract herbal drugs.</li> <li>Understand the definition, history, scope, and development of pharmacognosy.</li> <li>Identify and classify crude drugs.</li> <li>Understand the chemistry of secondary metabolites.</li> <li>Describe the methods of extraction, purification, and standardization of crude drugs.</li> <li>Understand the pharmacology of crude drugs.</li> <li>Evaluate the safety and efficacy of herbal medicines.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	<b>Classification Of Herbal Drugs</b> <b>Extraction Of Herbal Drugs</b> <b>Extraction methods</b> <b>Guidelines for harvesting medicinal plants (GMP- Good Manufacturing Practices)</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)</li> </ul>
02-01 02-02 02-03 02-04	<b>Preparation Of Medicines</b> <b>Herbal preparations</b> <b>Active Principles</b> <b>Phytochemistry</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit ( Application Oriented problems)	CR
1-1	<b>Classification Of Herbal Drugs:</b> Classification of plant drugs, plant parts, chemical constituents, morphological, pharmacological, secondary metabolites on curative properties and uses – <i>Piper longum</i> , <i>Ficusbengalensis</i> , <i>Pandanus fascicularis</i> , <i>Embllica officinalis</i> , <i>Cyperusrotundus</i> , <i>Gmelinaarborea</i> , <i>Oroxylumindica</i> (bark and stem).	<b>CR 01</b>
1-2	<b>Extraction Of Herbal Drugs:</b> Extraction of phytopharmaceuticals – selection of plant	

	material, collection, identification, drying and grinding, cutting, processing and powdering of herbs; choice of solvent.	
1-3	<b>Extraction methods:</b> Soxhlet extraction, steam distillation, vaporization, infusion, decoction, maceration and percolation.	
1-4	<b>Guidelines for harvesting medicinal plants (GMP- Good Manufacturing Practices).</b>	
2-1	<b>Preparation Of Medicines:</b> Preparation of herbal medicines for primary health care and their healing properties.	<b>CR 02</b>
2-2	<b>Herbal preparations:</b> powder, fresh juice, poultice, oils, ghee and syrups.	
2-3	<b>Active Principles:</b> Active principles of medicinal plants namely <i>Ocimum sanctum</i> , <i>Withaniasomnifera</i> , <i>Aloe vera</i> , <i>Asparagus racemosus</i> , <i>Adathodavasica</i> , <i>Terminalia arjuna</i> , <i>Terminalia bellerica</i> and <i>Tinosporacordifolia</i> (classification, active principle, extraction, preparation and safety and efficacy)	
2-4	<b>Phytochemistry</b> – Preliminary screening of secondary metabolites - Alkaloids, flavanoids, tannins and saponins	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT603-To1	Pharmacognosy – Dr. Sudhin. C. Dalave	2023	YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT603:RB1	Glossary of Indian medicinal plants, – R.N.Chopra, S.L.Nayar and I.C.Chopra.	1956	C.S.I.R, New Delhi.
BOT603:RB2	Pharmacognosy, – Dr.C.K.Kokate et al.	1999	NiraliPrakashan
BOT603:RB3	Principles of Ayurveda, – Anne Green.	2000	Thomsons, London
BOT603:RB4	Ayurveda and Aromatherapy. – Miller, Light and Miller, Bryan.	1998	Banarsidass, Delhi.
BOT603:RB5	Ayurvedic drugs and their plant source. – V.V. Sivarajan and Balachandran Indra.	1994	Oxford IBH publishing Co
BOT603:RB6	Herbal plants and Drugs - Agnes Arber.	1999	Mangal Deep Publications.
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT603:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT603:WL1			

### COURSE OUTCOMES

After successful completion of this course, student should be able to

- Identify and classify crude drugs by their common and scientific names.
- Describe the chemistry of secondary metabolites, such as alkaloids, glycosides, and tannins.
- Describe the methods of extraction, purification, and standardization of crude drugs.
- Understand the pharmacology of crude drugs, such as their mechanisms of action and side effects.
- Evaluate the safety and efficacy of herbal medicines.

## BOT604: LAB ACTIVITIES ON BOT601, BOT602 & BOT603

### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik- 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern]

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSC	BOT604	Lab Activities on BOT601, BOT602 & BOT603	4	12	120	50	50	100	P

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>BSc with Botany or equivalent from a recognized University/Board</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Develop technical skill</li> <li>Empower the students with practical skills</li> <li>Understand the principles of cytogenetics and plant breeding.</li> <li>Apply these principles to the study of plant growth, development, and responses to the environment.</li> <li>Conduct research on plant physiology and plant breeding.</li> <li>Communicate effectively about plant physiology and plant breeding.</li> </ul>

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	Estimation of Leghaemoglobin and Demonstration of Nitrates in Green Plants	CR 01
1-2	Extraction and Estimation of Lipids – Folch Method	
1-3	Estimation of Lipase Activity	
1-4	Saponification Value of Oils and Iodine Number	
1-5	Quantitative Estimation of Flavanoids	
1-6	Effect of Salt Stress on Accumulation of Proline and Estimation	
2-1	Determination of Secondary Metabolites.	CR 02
2-2	Study of Two Plants/Class (Two Families Per Practical)	
2-3	Study of Two Plants/Class (Two Families Per Practical)	
2-4	Plant Breeding Principles Within The Myrtaceae Family	
2-5	Plant Breeding Principles Within The Rubiaceae Family	
2-6	Plant Breeding Principles Within The Euphorbiaceae Family	
3-1	Identification of Organized and Unorganized Plant Drugs (Digitalis Leaf, Senna Leaf, Vasaka Leaf).	
3-2	Quantitative Estimation of An Alkaloid –Solanine.	
3-3	Separate Anthocyanin Compounds from Flower Petals	
3-4	Extraction and Estimation of Lycopene.	

3-5	Evaluation of Natural Products	
3-6	Estimation of Rutin	
4-1	Identification of Organized and Unorganized Plant Drugs (Opium Latex, Acacia Gum, Catecha Extract, Aloe Juice).	<b>CR 04</b>
4-2	Determination of pH of Fresh and Dry Material of the Following Plants (Oscimum, Adhatoda Leaves, Terminalia arjuna Fruit,)	
4-3	Chemical Test: For Acacia	
4-4	Determination of Stomatal Number	
4-5	Systematic Pharmacognostic Study of Cinnamon	
4-6	Systematic Pharmacognostic Study of Clove	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT604-P01	Lab Activities on BOT601, BOT602 & BOT603 - Complied	2024	Publication 2882 & 2646, YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BNY133-P01	Lab Activities -Prof. Rajesh. B. Nagare	2023	Publication 2882 YCMOU, Nashik
BNY136-P02	Lab Activities - Dr. M. B. Patil	2023	Publication 2646 YCMOU, Nashik
BOT604-T01	Cytogenetics and Plant Breeding	2023	YCMOU, Nashik
BOT604-T02	Advanced Plant Physiology - Dr. V. B. Kadam	2023	YCMOU, Nashik
BOT603-T01	Pharmacognosy - Dr. Sudhin. C. Dalave	2023	YCMOU, Nashik
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT604:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT604:WL1			

### COURSE OUTCOMES

After successful completion of this course, student should be able to

- Identify and interpret chromosomal abnormalities in plant cells.
- Apply cytogenetics to plant breeding by selecting parents with desirable traits and using various breeding methods.
- Design and execute breeding experiments using proper techniques.
- Evaluate the results of breeding experiments and draw conclusions about the effectiveness of the breeding methods used.
- Understand the basic principles of plant physiology, such as photosynthesis, respiration,

transpiration, and the role of hormones in plant growth and development.

- Apply these principles to the study of plant growth, development, and responses to the environment.

## BOT605: RESEARCH PROJECT

### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern}

### COURSE INFORMATION

Sem	Other	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	RP	BOT605	Research Project	4	12	120	50	50	100	PW

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>BSc/BA with Mathematics or equivalent from a recognized University/Board.</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Evaluate the process and outcomes of an experiment quantitatively and qualitatively,</li> <li>Extend the scope of an investigation whether or not results come out as expected.</li> <li>Develop a research question or hypothesis.</li> <li>Conduct a literature review.</li> <li>Design and conduct an experiment.</li> <li>Analyze and interpret data.</li> <li>Write a research report.</li> <li>Present research findings.</li> </ul>

### GUIDELINES:

No	Guidelines for the Students and Study Centers for the conduct of Project
1	The "Project Work" course aims to imbibe in students the principle that working is learning. Learning and working are two sides of the same coin and thus, work experience enhances the learning.
2	<p>This course is based on preliminary research oriented topics both in theory and experiment.</p> <p>The subject expert/ counsellor will act as supervisors for the projects.</p> <p>Project shall be on the current and relevant topics and issues.</p> <p>Project topic is jointly finalized by the student and the project supervisors through discussion.</p> <p>At the completion of the project by the semester end, the student will submit a Project Report in the form of Dissertation which will be examined by the examiners. The end examination shall consist of</p> <p>(a) Presentation and (b) Comprehensive viva-voce.</p>
3	Students are expected to work on "Project Work" for about 6 hours per week (About 2 hour's self-study at residence and 12 hours in counselling session at study centre), during a semester. <b>Thus only those projects, demanding such study efforts on all those</b>



	<b>activities, listed in above, should be selected.</b>
4	<b>A single student will have to do a project.</b> Since. The student invests his energy, time and resources in a project. The project therefore should, have important focus on some relevant practical aspects. This will help student to justify his efforts on project.
5	Employed Students are allowed to complete “Project Work” in the industry where he/ she is employed or his/ her place of choice. Such a student has to identify a resource person in industry, who can take responsibility of guiding him in project work. Such person should be eligible to work as “ProjectGuide”.
6	Study centre should assist unemployed students, in locating sponsored “Projects” from local industries. Students are encouraged to locate sponsored projects from the local industries. <b>But, in case, a student is unable to locate such project, he is also allowed to complete “Project Work” at his study center.</b>
7	<b>The Project Work must involve practical research work related to your selected discipline.</b>
8	Students have to finance expenditure on “Project” by his own. Hence students should select those projects, accordingly.
9	Each “Project Guide” may be assigned <b>maximum</b> 5 students.
10	The original design requirements <b>are not essential</b> , although highly encouraged. Hence, normally, projects should not be repeated. The same project undertaken in recent past, by past students, should be avoided. But it is most important that, students must put his independent study efforts on the project. Thus, student should gain practical project execution knowledge about making some useful product, after he goes through all projects completion steps listed above.
11	There project report should be file bound/spiral bound/hard bound and should have following format <ul style="list-style-type: none"> <li>• <b>Title Page/Cover page</b></li> <li>• <b>Certificate endorsed by Project Guide/Supervisor, Learner Support Center Coordinator and Head</b></li> <li>• <b>Declaration for followed ethical practice and non-plagiarism</b></li> <li>• <b>Acknowledgement</b></li> <li>• <b>Abstract of the project</b></li> <li>• <b>Table of Contents</b></li> <li>• <b>List of Figures</b></li> <li>• <b>List of Tables</b></li> <li>• <b>Chapters of Project Report –</b> <p><b>Chapter 1: Introduction:</b> Background of the project, Need for the project, Brief idea of the project, Literature review, Aims and Objectives of the project</p> <p><b>Chapter 2: Design and Methodology:</b> overview of the complete project, the scientific principles involved in the design of the project, Block Diagrams, Experimental/Theoretical Methodology/Circuit/Model/ materials required, etc.</p> <p><b>Chapter 3: Testing, Conduct of Experiment/ Module:</b> Actual conduct of experiment, Majorments, observations, etc.</p> <p><b>Chapter 4: Analysis of Data:</b> Analysis of the data and observations received during experimentation</p> <p><b>Chapter 5: Results, Discussion and Conclusions:</b> Discuss why the specifications were not met or the reasons for the failure, if any. Discussed the problems and</p> </li> </ul>

	<p>difficulties encountered and how they were / can be eliminated. Discuss any extension work or modifications, which you want to suggest.</p> <p><b>Chapter 6: References:</b> List the books, reference books, journals, websites, magazines and data manuals used, etc.</p>
12	<p><b>Project Report Submission Process:</b> Student should prepare 2 copies of the Project Report. At the beginning, the respective Project Guide must approve both copies positively before the end examination of Project Work. Then respective Study Center Coordinator approves both copies of the Project Report. Student should submit one of these approved copies to the study center. The student should retain remaining one of these approved copies. Study center should preserve their copy of, all project reports, till the end examination of Project Work. <b>Even student must bring his own copy during this end examination.</b></p>
13	<p><b>Project Report Format:</b></p> <ol style="list-style-type: none"> <li>The project report should be printed on only right side of A4 size (210 mm × 297 mm) paper. There is no minimum or maximum page number limit for the “Project Report”, but report of minimum 50–70 pages is expected. University recommends only flexible binding for the “Project Report”. But, if student wishes, he may also use spiral binding.</li> <li>Margins should be as follows: <ul style="list-style-type: none"> <li>Left Margin : 40mm</li> <li>Right Margin : 20mm</li> <li>Top Margin : 20mm</li> <li>Bottom Margin : 27mm</li> </ul> </li> <li>Header should not be used. Footer, containing page number at the center should only be used, with footer margin of 25mm.</li> <li>Text should be printed in font size of 12 points and at interline distance of 18 points. (That is 1.5 line spacing). Normally, figures should be embedded in the text, where their first reference occurs. But if necessary, figures may be grouped on separate pages. Figure should be numbered as ‘Fig C.F’, where ‘C’ is chapter number and ‘F’ is figure number. Figure number ‘F’ is reset back to 1 for each new chapter.</li> </ol> <p><b>Page Sequence:</b> (1) Cover page as per specimen 1 (2) Certificate page as per specimen 2 (3) Acknowledgement page for the help offered by individuals and institution (4) Content page as per specimen 3. Following suggested scheme of chapters in project report then follows these first 4 pages.</p>

14	<b>Specimen of Pages</b>	<b>Specimen 2</b>	
	<b>Specimen 1</b>	<b>Certificate</b>	
	<b>Project Title- M.Sc. in .....</b>	This is to certify that	
	<b>Submitted by</b>	Mr/Ms.....	
	<b>Name of Student-</b>	.....(PRN ... )	
<b>Name of Project Guide-</b>	has successfully completed a project		
<b>Name of the Learner Support</b>	entitled "....."		
<b>Center–</b>	in partial fulfilment for the requirement of		
<b>Yashwantrao Chavan</b>	<b>Master of Science in .....</b>		
<b>Maharashtra</b>	Signature with Date		
<b>Open University</b>	Project Guide	LSC Coordinator	
<b>20... - ...</b>	Internal Examiner	External Examiner	

### **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Define the terms "research question", "hypothesis", "literature review", "experiment", "data analysis", "research report", and "presentation" and explain their relationship to each other.
- Develop a research question or hypothesis that is relevant to the field of botany.
- Conduct a literature review to identify relevant research and theories.
- Design and conduct an experiment to test the hypothesis.
- Analyze and interpret data using appropriate statistical methods.
- Write a research report that clearly presents the findings of the experiment.
- Present research findings to an audience in a clear and concise manner.

## BOT606: BIOSTATISTICS (ELECTIVE)

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ymou.ac.in/">http://www.ymou.ac.in/</a> and <a href="http://ymou.digitaluniversity.ac/">http://ymou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSE	BOT606	Biostatistics	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	Objectives of this course are to <ul style="list-style-type: none"> <li>Calculate data using statistics</li> <li>Handle data statistically.</li> <li>Understand the principles of statistics.</li> <li>Apply statistical methods to the analysis of botanical data.</li> <li>Communicate effectively about statistical results.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01	<b>Presentation of Data</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks</li> </ul> (LAQ may contain sub-questions (a), (b) and so on.)
01-02	<b>Majors of Locations and Dispersion</b>		
01-03	<b>Deviation</b>		
01-04	<b>Probability and Distributions</b>		
02-01	<b>Correlation and Regression</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
02-02	<b>Linear regression and equations of line of regression</b>		
02-03	<b>Sampling</b>		
02-04	<b>Probability and non-probability sampling</b>		
03-01	<b>Types of sampling</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
03-02	<b>Tests of significance</b>		
03-03	<b>Chi- square Distribution</b>		
03-04	<b>Experimental Designs</b>		
04-01	<b>Latin square designs</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	
04-02	<b>ANOVA</b>		
04-03	<b>Two way ANOVA</b>		
04-04	<b>Uses of ANOVA</b>		

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Presentation of Data:</b> Frequency distributions; graphical presentation of data by histogram, frequency polygon, frequency curve and cumulative frequency curves.	<b>CR 01</b>
1-2	<b>Majors of Locations and Dispersion:</b> Mean, median, mode and their simple properties (with-out derivation) and calculation of median by graphs;	

1-3	<b>Deviation:</b> Range, mean deviation, standard deviation, standard error, coefficient of variation.	
1-4	<b>Probability and Distributions:</b> Random distributions; events exhaustive, mutually exclusive and equally likely; definition of probability (with simple exercises); definitions of binomial, Poisson and normal distributions; and simple properties of the above distributions (without derivation).	
2-1	<b>Correlation and Regression:</b> Bivariate data-simple correlation and regression coefficients and their relation; Spearman rank correlation; limits of correlation coefficient; effect of change of origin and scale on correlation coefficient;	<b>CR 02</b>
2-2	<b>Linear regression and equations of line of regression:</b> association and independence of attributes.	
2-3	<b>Sampling:</b> Concept of population and sample; random samples; methods of taking a simple random sample.	
2-4	<b>Probability and non-probability sampling:</b> Concept and difference	
3-1	<b>Types of sampling:</b> Simple random sampling, Systematic sampling. Stratified sampling. Clustered sampling. Convenience sampling. Quota sampling Judgement (or Purposive) Sampling. Snowball sampling.	<b>CR 03</b>
3-2	<b>Tests of significance:</b> Sampling distribution of mean and standard error; z and t-test (equality of means; paired and unpaired t-test); t-test for comparison of means when variances of two populations differ;	
3-3	<b>Chi- square Distribution:</b> Chi- square test for goodness of fit; independence of attributes, and homogeneity of samples; interrelation between t-test and F-Test	
3-4	<b>Experimental Designs:</b> Principles of experimental designs; completely randomized, randomized complete block design(missing lot value in RBD)	
4-1	<b>Latin square designs:</b> Latinsquare designs, augmented block design, simple factorial experiments (mathematical derivations not required)	<b>CR 04</b>
4-2	<b>ANOVA:</b> Analysis of variance(ANOVA): One way ANOVA	
4-3	<b>Two way ANOVA:</b> Introduction, Use and Application	
4-4	<b>Uses of ANOVA:</b> Use including estimation of LSD (CD)	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT606-T01	Biostatistics –	2023	YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT606:RB1	Elements of Biostatistics – Sadguru Prasad.		Rastogi Publications, Meerut.
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT606:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT606:WL1			

### **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Calculate basic statistical Measures, such as the mean, median, and standard deviation.
- Use statistical software to analyze botanical data.
- Interpret the results of statistical analyses.
- Communicate the results of statistical analyses in a clear and concise manner.

## BOT607: MYCOLOGY AND PLANT PATHOLOGY (ELECTIVE)

### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSE	BOT607	Mycology and Plant Pathology	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Understanding structure, reproduction of bacteria, viruses, fungi and mycorrhiza.</li> <li>Understanding &amp; Application of knowledge human diseases caused by various fungi</li> <li>Understanding fungal metabolite production and its uses.</li> <li>Know the history, milestones in phytopathology of India</li> <li>Knowledge on host-parasite relationship, defence mechanism in host.</li> <li>Knowledge on bacterial, viral, mycorrhizal and nematode diseases, symptoms and their importance.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01	<b>General Microbiology</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)</li> </ul>
01-02	<b>Rickettsia- General Characters</b>		
01-03	<b>Mycorrhiza</b>		
01-04	<b>Medical Mycology</b>		
02-01	<b>Production of Metabolites</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
02-02	<b>Non Industrial Fungal Metabolites</b>		
02-03	<b>Fungi as welfare to human beings</b>		
02-04	<b>Concept of biodeterioration and Biodegradation</b>		
03-01	<b>History: Milestones in phytopathology</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
03-02	<b>Altered metabolism of plants</b>		
03-03	<b>Principles of Plant pathology</b>		
03-04	<b>Defence mechanism in host plants against pathogens</b>		



04-01	<b>Detailed study of the Diseases of the following crops</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	
04-02	<b>Diseases of Vegetable crops</b>		
04-03	<b>Bacterial diseases of plants</b>		
04-04	<b>Mycoplasma/Phytoplasma (PPLO) Diseases of Plants</b>		

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>General Microbiology:</b> Bacteria- Morphology, size, shape, structure, Characters of Eubacteria, Actinomycetes, Archaeobacteria, Bacterial nutrition, reproduction.	<b>CR 01</b>
1-2	<b>Rickettsia-</b> General Characters: Fungal diversity in different ecosystems, effect of environment on fungal growth and behaviour.	
1-3	<b>Mycorrhiza:</b> 1. Kinds of mycorrhizae. Ectotrophic and endotrophic mycorrhizae, their morphology and anatomy. V A-mycorrhiza. Mycorrhiza in plant growth promotion, mycorrhiza in plant disease control. 2. Rhizosphere and phyllosphere -General concept and importance.	
1-4	<b>Medical Mycology-</b> Dermatophytic fungi -Knowledge of common dermatophytes and human diseases caused by them viz. Tinea pedis, Tinea capitis, Tinea barbae. Tinea, corporis and Tinea manuum; Aspergillosis, fungi allergic to human beings.	
2-1	<b>Production of Metabolites by Fungi:</b> A) Industrial Fungal Metabolites: i) Antibiotics - Penicillin, Cephalosporin, Griseofulvin, Industrial production of Penicillin ii) Enzymes - Amylase, proteases, Lipases, Pectinases, Cellular and xylanases. iii) Organic acids -Citric acid, Gluconic acid, lactic acid, kojic acid, Itaconic acid.	<b>CR 02</b>
2-2	<b>Non Industrial Fungal Metabolites:</b> i) Phytoalexins, ii) Mycotoxins	
2-3	<b>Fungi as welfare to human beings:</b> i) Fungi in food processing: soybean products, cheese, fermented milk, other fermented foods. ii) Fungal metabolites – General account of production and application: Primary metabolites (vitamins, proteins), Secondary metabolites (antibiotics, pigments, alkaloids) iv) Fungi as food -edible mushrooms, methods of their cultivation.	
2-4	<b>Concept of biodeterioration and Biodegradation:</b> a) Biodeterioration of non-cellulosic materials (leather, plastics, hydrocarbons, pesticides) b) Biodeterioration of cellulosic materials. c) Role of microorganisms in Biodegradation of organic wastes. Factors affecting the process of Biodegradation.	
3-1	<b>History: Milestones in phytopathology</b> with particular reference to India. Major epidemics and their social impacts. Historical developments of chemicals, cultural and biological protection measures.	<b>CR 03</b>
3-2	<b>Altered metabolism of plants</b> under biotic and abiotic stresses. Koch's Postulates, Epidemiology and forecasting of plant diseases, Indian Institutes and their research activities in Mycology and Plant Pathology.	
3-3	<b>Principles of Plant pathology:</b> i. Principles of plant pathology-Importance, nature, classification and general symptoms of plant diseases. ii. Pathogenicity of microorganisms and pathogenesis. iii. Host parasite relationship and Interaction; Signal transduction.	
3-4	<b>Defence mechanism in host plants against pathogens :</b> morphological or structural defence mechanism; Biochemical defence mechanisms - role of phenolic compounds, enzymes and toxins, v. Principles and methods of plant disease control -cultural methods, chemical methods, Biological control, transgenic approach for plant disease control, integrated pest management (IPM), Biopesticides.	



4-1	<b>Detailed study of the Diseases:</b> Following crops caused by fungal pathogens with effective control measures. Diseases of Cereals: Seedling blight of cereals, Smut of wheat, Foot rot of wheat, Covered smut of Barley, False smut of rice, Downey mildew of jowar, Green ear disease of Bajra, Ergot of Bajra, Downey mildew of maize.	<b>CR 04</b>
4-2	<b>Diseases of Vegetable crops:</b> With special reference to the important diseases of the following: Chilli, Brinjal, Tomato, Onion, Bhindi. General knowledge of post harvest diseases of fruits and vegetables and their control. Diseases of Oil Seed Crops viz. Linum, Sesamum, Groundnut, Mustard and Sunflower. Diseases of Fruit Trees-With special reference to important diseases of the following Citrus, Apple, Mango, Banana and Grapes.	
4-3	<b>Bacterial diseases of plants:</b> Bacterial blight of rice, Tundu disease of wheat, Angular leaf spot of cotton, stalk rot of maize, Fire blight of Apple, Bacterial soft rot of fruits and Vegetables. <b>Viral Diseases of Plant:</b> Bunchy top of Banana, Leaf curl of Papaya, Yellow vein mosaic of Bhindi. Mosaic of Cucurbits, Viral diseases of Tobacco, Potato and Tomato.	
4-4	<b>Mycoplasma/Phytoplasma (PPLO) Diseases of Plants:</b> Citrus greening, Rice yellow dwarf: Little leaf of Brinjal, Sandal Spike. <b>Nematode Diseases of Plants:</b> General knowledge of plant parasitic nematodes and important nematode diseases viz. Root knot of Vegetables, Ear cockle of wheat.	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT607:T01			
Reference-Books: Explore additional details and reinforce learning, with this optional learning resource!			
BOT607:RB1	Plant Pathology - Agrios, G.N.	1980	Academic Press, INC, New York. 2
BOT607:RB2	The Fungi, An advance Treatise Vol.I, II, III & IV – Ainsworth, G.C. and A.S.Sussman (eds).		Academic Press, New York.
BOT607:RB3	Introductory Mycology – Alexopoulos, C.J.	1962	John Wiley Eastern Pvt. Ltd.
BOT607:RB4	Introductory Mycology - Alexopoulos, C.J. and Mims C.W	3rd Edition 1979	John Wiley and Sons, Inc. Wiley, New York
BOT607:RB5	Mims and Black well - Alexopoulos, C.J.	4th ed 1996	John Wiley and Sons, Inc. Wiley, New York
BOT607:RB6	Experimental in Microbiology, Plant Pathology & Tissue Culture – Aneja, K.R.	1993	Wiswa Prakashan, New Delhi
BOT607:RB7	Morphology and Taxonomy of Fungi - Bessey, E.A.	1950	The Blakiston co. Philadelphia
BOT607:RB8	A text Book of Modern Plant Pathology -Bilgrami, K.S. and H.C.Dube	1985	Vikas Publication House, New Delhi
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT607:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT607:WL1			

## **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Learning the structure, life cycles, economic importance etc of bacteria, virus, fungi and apply this knowledge in identification of organisms.
- Analysis of diseases based on symptoms, and apply knowledge for identification of disease
- Understanding and application of knowledge of fungal metabolites, their uses for human welfare.
- Knowledge on the history, milestones in phytopathology of India
- Learn host-parasite relationships, various diseases and control methods.
- Practical knowledge on disease control measures in various crops.
- Knowledge on bacterial, viral, mycorrhizal and nematode diseases, symptoms and their importance.

## BOT608: RENEWABLE ENERGY STUDIES

### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in">http://www.ycmou.ac.in</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V152: M.Sc.(Environmental Science) {2023 Pattern}, V153: M.Sc (Physics) {2023 Pattern}, V156: M.Sc.(Botany) {2022 Pattern}, V141: M.Sc (Physics) {2022 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
03	DSE	BOT608	Renewable Energy Studies	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	<p>The objectives of this course are–</p> <ul style="list-style-type: none"> <li>Gain a solid understanding of various renewable energy technologies</li> <li>Familiar with energy policies and regulations</li> <li>Assess the environmental impact of renewable energy technologies</li> <li>Develop research skills to conduct independent studies</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01	<b>Indian Energy Scenario</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks</li> </ul> (LAQ may contain sub-questions (a), (b) and so on.)
01-02	<b>Various types of energy sources</b>		
01-03	<b>Energy Security</b>		
01-04	<b>Non Renewable Energy sources &amp; Renewable Energy sources</b>		
02-01	<b>Importance of Solar Energy</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
02-02	<b>Basics of Heat transfer</b>		
02-03	<b>Solar Radiation and Its Measurements</b>		
02-04	<b>Selective coatings</b>		
03-01	<b>Solar Photovoltaics (SPV)</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
03-02	<b>Application of SPV</b>		
03-03	<b>Solar Thermal Devices and Systems</b>		
03-04	<b>Solar Devices</b>		
04-01	<b>BioEnergy, Biogas, Biofuel</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	
04-02	<b>Hydrogen Energy</b>		
04-03	<b>Wind Energy</b>		
04-04	<b>Energy Storage</b>		

## DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Indian Energy Scenario:</b> Role of energy in economic development and social transformation, Energy and Gross Domestic product (GDP), Gross National Product (GNP) and its dynamics	<b>CR 01</b>
1-2	<b>Various types of energy sources:</b> Energy sources and overall energy demand, Availability of energy sources, Energy consumption in various sectors and its changing pattern, projected energy demands	
1-3	<b>Energy Security:</b> Energy for security and security of energy, Energy consumption and its Impact on environmental climatic change, Future Energy Option: Sustainable development, Energy crisis, Transition from carbon Free technologies, Parameters of transition, Carbon credits.	
1-4	<b>Non Renewable Energy sources:</b> Coal, Oil, Natural gas, Nuclear power, Hydroelectricity, <b>Renewable Energy sources:</b> Solar ,Wind, Biomass, Tidal, Ocean wave, Ocean thermal, Geothermal and other, Depletion of energy sources and impact of exponential rise in energy, consumption on economics of India and on international relations.	
2-1	<b>Importance of Solar Energy:</b> Nature of solar radiation, Sun as a fusion reactor, special distribution of extraterrestrial radiation	<b>CR 02</b>
2-2	<b>Basics of Heat transfer:</b> Heat and Thermodynamics: Basic units, dimensions, Concept of heat, energy and work, Ideal gas flow, 1st and 2nd law of thermodynamics. <b>Types of heat transfer:</b> Conductive, Radioactive, Convective	
2-3	<b>Solar Radiation and Its Measurements:</b> Estimation of extraterrestrial solar radiation, Radiation on horizontal and tilted surfaces, Beam, diffuse, global radiation and their measurement.	
2-4	<b>Selective coatings:</b> Ideal characteristics of selective coating for various applications, Types of selective coatings, materials and techniques for selective coatings, Effect of selective coating on the efficiency of solar collectors.	
3-1	<b>Solar Photovoltaics (SPV):</b> Solar Photovoltaics (SPV) Conversion, Basic principles, Types of solar cell materials, Fabrication of solar photovoltaic cells, solar cell parameters and characteristics, Block diagram of general SPV conversion system and their characteristics, Different configurations	<b>CR 03</b>
3-2	<b>Application of SPV:</b> Such as street light, water pumps, Radio/TV, Small capacity power generation, Solar Photovoltaic (SPV) Systems Designing : Load estimation, selection of inverters, battery sizing, array sizing	
3-3	<b>Solar Thermal Devices and Systems :</b> Different types of collectors, Flat plate collector(Basic principle, construction), Energy balance equation of steady state, Testing, Methods to reduce losses	
3-4	<b>Solar Devices:</b> Solar cookers, Domestic hot water system, Solar dryers, solar pond, Solar still, Solar furnace, Solar refrigeration, Solar concentrators, systems based on use of solar concentrators	
4-1	<b>Bio Energy:</b> Biomass, Generation and utilization, Property of biomass, Agriculture crop and Forestry residues used as fields. Physical, Chemical and biological conversion of biomass into useful form of energy. Gasification, Biomass gasifiers and types. <b>Biogas:</b> Generation of biogas, Aerobic and anaerobic bioconversion process. Substances used to produce biogas, Digesters and their designs, Pyrolysis and gasification, Fermentation process <b>Biofuels:</b> Types of biofuels, Production processes, Biofuel applications	<b>CR 04</b>
4-2	<b>Hydrogen Energy:</b> Hydrogen Fuel: Importance of Hydrogen as a future fuel, Sources of Hydrogen, Fuel of vehicles, Hydrogen production : Production of Hydrogen by various methods, Direct electrolysis of water, decomposition of water, Biological and biochemical methods of hydrogen production, Hydrogen storage : Gaseous, Cryogenic and Metal hydride. Utilization of hydrogen : Fuel cell – Principle, construction and applications	

4-3	<b>Wind Energy:</b> Introduction, Basic principle of wind energy conversion, Extraction of maximum power from wind and its dependence on various parameters. Wind Mills : Types of wind mills, Vertical axis and Horizontal axis wind mills their performance, Merits and Demerits, Limitations of wind energy conversions	
4-4	<b>Energy Storage:</b> Types of energy storage systems : sensible and latent heat storage systems, Electric energy storage systems, Chemical energy storage systems, Heat exchanges, Hydro-storage, solar pond as a energy storage, Green house	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Text-Books</b>			
BOT6o8			
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT6o8–RB1	Solar Energy Thermal Processes – J.A.Duffie and W.A.Beckman	1980	John Wiley and Sons
BOT6o8–RB2	Heat and Thermodynamics – M.W.Zemansky		McGrawHill Publication
BOT6o8–RB3	Renewable Energy Sources and Conversion Technology, – N.K. Basal, M. Kleeman And S.N.Srinivas	1996	Tata Energy Research Institute, NewDelhi
BOT6o8–RB4	Renewable Energy Technology: A practical guides of beginners, – Chetan Singh Solanki		PHI Learning Private-Ltd., NewDelhi
BOT6o8–RB5	Non-conventional Energy sources, - G.D.RAI		Khanna Publishers, Delhi
BOT6o8–RB6	Solar Energy Utilization, - G.D.Rai		Khanna Publishers, Delhi
<b>CD/ DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT6o8-CD1			
<b>WebLinks:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT6o8-WL1			

### COURSE OUTCOMES

<p>After successful completion of this course, student should be able to –</p> <ul style="list-style-type: none"> <li>• Critically analyze and evaluate different renewable energy technologies and their suitability for specific contexts.</li> <li>• Capability of planning, designing, and managing renewable energy projects, considering technical, economic, and regulatory aspects.</li> <li>• Demonstrating an understanding of the environmental and social implications of renewable energy deployment and make informed decisions to minimize negative impacts.</li> <li>• Navigating energy policies and regulations and advocate for sustainable and renewable energy initiatives.</li> </ul>
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## SEMESTER 4

### BOT609: TAXONOMY OF ANGIOSPERMS

#### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern]

#### COURSE INFORMATION

Sem	MAJOR	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	DSC	BOT609	Taxonomy of Angiosperms	4	12	120	30	70	100	T

#### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>B. Sc with Botany or equivalent from a recognized University/Board.</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Explain applications of taxonomy</li> <li>Enlist importance of angiosperms.</li> <li>Understand the principles of taxonomy and classification.</li> <li>Identify and classify angiosperms using morphological, anatomical, and molecular data.</li> <li>Understand the evolutionary history of angiosperms.</li> <li>Apply taxonomic principles to the study of angiosperms in the field and laboratory.</li> <li>Communicate effectively about angiosperm taxonomy.</li> </ul>

#### UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	<b>Introduction And General Account To Taxonomy</b> <b>Phylogenetic classification</b> <b>Plant Nomenclature</b> <b>Citation</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	<p>As per evaluation pattern, on <b>Each Credit</b>, Student is required to answer</p> <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks</li> </ul> <p>(LAQ may contain sub-questions (a), (b) and so on.)</p>
02-01 02-02 02-03 02-04	<b>Taxonomic Literature</b> <b>Maintenance And Significance Of Herbarium</b> <b>Families I</b> <b>Families II</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
03-01 03-02 03-03 03-04	<b>Families III</b> <b>Families IV</b> <b>Families V</b> <b>Families VI</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
04-01 04-02 04-03 04-04	<b>Modern Taxonomy</b> <b>Computer application in taxonomy</b> <b>Taxonomic Evidences</b> <b>Serological Characters And Molecular Approach</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	

## DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Introduction And General Account To Taxonomy-</b> Definition, scope and objectives of taxonomy; Taxonomic hierarchy; A critical study of principles, outline and phylogeny of Angiospermic classification of Linnaeus (Artificial system of classification), Bentham and Hooker (Natural system of Classification),	<b>CR 01</b>
1-2	<b>Phylogenetic classification:</b> Engler and Prantl (Phylogenetic classification); Hutchinsons classification; a brief account on Angiosperm Phylogeny Group I, II and III (APG System).	
1-3	<b>Plant Nomenclature</b> – Major rules; problems of common/vernacular names; binomial nomenclature, importance, principles and aims of ICN (ICBN); codes, principles and priorities; Typification; Nominaconsevanda;	
1-4	<b>Citation;</b> Rejection of names; Valid and effective publication; Principles of priority and limitation of priority; Rules and Recommendations; International Code of Nomenclature for Cultivated Plants (ICNCP).	
2-1	<b>Taxonomic Literature-</b> Floras, Monographs and Revisions; Bibliography, Botanical Survey of India; general account of keys;	<b>CR 02</b>
2-2	<b>Maintenance And Significance Of Herbarium:</b> Method of preparation, maintenance and significance of herbarium; Botanical gardens - Kew, Calcutta and Bangalore.	
2-3	<b>Families I</b> - Salient features, morphological peculiarities, systematic position, affinities and economic importance of the following families – Dicots - Polypetalae – Myrtaceae, Meliaceae	
2-4	<b>Families II</b> Sapindaceae, Combretaceae and Umbelliferae	
3-1	<b>Families III:</b> Dicots - Gamopetalae – Solanaceae, Acanthaceae, Rubiaceae,	<b>CR 03</b>
3-2	<b>Families IV:</b> Scrophulariaceae and Asteraceae.	
3-3	<b>Families V:</b> Monocots – Cannaceae, Poaceae, Orchidaceae,	
3-4	<b>Families VI:</b> Musaceae and Arecaceae	
4-1	<b>Modern Taxonomy:</b> Cytotaxonomy, Numerical taxonomy,	<b>CR 04</b>
4-2	<b>Computer application in taxonomy:</b> Chemotaxonomy and Computer application in taxonomy.	
4-3	<b>Taxonomic Evidences:</b> Study of morphological, anatomical, embryological, palynological.	
4-4	<b>Serological Characters And Molecular Approach:</b> serological characters and molecular approach (DNA finger printing) and ecology in relation to taxonomy.	

## LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT609:RB1	Economic Botany, Bendre and Kumar		Rastogi Publication, Meerut.
BOT609:RB2	Taxonomy of Angiosperm, Singh and Jain		Rastogi Publication, Meerut
BOT609:RB3	Plant Taxonomy O.P. Sharma Tata Mc Graw – Hill, Economic Botany BD Pandey		S. Chand & Comp Ltd New Delhi



BOT609:RB4	Plant Taxonomy, Saxena and Saxena,		Pragathi Prakashan, Meerut
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT609:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT609:WL1			

### **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Identify and classify angiosperms by their common and scientific names.
- Describe the morphological, anatomical, and molecular features of angiosperms.
- Explain the evolutionary history of angiosperms.
- Apply taxonomic principles to the study of angiosperms in the field and laboratory.
- Communicate effectively about angiosperm taxonomy through written reports, presentations, and other media.



## BOT610: SEED TECHNOLOGY

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	DSC	BOT610	Seed Technology	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	Objectives of this course are to <ul style="list-style-type: none"> <li>Assure rapid seed multiplication of desirable varieties.</li> <li>Increase agricultural production.</li> <li>Understand the basic principles of seed technology.</li> <li>Apply these principles to the production, processing, and storage of seeds.</li> <li>Communicate effectively about seed technology.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01	<b>Introduction</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)</li> </ul>
01-02	<b>Seed Classification and Morphology</b>		
01-03	<b>Seed Dormancy and Seed Germination</b>		
01-04	<b>Genetic Purity</b>		
02-01	<b>Quality testing</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
02-02	<b>Seed Production</b>		
02-03	<b>Procedure of seed production</b>		
02-04	<b>Seed Testing</b>		
03-01	<b>Field Inspection</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
03-02	<b>Seed Pathology</b>		
03-03	<b>Seed entomology</b>		
03-04	<b>Seed Processing</b>		
04-01	<b>Seed treatment</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	
04-02	<b>Packaging and handling of seeds</b>		
04-03	<b>Seed Deterioration and Seed Storage</b>		
04-04	<b>Seed legislation</b>		

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit ( Application Oriented problems)	CR
1-1	<b>Introduction:</b> Scope, Importance and Definition of Seed Technology, Definition, Difference between seed and grain.	<b>CR 01</b>
1-2	<b>Seed Classification and Morphology:</b> Orthodox and Recalcitrant seed, Classes of seed, Seed quality characteristics, Seed structure (embryo, endosperm and seed coat), Chemical	

	composition of seed (carbohydrates, proteins, oils, fats and other)	
1-3	<b>Seed Dormancy and Seed Germination:</b> Definition of dormancy, Types of dormancy, Causes of seed dormancy, Methods of breaking dormancy, Definition of seed germination, Types of germination, Factors affecting seed germination, Seed vigour, Seed ageing and Seed viability,	
1-4	<b>Genetic Purity:</b> GOT (grow out test), Germination testing, its methods (paper, sand and soil), evaluation and reporting of results.	
2-1	<b>Quality testing:</b> Moisture testing: Moisture Meter and Air oven method, Physical purity analysis, Biochemical tests (Quick viability test (Tz), Peroxidase and Phenol colour test), Aids for varietal identification: PCR, RAPD, RFLP, DNA finger printing, ELISA test.	
2-2	<b>Seed Production:</b> General Principles of seed production, Artificial pollination (Hand pollination, Dusting and Honey bee), Seed production techniques in hybrids (use of Male Sterility, Self Incompatibility and gametocides).	
2-3	<b>Procedure of seed production:</b> Procedure of seed production in tomato, okra, soybean, cotton and maize (Land requirements, isolation requirements, brief cultural practices, plant protection-physical, chemical and biological, types of chemical pesticides-systemic and contact, roguing, harvesting and threshing), True potato seed (TPS), Artificial Seed Production.	<b>CR 02</b>
2-4	<b>Seed Testing:</b> Objectives and Definition, ISTA, CSTL and SSTL, Seed Sampling: Definition, Sampling, Dividing and Mixing equipments, Procedure of sampling, (Kinds-Primary, composite, submitted and working), Types of seed samples (Service, official and certification sample)	
3-1	<b>Field Inspection:</b> Seed inspector, powers and duties, Number of inspection with reference to stage of crop, Procedure and observations during field inspection	
3-2	<b>Seed Pathology:</b> Definition, Mechanism of seed transmission and entry point of seed infection (soil, air, insect and nematodes), Quarantine for seed, Integrated management of seed borne diseases, Seed health testing methods.	<b>CR 03</b>
3-3	<b>Seed entomology:</b> Relation of insects and plants, Pest of fibre crop, pulses, vegetable and storage grain pest (Any one example from each) with respect to their life cycle, way of infestation and control Majors (Physical, Chemical and Biological).	
3-4	<b>Seed Processing:</b> Objectives of seed processing, General layout of seed processing unit, Steps in Seed Processing (Receiving, Drying, Pre-cleaning, Grading, Treatment, weighing, Packing and Storage), Study of Seed processing machineries and its working, Pre-cleaners, Scalper, Debearder and Huller, Seed dryers, Air screen cleaner, Specific gravity separator, Magnetic separator, Colour separator.	
4-1	<b>Seed treatment:</b> Importance, Seed treating equipment- slurry, mist-o-matic and drum mixer. Chemicals used and precautions in seed treatment.	
4-2	<b>Packaging and handling of seeds:</b> Bagger weighed machine, Automatic packing machine, Material used for packing, Handling of seeds: Conveyor and Elevators, Precautions during packaging.	
4-3	<b>Seed Deterioration and Seed Storage:</b> Definition, manifestation and causes of seed deterioration, Prevention Majors of seed deterioration, Definition of seed storage, Factors affecting seed storage, Ideal ware house for seed storage, sanitation, fumigation and dehumidification, Cold storage.	<b>CR 04</b>
4-4	<b>Seed legislation:</b> Seed legislation in India, Types of seed legislation. Seed Certification and Quality Control, General procedure for seed certification, Seed certification Board, Central Seed committee and their functions, Minimum seed certification Standards (Field and Seed)	

## LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT610-T01	Seed Technology - Dr. S. R. Valvi	2023	978-81-19453-02-3 YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT610:RB1	Germination of Seeds. - Mayer, A.M. and A.P. Mayber	1989	. Pergamon Press, Oxford
BOT610:RB2	Advances in Research and Technology of Seeds. Part - 1, 3 & 4. Centre for Agrl. - Thompson, J.R.	1977	Publishing and Documentation, Washington
BOT610:RB3	Anonmyous. Seed Technology in Tropics	1997	. ISTA Zurich.
BOT610:RB4	Principles of Ecology in Plant Production, - Sinclair, T.R. and F.P. Gardner	1997.	CAB international, G.K.
BOT610:RB5	Hybrid Research and Development. Indian Society of Seed Technology. - Rai. M. and S. Mauria.	1995	IARI. New Delhi
BOT610:RB6	Seed Technology - Agrawal, R.L.	1996	, IBH publishing Co., New Delhi.
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT610:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT610:WL1			

## COURSE OUTCOMES

After successful completion of this course, student should be able to

- Define the terms "seed technology", "seed production", "seed processing", and "seed storage" and explain their relationship to each other.
- Understand the basic principles of seed technology, such as the structure of seeds, the germination process, and the factors that affect seed quality.
- Apply these principles to the production, processing, and storage of seeds, such as the selection of seed parents, the production of seedbeds, and the storage of seeds in a cool, dry environment.
- Communicate effectively about seed technology through written reports, presentations, and other media.

## BOT611: LAB ACTIVITIES ON BOT609 & BOT610

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern]

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	DSC	BOT611	Lab Activities On BOT609 & BOT610	4	12	120	50	50	100	P

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	Objectives of this course are to <ul style="list-style-type: none"> <li>Assure rapid seed multiplication of desirable varieties.</li> <li>Increase agricultural production.</li> <li>Understand the basic principles of seed technology.</li> <li>Apply these principles to the production, processing, and storage of seeds.</li> <li>Communicate effectively about seed technology.</li> </ul>

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
	<b>Taxonomy of Angiosperms: Practical</b>	
1-1	Use of Flora; Study of two plants / class (Two families per practical)	<b>CR 01</b>
1-2	Study of Two plants / class (Two families per practical)(Polypetalae – Myrtaceae, Meliaceae, Sapindaceae, Combretaceae and Umbelliferae)	
1-3	Study of Two plants / class (One family per practical) (Gamopetalae – Solanaceae, Acanthaceae, Rubiaceae, Scrophulariaceae and Asteraceae.)	
1-4	Preparation of dichotomous keys	
1-5	Construct the phylogenetic tree based on gene sequences of the given species from NCBI database	
1-6	Study of Two plants / class (One family per practical)(Monocots – Cannaceae, Poaceae, Orchidaceae, Musaceae and Arecaceae (Palmae)	
	<b>Taxonomy of Angiosperms: Practical</b>	
2-1	Study of chemical composition and seed structure.	<b>CR 02</b>
2-2	Study of methods of breaking seed dormancy.	
2-3	Study of seed germination (epigeal, hypogeal and viviparous types).	
2-4	Study of seed germination testing methods (Paper, soil and sand).	
2-5	Study of physical purity test.	
2-6	Moisture Testing by moisture meter and oven method.	

2-7	Study of Sampling, dividing and mixing equipments.	
2-8	Visit to a seed industry and research institute/apiculture.	
<b>Seed Technology- Practical</b>		
3-1	Staining techniques - Histochemical studies – staining technique	<b>CR 03</b>
3-2	Xylem, phloem, maceration ( <i>Aristolochia, Saraca, Tinospora, Cupresses</i> ) and Thickenings in vessels and tracheids; Nodal anatomy - Unilacunar – <i>Nerium</i> ,	
3-3	Embryology – microsporangium – young and old anther; types of pollen (based on availability)	
3-4	Effect of chemical mutagens on seed germination and seedling growth.	
3-5	To study pollen viability and floral morphology of crops.	
<b>Seed Technology- Practical</b>		
4-1	Estimation of total amino acids in germinating and non germinating seeds	<b>CR 04</b>
4-2	Estimation of pollen fertility; Acetolysis of pollen grains	
4-3	Cytochemical localization of stigma – surface esterases	
4-4	Demonstration of seed sampling equipments with the help of photographs and Sampling in Seed Testing Laboratory.	
4-5	Visual Examination of Dry Seeds for Disease Symptoms.	
4-6	To study any one common seed insect pest with respect to their life cycle, way of infestation/ damage, symptoms and control measures.	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT611-PO1	Lab Activities On BOT609 & BOT610 – Dr. S. R. Valvi	2023	YCMOU, Nashik
BOT611-TO1	Taxonomy of Angiosperms – Dr. M. B. Patil & Dr. Amanulla Khan N, Pathan	2023	978-93-95855-73-0 YCMOU, Nashik
BOT611-TO2	Seed Technology - Dr. S. R. Valvi	2023	978-81-19453-02-3 YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT611:RB1	Germination of Seeds. – Mayer, A.M. and A.P. Mayber.	1989	Pergamon Press, Oxford.
BOT611:RB2	Advances in Research and Technology of Seeds. Part - 1, 3 & 4. - Thompson, J.R.	1977	Centre for Agrl. Publishing and Documentation, Washington
BOT611:RB3	Anonmyous. Seed Technology in Tropics.	1997	ISTA Zurich.
BOT611:RB4	Principles of Ecology in Plant Production, – Sinclair, T.R. and F.P. Gardner.	1997.	CAB international, G.K.
BOT611:RB5	Hybrid Research and Development. Indian Society of Seed Technology – Rai. M. and S. Mauria.	1995	IARI. New Delhi.
BOT611:RB6	Seed Technology – Agrawal, R.L.	1996	IBH publishing Co., New Delhi.
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			

BOT611:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT611:WL1			

### **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Write here outcomes.
- Write here outcomes
- Write here outcomes
- Write here outcomes

## BOT612: RESEARCH PROJECT

### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nashik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern}

### COURSE INFORMATION

Sem	Other	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	RP	BOT612	Research Project	6	12	120	75	75	150	PW

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
For successful completion of this course, student should have successfully complete: <ul style="list-style-type: none"><li>B.Sc. with Botany or equivalent from a recognized University/Board.</li></ul>	Objectives of this course are to <ul style="list-style-type: none"><li>Assure rapid seed multiplication of desirable varieties.</li><li>Increase agricultural production.</li><li>Develop a research question or hypothesis.</li><li>Conduct a literature review.</li><li>Design and conduct an experiment.</li><li>Analyze and interpret data.</li><li>Write a research report.</li><li>Present research findings.</li></ul>

### GUIDELINES:

No	Guidelines for the Students and Study Centers for the conduct of Project
1	The "Project Work" course aims to imbibe in students the principle that working is learning. Learning and working are two sides of the same coin and thus, work experience enhances the learning.
2	This course is based on preliminary research oriented topics both in theory and experiment. The subject expert/ counselor will act as supervisors for the projects. Project shall be on the current and relevant topics and issues. Project topic is jointly finalized by the student and the project supervisors through discussion. At the completion of the project by the semester end, the student will submit a Project Report in the form of Dissertation which will be examined by the examiners. The end examination shall consist of (a) Presentation and (b) Comprehensive viva-voce.
3	Students are expected to work on "Project Work" for about 6 hours per week (About 2 hour's self-study at residence and 12 hours in counselling session at study centre), during a semester. <b>Thus only those projects, demanding such study efforts on all those activities, listed in above, should be selected.</b>
4	<b>A single student will have to do a project.</b> Since. The student invests his energy, time and resources in a project. The project therefore should, have important focus on some relevant practical aspects. This will help student to justify his efforts on project.
5	Employed Students are allowed to complete "Project Work" in the industry where he/ she is employed or his/ her place of choice. Such a student has to identify a resource person in industry, who can take responsibility of guiding him in project work. Such person should be eligible to work as



	“ProjectGuide”.
6	Study centre should assist unemployed students, in locating sponsored “Projects” from local industries. Students are encouraged to locate sponsored projects from the local industries. <b>But, in case, a student is unable to locate such project, he is also allowed to complete “Project Work” at his study center.</b>
7	<b>The Project Work must involve practical research work related to your selected discipline.</b>
8	Students have to finance expenditure on “Project” by his own. Hence students should select those projects, accordingly.
9	Each “Project Guide” may be assigned <b>maximum</b> 5 students.
10	The original design requirements <b>are not essential</b> , although highly encouraged. Hence, normally, projects should not be repeated. The same project undertaken in recent past, by past students, should be avoided. But it is most important that, students must put his independent study efforts on the project. Thus, student should gain practical project execution knowledge about making some useful product, after he goes through all projects completion steps listed above.
11	<p>There project report should be file bound/spiral bound/hard bound and should have following format</p> <ul style="list-style-type: none"> <li>• <b>Title Page/Cover page</b></li> <li>• <b>Certificate endorsed by Project Guide/Supervisor, Learner Support Center Coordinator and Head</b></li> <li>• <b>Declaration for followed ethical practice and non-plagiarism</b></li> <li>• <b>Acknowledgement</b></li> <li>• <b>Abstract of the project</b></li> <li>• <b>Table of Contents</b></li> <li>• <b>List of Figures</b></li> <li>• <b>List of Tables</b></li> <li>• <b>Chapters of Project Report –</b></li> </ul> <p><b>Chapter 1: Introduction:</b> Background of the project, Need for the project, Brief idea of the project, Literature review, Aims and Objectives of the project</p> <p><b>Chapter 2: Design and Methodology:</b> overview of the complete project, the scientific principles involved in the design of the project, Block Diagrams, Experimental/Theoretical Methodology/Circuit/Model/ materials required, etc.</p> <p><b>Chapter 3: Testing, Conduct of Experiment/ Module:</b> Actual conduct of experiment, Majorments, observations, etc</p> <p><b>Chapter 4: Analysis of Data:</b> Analysis of the data and observations received during experimentation</p> <p><b>Chapter 5: Results, Discussion and Conclusions:</b> Discuss why the specifications were not met or the reasons for the failure, if any. Discussed the problems and difficulties encountered and how they were / can be eliminated. Discuss any extension work or modifications, which you want to suggest.</p> <p><b>Chapter 6: References:</b> List the books, reference books, journals, websites, magazines and data manuals used, etc</p>
12	<b>Project Report Submission Process:</b> Student should prepare 2 copies of the Project Report. At the beginning, the respective Project Guide must approve both copies positively before the end examination of Project Work. Then respective Study Center Coordinator approves both copies of the Project Report. Student should submit one of these approved copies to the study center. The student should retain remaining one of these approved copies. Study center should preserve their copy of, all project reports, till the end examination of Project Work. <b>Even student must bring his own copy during this end examination.</b>



13	<p><b>Project Report Format:</b></p> <ol style="list-style-type: none"> <li>The project report should be printed on only right side of A4 size (210 mm × 297 mm) paper. There is no minimum or maximum page number limit for the “Project Report”, but report of minimum 50–70 pages is expected. University recommends only flexible binding for the “Project Report”. But, if student wishes, he may also use spiral binding.</li> <li>Margins should be as follows: <ul style="list-style-type: none"> <li>Left Margin : 40mm</li> <li>Right Margin : 20mm</li> <li>Top Margin : 20mm</li> <li>Bottom Margin : 27mm</li> </ul> </li> <li>Header should not be used. Footer, containing page number at the center should only be used, with footer margin of 25mm.</li> <li>Text should be printed in font size of 12 points and at interline distance of 18 points. (That is 1.5 line spacing). Normally, figures should be embedded in the text, where there first reference occurs. But if necessary, figures may be grouped on separate pages. Figure should be numbered as ‘Fig C.F’, where ‘C’ is chapter number and ‘F’ is figure number. Figure number ‘F’ is reset back to 1 for each new chapter.</li> </ol> <p>Page Sequence: (1) Cover page as per specimen 1 (2) Certificate page as per specimen 2 (3) Acknowledgement page for the help offered by individuals and institution (4) Content page as per specimen 3. Following suggested scheme of chapters in project report then follows these first 4pages.</p>								
14	<p><b>Specimen of Pages</b></p> <p><b>Specimen 1</b></p> <p>Project Title- M.Sc. in .....</p> <p>Submitted by Name of Student- Name of Project Guide- Name of the Learner Support Center–</p> <p><b>Yashwantrao Chavan Maharashtra Open University</b></p> <p>20... - ...</p>	<p><b>Specimen 2</b></p> <p><b>Certificate</b></p> <p>This is to certify that</p> <p>Mr/Ms.....</p> <p>.....(PRN..... )</p> <p>has successfully completed a project entitled ". ....." "</p> <p>in partial fulfilment for the requirement of</p> <p><b>Master of Science in .....</b></p> <table border="1"> <tr> <td colspan="2">Signature with Date</td> </tr> <tr> <td>Project Guide</td> <td>LSC Coordinator</td> </tr> <tr> <td>Internal Examiner</td> <td>External Examiner</td> </tr> </table>		Signature with Date		Project Guide	LSC Coordinator	Internal Examiner	External Examiner
Signature with Date									
Project Guide	LSC Coordinator								
Internal Examiner	External Examiner								

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning			

resource!			
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT146:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT146:WL1			

## **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Develop a research question or hypothesis that is relevant to the field of botany.
- Conduct a literature review to identify relevant research and theories.
- Design and conduct an experiment to test the hypothesis.
- Analyze and interpret data using appropriate statistical methods.
- Write a research report that clearly presents the findings of the experiment.
- Present research findings to an audience in a clear and concise manner.

## BOT613: ANATOMY AND EMBRYOLOGY (ELECTIVE)

### PROGRAMME INFORMATION

SN	Description	Details
1	University	Yashwantrao Chavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern} , V144: M.Sc. (Botany) [2022 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	DSE	BOT613	Anatomy and Embryology	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Explain meristems, wood diversity, vascular tissues</li> <li>Enlist applications of fertilization, apomixes, embryogenesis</li> <li>Describe the anatomical structures of different plant organs, including roots, stems, leaves, flowers, and fruits.</li> <li>Relate the structure of plant organs to their functions and adaptations in different environments.</li> <li>Explain the physiological processes occurring in plant tissues, such as water and nutrient transport, photosynthesis, and gas exchange.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01	<b>Theories of organization of apical meristems</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks</li> </ul> (LAQ may contain sub-questions (a), (b) and so on.)
01-02	<b>Diversity in structure of wood</b>		
01-03	<b>Vascular tissues</b>		
01-04	<b>Phloem</b>		
02-01	<b>Secretory cells and tissues, nodal anatomy</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
02-02	<b>Leaf anatomy</b>		
02-03	<b>Application of anatomy</b>		
02-04	<b>Ecological anatomy</b>		
03-01	<b>Microsporangium and ovule</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
03-02	<b>Pollen</b>		
03-03	<b>Ovule</b>		
03-04	<b>Sexual incompatibility</b>		
04-01	<b>Fertilization</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	
04-02	<b>Apomixis and polyembryony</b>		
04-03	<b>Endosperm and embryo</b>		
04-04	<b>Embryogenesis</b>		

## DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Theories of organization of apical meristems:</b> Shoot, root and reproductive meristems; Patterns of secondary wall; tyloses.	<b>CR 01</b>
1-2	<b>Diversity in structure of wood:</b> Classification of wood - reaction wood, heart wood and sap wood; growth rings and dendrochronology.	
1-3	<b>Vascular tissues:</b> Xylem – Concepts of Proto and Metaxylem, Xylem differentiation, Vascular differentiation in Shoot Apex and Leaf Primordia.	
1-4	<b>Phloem</b> – Ultrastructure and Differentiation of Phloem Elements, Characteristics of Phloem Components. A brief account of Histochemical staining technique.	
2-1	<b>Secretory cells and tissues, nodal anatomy:</b> Secretory cells and tissues (external and internal); structure, classification, types and economic importance. Nodal anatomy – unilacunar, trilacunar and multilacunar. Origin of bud traces.	<b>CR 02</b>
2-2	<b>Leaf anatomy:</b> Ontogeny and histogenesis of bifacial leaf – <i>Hibiscus</i> , unifacial leaf – grass; Stomata – development and types.	
2-3	<b>Application of anatomy:</b> Application of anatomy in detecting food adulteration and contamination, forensic science, as building material (application of wood and wood products) and in paper and fiber industry.	
2-4	<b>Ecological anatomy:</b> Hydrophytes – <i>Hydrilla</i> – Stem; Mesophytes – <i>Tridax</i> – leaf; Xerophytes – <i>Aloe</i> leaf, <i>Pinus</i> needle; Epiphytes – <i>Vanda</i> and <i>Dischidia</i> ; Halophytes <i>Sonneratia</i> – stem, leaf and pneumatophore, <i>Suaedamonoica</i> – leaf; Parasites – <i>Striga</i> and Saprophytes – <i>Monotropa</i> .	
3-1	<b>Microsporangium and ovule:</b> Structure of anther; Microsporogenesis- physiology and ultra-structure;	<b>CR 03</b>
3-2	<b>Pollen:</b> Structure, Classification and cytochemistry, pollen mitosis, male germ unit (MGU) concept, pollen viability, storage and germination, pollen allergens, mellitopalynology.	
3-3	<b>Ovule:</b> A general account of ontogeny and structure, Megasporogenesis and Megagametogenesis (Monosporic, disporic and tetrasporic) – Structure of embryo sac and a general account of embryo sac haustoria.	
3-4	<b>Sexual incompatibility:</b> Self incompatibility, Genetic basis of self- incompatibility, Physiology and biochemistry of incompatibility, Biological significance, Methods to overcome incompatibility.	
4-1	<b>Fertilization:</b> Fertilization - Introduction, Structure of stigma and style, pollen germination (in-vivo), pollen tube entry into stigma, pollen tube growth, entry of pollen tube into female gametophyte, pollen – pistil interaction, double fertilization and its significance, a brief note on heterofertilization.	<b>CR 04</b>
4-2	<b>Apomixis and polyembryony:</b> Apomixis, Polyembryony and their practical importance.	
4-3	<b>Endosperm and embryo:</b> Structure, composition and development of endosperm and embryo;	
4-4	<b>Embryogenesis:</b> Embryogenesis in <i>Ceratophalus falcatus</i> (dicot) and <i>Halophila ovata</i> (monocot), embryo – endosperm relationship; Suspensor structure and function.	

## LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
BOT613-T01	Anatomy and Embryology – Kirankumar Khandare	2022	978-93-95855-60-0 YCMOU, Nashik

**Reference-Books:** Explore additional details and reinforce learning, with this optional learning resource!

BOT613:RB1	An Introduction to Genetic Analysis, - Carroll S. B.; Doebley J., Griffiths, A. J. F. and Wessler, S. R.	2018 11th Edn	W. H. Freeman and Co. Ltd.
BOT613:RB2	Principles of Genetics - P. D. Snustad, M. L. Simmons	1997	
BOT613:RB3	Genetics - Verma P. S. and Agarwal V. K.	2014, 9th Edn.,	S. Chand and Co., New Delhi.
BOT613:RB4	Principles of Genetics, - Gardner, E. J. et al.	2006	John Wiley and Sons Inc
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT613:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT613:WL1			

### **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Identify and classify various types of plant tissues (e.g., epidermal, ground, vascular) and understand their functions.
- Understand the principles of plant embryogenesis, from the formation of the zygote to the development of seedlings.
- Compare and contrast the embryonic development of different plant groups, including angiosperms and gymnosperms.
- Analyze the factors influencing plant growth and development, including hormonal regulation and environmental cues.
- Apply anatomical and embryological knowledge to solve practical problems in plant propagation, breeding, and horticulture.
- Conduct research and experiments related to plant anatomy and embryology, using appropriate methodologies and data analysis techniques.

## BOT614: HYDROPONIC TECHNOLOGY (ELECTIVE)

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ymou.ac.in/">http://www.ymou.ac.in/</a> and <a href="http://ymou.digitaluniversity.ac/">http://ymou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V156: M.Sc.(Botany) {2023 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	DSE	BOT614	Hydroponics Technology	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Identify the different types of hydroponic systems.</li> <li>Explain the components of a hydroponic system and their functions.</li> <li>Select the appropriate hydroponic system for a given set of conditions.</li> <li>Calculate the nutrient requirements of a hydroponic system.</li> <li>Identify and troubleshoot these problems in order to keep the system running smoothly.</li> <li>Apply hydroponics principles to commercial agriculture</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01 01-02 01-03 01-04	<b>Introduction to hydroponics technology</b> <b>Types of hydroponics</b> <b>Plant Nutrition</b> <b>Environmental and Chemical Factors</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	<p>As per evaluation pattern, on <b>Each Credit</b>, Student is required to answer</p> <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks (LAQ may contain sub-questions (a), (b) and so on.)</li> </ul>
02-01 02-02 02-03 02-04	<b>Hydroponics entrepreneurship</b> <b>Nutrient Solutions and Media Inorganic salts (fertilizers)</b> <b>Weed control and disease control in hydroponics</b> <b>Good Agricultural Practices (GAP) and IPM for Hydroponics Cultivation</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
03-01 03-02 03-03 03-04	<b>Techniques in Hydroponics and Cultivation of crop plants</b> <b>Standard Protocols used in hydroponics</b> <b>Production Technology of Vegetables and Flowers Grown</b> <b>Marketing of hydroponics products</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	

04-01	<b>Application of abiotic stresses in hydroponics systems</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	
04-02	<b>Plant Hydroponic Cultivation</b>		
04-03	<b>The Role of Hydroponics Technique as a Standard Methodology</b>		
04-04	<b>Hydroponics and Environmental Clean</b>		

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>Introduction to hydroponics technology:</b> Definition and Concept, History and origin of Soil-less culture, Present status of Hydroponics - Contrasts with soil-based culture,	<b>CR 01</b>
1-2	<b>Types of hydroponics</b> , applications and future developments.	
1-3	<b>Plant Nutrition:</b> Essential, mineral elements, Functions and effects on plants, Deficiency Symptoms of the following Essential Minerals- N, P, Ca, Mg, K, S, Fe, Mn, Cu, Zn, B, Mo.	
1-4	<b>Environmental and Chemical Factors:</b> Light (Quality, Photoperiodism and systems), Temperature (heating and cooling), Humidity and CO <sub>2</sub> , pH, PPM / TDS.	
2-1	<b>Hydroponics entrepreneurship:</b> Definition; Significance of entrepreneurship; Challenges - family, social, technological, financial and policy; Role of government in promoting entrepreneurship; Stages in starting a small-scale industry.	<b>CR 02</b>
2-2	<b>Nutrient Solutions and Media Inorganic salts (fertilizers) :</b> Macronutrients, Micronutrients, Formulating, monitoring, and analyzing, pH adjustment, selecting fertilizers and nutrient monitoring; Media used for Hydroponics: Ex-clay, Rock wool, Coir, Perlite, Pumice, Vermiculite, Sand, Gravel, Brick shards, Polystyrene packing peanuts, wood fiber;	
2-3	<b>Weed control and disease control in hydroponics:</b> Weed management, diseases and pest control, Pollination, making clones of plants.	
2-4	<b>Good Agricultural Practices (GAP) and IPM for Hydroponics Cultivation:</b> Introduction, Major Steps for GAP and IPM in Hydroponics Cultivation, Advantages of Adopting GAP, General IPM for Soilless Cultivation, Government of India (GOI) initiatives for Hydroponics cultivation.	
3-1	<b>Techniques in Hydroponics and Cultivation of crop plants:</b> Techniques in Hydroponics – Static solution culture, Continuous – flow Solution culture, Aeroponics, Passive sub-irrigation, Ebb and flow or flood and drain irrigation, Deep water culture.	<b>CR 03</b>
3-2	<b>Standard Protocols used in hydroponics:</b> Protocols for – Tomato cultivation through Dutch bucket method, Chilly cultivation through NFT system, Spinach through Raft system, Fodder system.	
3-3	<b>Production Technology of Vegetables and Flowers Grown under Hydroponics Cultivation:</b> Brief production technology of vegetables (Capsicum, Cucumber, Tomato) and flowers (Rose, Carnation, Chrysanthemum, Liliium)	
3-4	<b>Marketing of hydroponics products:</b> Harvesting, grading, storage and marketing process of crops grown under hydroponics system global hydroponic market and commercial hydroponic production.	
4-1	<b>Application of abiotic stresses in hydroponics systems:</b> Introduction, application of hydroponics in salt stress, drought, elemental toxicities, nutrient deficiencies.	<b>CR 04</b>
4-2	<b>Plant Hydroponic Cultivation:</b> A Support for Biology Research in the Field of Plant-Microbe-Environment Interactions: Hydroponic culture systems as source of important biomass production for biological analyses, Control of growth parameters in hydroponic systems, Monitoring roots respiration and nodules nitrogen-fixation, Analysing plant	



	microbe interactions in hydroponic systems.	
4-3	<b>The Role of Hydroponics Technique as a Standard Methodology</b> in Various Aspects of Plant Biology Researches: Introduction, Plant nutrition, Allelopathy in rhizosphere, Abiotic stress, Heavy metals, Aluminium toxicity.	
4-4	<b>Hydroponics and Environmental Clean-Up:</b> Phytoremediation: concept, types; Rhizofiltration; Challenges of hydroponic phytotechnologies, Rhizofiltration and sustainable development.	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End Examination</b>			
<b>Text-Books</b>			
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT614:RB1	How to Hydroponics, Keith Roberto.	1968	The future garden press New York. 4th Edition.
BOT614:RB2	Hobby Hydroponics, Howard M. Resh..	1986	CRC Press USA.
BOT614:RB3	Prasad S and Kumar U. Green House Management for Horticultural Crops. Agrobios India		
BOT614:RB4	Organic Farming for Sustainable Agriculture. Agrobios India, Dahama A K.	1984	
BOT614:RB5	Biofertilizers in Agriculture and Forestry, Subbarao N.S.	1995	Oxford and IBH publishing Company Pvt. Ltd. New Delhi
BOT614:RB6	Hydroponic Method for Commercial, B. A. Kratky. A Suspended Net-Pot, Non-Circulating.		
BOT614:RB7	Hydroponics: A Standard Methodology for Plant Biological Researches, Asao, T.	2012	Intech Open, UK.
BOT614:RB8	Hydroponics for everybody, Texier, W	2016	Mama publishing, France.
BOT614:RB9	Hydroponics as an advanced technique for vegetable production: An overview, Sharma, N., Acharya, S., Kumar, K., Singh, N., and Chaurasia, O. P.	2018	Journal of Soil and Water Conservation, 17(4), 364-371.
BOT614:RB10	K A El-Kazzaz, A A El-Kazzaz. 2017. Soilless Agriculture a New and Advanced Method for Agriculture Development: an Introduction. Agri Res & Tech: Open Access J. 3(2): 555610. DOI: 10.19080/ARTOAJ.2017.03.555610.	2017	
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT614:CD1	<a href="https://gardeningtips.in/growing-leafy-greens-in-hydroponics-a-full-guide">https://gardeningtips.in/growing-leafy-greens-in-hydroponics-a-full-guide</a> .		



**Web Links:** Explore additional details and reinforce learning, with this optional learning resource!

BOT614:WL1	<a href="https://www.agrifarming.in/hydroponic-tomato-farming-nutrient-solution-yield">https://www.agrifarming.in/hydroponic-tomato-farming-nutrient-solution-yield</a>		
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### **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Understand the importance of water quality in hydroponics
- Identify the different types of grow lights and their applications
- Apply the principles of plant physiology to hydroponics
- Design and build a simple hydroponic system
- Conduct a research project on a topic related to hydroponics

## BOT615: MEDICINAL PLANTS AND THEIR APPLICATION (ELECTIVE)

### PROGRAMME INFORMATION

SN	Description	Details
1	University	YashwantraoChavan Maharashtra Open University Nasik - 422 222, Maharashtra, India Website: <a href="http://www.ycmou.ac.in/">http://www.ycmou.ac.in/</a> and <a href="http://ycmou.digitaluniversity.ac/">http://ycmou.digitaluniversity.ac/</a>
2	School	School of Sciences
3	Discipline	Science
4	Level	PG
5	Course Used in	V152: M.Sc.(Environmental Science) {2023 Pattern}, V156: M.Sc.(Botany) {2023 Pattern}, V144: M.Sc.(Botany) {2022 Pattern}

### COURSE INFORMATION

Sem	Major	Code	Course Name	CR	CST	ST	CA	EE	TM	Type
04	DSE	BOT615	Medicinal Plants and Their Application	4	12	120	30	70	100	T

### PRESUMED KNOWLEDGE AND LEARNING OBJECTIVES

Presumed Knowledge	Learning Objectives
<p>For successful completion of this course, student should have successfully complete:</p> <ul style="list-style-type: none"> <li>B.Sc. with Botany or equivalent from a recognized University/Board.</li> </ul>	<p>Objectives of this course are to</p> <ul style="list-style-type: none"> <li>Identify medicinal importance of plants.</li> <li>Identify and classify medicinal plants.</li> <li>Understand the chemical constituents of medicinal plants and their effects on humans.</li> <li>Describe the traditional and modern uses of medicinal plants.</li> <li>Evaluate the safety and efficacy of medicinal plants.</li> <li>Apply ethical principles to the study and use of medicinal plants.</li> </ul>

### UNITS

UN	Name of the Unit	CSs	Questions
01-01	<b>History Of Medicinal And Aromatic Plants</b>	<b>CR 01</b> <b>MLs</b> <b>01-20</b>	As per evaluation pattern, on <b>Each Credit</b> , Student is required to answer <ul style="list-style-type: none"> <li>Very Short Answer Question (VSAQ), of 03 marks</li> <li>Short Answer Question (SAQ), of 05 marks</li> <li>Long Answer Question (LAQ) of 10 Marks</li> </ul> (LAQ may contain sub-questions (a), (b) and so on.)
01-02	<b>Herbal Industry</b>		
01-03	<b>Importance Of Medicinal Plants</b>		
01-04	<b>Indigenous systems of medicine</b>		
02-01	<b>Poisonous And Allergic Plants</b>	<b>CR 02</b> <b>MLs</b> <b>21-40</b>	
02-02	<b>Plant Allergens</b>		
02-03	<b>Remedial Plants</b>		
02-04	<b>Psychoactive Plants</b>		
03-01	<b>Marine Drugs, Natural Pesticides And</b>	<b>CR 03</b> <b>MLs</b> <b>41-60</b>	
03-02	<b>Antibiotics Natural Pesticides</b>		
03-03	<b>Antibiotics</b>		
03-04	<b>Trade and commerce of medicinal plants of India</b>		

04-01	<b>Herbal medicine</b> <b>Study of few commercial /raw drugs/ medicinal plants</b> <b>Traditional Agriculture Practices in Ancient India</b> <b>Aspects of Biodiversity</b>	<b>CR 04</b> <b>MLs</b> <b>61-80</b>	
04-02			
04-03			
04-04			

### DETAILED SYLLABUS

UN	Detailed Syllabus of the Unit	CR
1-1	<b>History Of Medicinal And Aromatic Plants:</b> History of medicinal and aromatic plants - some important terms used in herbal medicine	<b>CR 01</b>
1-2	<b>Herbal Industry:</b> WTO Indian scenario- Prospects and constraints, export and import status; AAYUSH – Amchi (Tibetan), Ayurveda, Unani, Siddha and Homoeopathy; Chinese; Bach's flower remedy; Aromatherapy.	
1-3	<b>Importance Of Medicinal Plants:</b> Relevance of herbal medicine as primary health care package; sources of information on medicinal plants; Organization of information in database (national and international)	
1-4	<b>Indigenous systems of medicine:</b> Causes for the decline and the current scenario in Indigenous systems of medicine; a comparative evaluation of accessibility and benefits of different systems of medicine	
2-1	<b>Poisonous And Allergic Plants:</b> Poisonous plants – classification; chemical constituents, symptoms, treatment and systematic description of some poisonous plants - <i>Papaver somnifera</i> , <i>Calotropis gigantea</i> , <i>Gloriosa superba</i> , <i>Digitalis purpurea</i> , <i>Datura metel</i> , <i>Strychnos nux-vomica</i>	<b>CR 02</b>
2-2	<b>Plant Allergens:</b> Types and classification; description, symptoms, chemical constituents and treatment of the following allergic plants - <i>Parthenium hysterophorus</i> , <i>Urtica sp.</i> , <i>Acacia sp.</i> , <i>Eucalyptus globulus</i> , <i>Arachis hypogaea</i> and <i>Solanum</i> .	
2-3	<b>Remedial Plants:</b> Heart, respiratory, skin, cancer, autoimmune, and liver diseases; nutraceuticals and cosmeceuticals; Vrikshayurveda - herbal remedies for plant disease.	
2-4	<b>Psychoactive Plants:</b> Classification; stimulants, nootropic plants (Plants for mental health), hallucinogens, depressants and anti-depressants.	
3-1	<b>Marine Drugs, Natural Pesticides And Antibiotics:</b> Marine Drugs – Introduction, Classification – antimicrobial, anti-inflammatory, antispasmodic, antiparasitic, anticancer, cardiovascular, insecticide, anticoagulants, marine toxins.	<b>CR 03</b>
3-2	<b>Natural pesticides</b> – Introduction, method of pest control, classification, essentials of a good pesticide, pesticide and environment, examples – <i>Pyrethrum (flowers)</i> , <i>Derris (root)</i> , <i>Nicotiana</i> and <i>Azadirachta (leaf)</i> and <i>Cymbopogon (Citronella oil)</i> .	
3-3	<b>Antibiotics:</b> Introduction and classification – Aminoglycosides, Cephalosporins, Tetracyclines and Penicillins.	
3-4	<b>Trade and commerce of medicinal plants of India:</b> Potentials of medicinal plants – WHO and Indian Scenario	
4-1	<b>Herbal medicine:</b> A natural resource; commercial and medicinal uses of medicinal plants in India	<b>CR 04</b>
4-2	<b>Study of few commercial /raw drugs/ medicinal plants:</b> <i>Usnea</i> ; <i>Drynaria</i> ; <i>Pinus</i> ; <i>Vincarosea</i> ; <i>Rauwolfia serpentina</i> ; <i>Withania somnifera</i> ; <i>Coleus forskohlii</i> ; <i>Emblica officinalis</i> ; <i>Saraca asoca</i> ; <i>Aloe vera</i> ; <i>Glycyrrhiza glabra</i> ; <i>Commiphora mukul</i> , <i>Bosweliaserrata</i> .	
4-3	<b>Traditional Agriculture Practices in Ancient India:</b> Traditional Agriculture Practices in Ancient India	
4-4	<b>Aspects of Biodiversity:</b> Some aspects of Biodiversity and Indian Traditions.	

### LEARNING RESOURCE DETAILS

LR Code	Title Author	Edition Year	ISBN Publisher
<b>Course Website Link for (1) Mobile and Online Lectures, (2) Discussion Forum for online interaction and (3) Self-Test for each CR Block, Continuous Assessment Test and End</b>			

<b>Examination</b>			
<b>Text-Books</b>			
BOT615-T01	Medicinal Plants & Their Applications – Dr. Madhukar Bhagwan Patil, Dr. Amanulla Khan N.K.Pathan,	2023	978-9395855648 YCMOU, Nashik
<b>Reference-Books:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT615:RB1	Glossary of Indian medicinal plants – R.N.Chopra, S.L.Nayar and I.C.Chopra.	1956	C.S.I.R, NewDelhi.
BOT615:RB2	The indigenous drugs of India – Kanny,Lall, Deyand RajBahadur.	1984	International Book Distributors.
BOT615:RB3	Herbal plants and Drugs – Agnes Arber.	1999	Mangal Deep Publications.
BOT615:RB4	Ayurvedic drugs and their plant source. – V.V. Sivarajan and Balachandran Indra.	1994	Oxford IBH publishing Co
BOT615:RB5	Ayurveda and Aromatherapy – Miller, Light and Miller,Bryan.	1998	Banarsidass, Delhi.
BOT615:RB6	Principles of Ayurveda – Anne Green.	2000	Thomsons, ondon.
BOT615:RB7	Pharmacognosy, – Dr. C.K. Kokateetal.	1999	Nirali Prakashan
<b>CD / DVD:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT615:CD1			
<b>Web Links:</b> Explore additional details and reinforce learning, with this optional learning resource!			
BOT615:WL1			

### **COURSE OUTCOMES**

After successful completion of this course, student should be able to

- Identify medicinal plants by their common and scientific names.
- Describe the chemical constituents of medicinal plants and their effects on humans.
- Discuss the traditional and modern uses of medicinal plants.
- Evaluate the safety and efficacy of medicinal plants.
- Apply ethical principles to the study and use of medicinal plants.

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