DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY

CIRCULAR NO.SU./B.Sc.CBC & GS/11/2022

It is hereby inform to all concerned that, on the recommendation of Faculty of Science & Technology Meeting dated 24.08.2022, **the Academic Council at its meeting held on 29 August 2022 has accepted the following Syllabi of B.Sc. Degree under the Choice Based Credit & Grading System along with Rules and Regualtion** as appended herewith:-

1.	B.Sc.Computer Science (Optional)	Ist and IInd semester
2.	B.Sc.Computer Application (Optional)	Ist and IInd semester
3.	B.Sc.Computer Application (Degree)	Ist and IInd semester
4.	B.Sc.Computer Science (Degree)	Ist and IInd semester
5.	B.Sc.Horticulture (Optional)	Ist to VIth semester
6.	B.Sc.Botany (Optional)	Ist to VIth semester
7.	B.Sc. Agrochemical & fertilizer (Optional)	Ist to VIth semester
8.	B.Sc.Home Science (Optional)	Ist and IInd semester
9.	B.Sc.Automobile Technology (Degree)	Ist and IInd semester
10.	B.Sc.Workshop Technology (Degree)	Ist and IInd semester
11.	B.Sc.Refrigeration and Air Conditioning (Degree)	Ist and IInd semester
12.	B.Sc.Environmental Science (Optional)	Ist and IInd semester
13.	B.Sc.Biotechnology (Degree)	Ist and IInd semester
14.	B.Sc.Biotechnology (Optional)	Ist and IInd semester
15.	B.Sc.Dairy Sci.& Tech (Optional)	Ist and IInd semester
16.	B.Sc.Zoology (Optional)	Ist to VIth semester
17.	B.Sc.Polymer Chemistry (Optional)	Ist and IInd semester
18.	B.Sc.Fisheries Science (Optional)	Ist and IInd semester
19.	B.Sc.Instrumentation Practice (Optional)	Ist semester
20.	B.Sc.Biochemistry (Optional)	Ist and IInd semester
21.	B.Sc.Non Conventional & Conventional Energy (Degree)	Ist and IInd semester

This is effective from the Academic Year 2022-23 and onwards.

All concerned are requested to note the contents of this circular and bring notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
Ref.No. SU/B.Sc./2022/8428-35
Date:-29.08.2022.

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Deputy Registrar,
Academic Section

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Copy forwarded with compliments to :-

1] **The Principal, concerned affiliated College,**
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.

2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

1] The Director, Board of Examinations & Evaluation,
2] The Section Officer,[B.Sc.Unit] Examination Branch,
3] The Programmer [Computer Unit-1] Examinations,
4] The Programmer [Computer Unit-2] Examinations,
5] The In-charge, [E-Suvidha Kendra],
Rajarshi Shahu Maharaj Examination Branch,
6] The Public Relation Officer,
7] The Record Keeper,

JS*29082022/-

Dr. Babasaheb Ambedkar Marathwada University,

Aurangabad- 431004(MS) India

Undergraduate Bachelor Degree Program in Science (B.Sc.)

BOTANY (Optional Subject)

Ist to VIth Semester

Course Structure and Curriculum

(Outcome Based Curriculum)

Choice Based Credit & Grading System

(Effective from Academic Year 2022-23)

2022-2023

22/08/22

Effective from 2022 – 2023 for all affiliated Colleges

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

B.Sc. Botany

Choice Based Credit & Grading System B.Sc. Botany syllabus was finalized in the meeting of Board of Studies held on 20-08-2022, effective from academic year 2022-23 for B.Sc. FY onwards. The following members were present:

1. **Prof. Ravi P. Patil** — **BOS Chairman**

Advisory Committee

2. **Prof. Ashok M. Chavan** — **Member**
3. **Prof. Arvind S. Dhabe** — **Member**
4. **Prof. Anil Bhuktar** — **Member**

Chairman, BOS, Botany
Dr BAMU, Aurangabad

Head
UG & PG Dept of Botany
Deogiri College, Aurangabad,

Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad- 431004(MS) India

Syllabus Designing Committee for Choice Based Credit & Grading System (B.Sc. Botany) constituted by Chairman, Board of Studies in Botany is given below:

BSc Ist and IInd Semester

Chairman: Dr. V. S. Sawant.
Members: Dr. Mukund P.Kulthe, Dr. V. D. Devarkar, Dr. S. N.Solunke, Dr Sunita Bhosle & Dr.T.A. Gitte

BSc IIIrd and IVth Semester

Chairman: Dr. Gulab Rathod.
Members: Dr.Umesh Mogle, Dr.Santosh Talekar, Dr.Anil Kshirsagar, Dr.Vishal Sarwade,& Dr.Mustafa Dandu

BSc Vth and VIth Semester

Chairman: Dr V. C. Khilare.
Members: Dr. U. N. Bhale, Dr. U. S. Salve, Dr Smita Basole, Dr A.S.Taware, Dr Asfaque Khan, Dr. S. T.Bandewar, Dr M.A. Kare, Dr. Datta Ghogare, Mrs Archana Mukhedkar & Dr. Sachin Chavan

Skill Enhancement Courses

Chairman: Dr V.S.Gambhire.
Members: Dr.M.S.Wadikar, Dr J.N.Rajkonda, Dr Deepak Pardhe, Dr R.D.Madhekar, Dr S.V.Kachare & Dr S.A.Survase

Dr Ravi Pandurang Patil
Head
UG & PG Dept of Botany
Deogiri College, Aurangabad.

(Professor & Head, Dept of Botany, Deogiri College)
Chairman. Board of Studies in Botany,
Dr Babasaheb Ambedkar Marathwada University,
Aurangabad.

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1. Preamble

The education plays enormously significant role in building of a nation. There are quite a large number of educational institutions, engaged in imparting education in our country. Majority of them have entered recently into semester system to match with international educational pattern. However, our present education system produces young minds lacking knowledge, confidence, values and skills. It could be because of complete lack of relationship between education, employment and skill development in conventional education system. The present alarming situation necessitates transformation and/or redesigning of education system, not only by introducing innovations but developing "learner-centric approach in the entire education delivery mechanism and globally followed evaluation system as well.

Majority of Indian higher education institutions have been following marks or percentage based evaluation system, which obstructs the flexibility for the students to study the subjects/courses of their choice and their mobility to different institutions. There is need to allow the flexibility in education system, so that students depending upon their interests and aims can choose inter disciplinary, intra-disciplinary and skill-based courses. This can only be possible when choice based credit system (CBCS), an internationally acknowledged system, is adopted. The choice based credit system not only offers opportunities and avenues to learn core subjects but also exploring additional avenues of learning beyond the core subjects for holistic development of an individual. The CBCS will undoubtedly facilitate us bench mark our courses with best international academic practices.

Today plant science is a becoming an important discipline because of its inputs in the welfare of human society. Botanists are consistently working on the almost all the facets of the plant science like Plant Morphology, Plant Taxonomy, Plants Anatomy, Plant Physiology, Palaeobotany, Palynology, Algology, Bryology, Pteridology, Mycology, Plant Pathology, Cytogenetics, Phytogeography, Phytochemistry, Medicinal Plants, Ethnobotany, Pharmacology, Evolutionary Biology, Phylogeny, Molecular genetics, Plant Breeding, Ecology & Environment, Environmental Impact Assessment, Developmental Biology, Cell biology, Biochemical studies, Biophysics, Bioinformatics, etc. Because of which plant science has shown enormous gain in information and applications owing to incredible inputs from research in all its aspects. With global recognition of the necessitate for conservation, field plant biologists have contributed appreciably in assessing plant diversity. New insights have been gained in functional and structural aspects of plant development by utilizing novel tools and techniques for botanical

research. Keeping these advancements in view, a revision of the curriculum at the undergraduate level is perfectly timed. Therefore, the Botany students shall have the benefit of updated, balanced and carefully prepared course with giving due weightage to every branches of botany over the six semesters. It is essential for the undergraduate students to acquaint themselves with various tools and techniques for exploring the world of plants up to the very advance level, so that they can select the proper line of their PG studies and research. Keeping the employment entrepreneurship in mind, applied courses should have also been introduced. These courses shall provide the botany students hands on experience and professional inputs. On the whole, the curriculum is a source of lot of information and is supported by practical training. It is hoped that a student graduating with Botany subject with the new curriculum will be having sufficient information and knowledge to indulge interest in the subject and selecting the future line of his studies & research.

2. Choice Based Credit System (CBCS):

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising core, elective/minor or skill based courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Advantages of the choice based credit system:

1. Shift in focus from the teacher-centric to student-centric education.
2. Student may undertake as many credits as they can cope with (without repeating all courses in a given semester if they fail in one/more courses).
3. CBCS allows students to choose inter-disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude and more flexibility for students).
4. CBCS makes education broad-based and at par with global standards. One can take credits by combining unique combinations. For example, Physics with Economics, Microbiology with Chemistry or Environment Science etc.
5. CBCS offers flexibility for students to study at different times and at different institutions to complete one course (ease mobility of students). Credits earned at one institution can be transferred.

3. Applicability of the Grading System

These guidelines shall apply to all undergraduate level degree, diploma and certificate programs under the credit system awarded by the University.

4. Definitions of Key Words:

4.1. Academic Year: Two consecutive (one odd + one even) semesters constitute one academic year.

4.2 Choice Based Credit System (CBCS): The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses).

4.3. Course: Usually referred to, as 'papers' is a component of a program. All courses need not carry the same weightage. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/laboratory work/ field work/outreach activities/project work/vocational training/viva/seminars/term papers/assignments/ presentations/self-study etc. or a combination of some of these.

4.4. Credit Based Semester System (CBSS): Under the CBSS, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be completed by the students.

4.5. Credit Point: It is the product of grade point and number of credits for a course.

4.6. Credit: A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work for 15 weeks in a semester.

4.7. 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. It is expressed up to two decimal places.

4.8. Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale.

4.9. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F.

4.10. Program: An educational program leading to award of a Degree, diploma or certificate.

4.11. Semester Grade Point Average (SGPA): It is a measure of performance of work donein a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

4.12. Semester: Each semester will consist of 15 weeks of academic work equivalent to 90actual teaching days. The odd semester may be scheduled from July to December and even semester from January to June.

4.13. 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.

1. Title and Commencement

a) These regulations shall be called "The Regulations Governing the Choice Based Credit System (Semester Scheme) in the Undergraduate Programs in the faculty of Science.

b) These regulations shall come into force for award of the degree from the date of assent of the Chancellor (2022-2023 batch onwards).

2. Duration of the programs, requirement and Options

The total duration of the B.Sc. program shall be of 3 years. The pattern of CBCS program shall be of semester type. There shall be **SIX** semesters each of six months duration. Each semester shall consist of at least 15 weeks of study with minimum of 90 working days (Including the time spent for the conduct of final examination of each semester). The candidate shall complete courses equivalent to at least 149creditsto become eligible for the Regular Bachelor Degree. He/she shall be eligible to rejoin the program within three years to complete the degree. Further, all candidates will be awarded Bachelor Degree on successfully completion of SIX semesters (Three academic years) of the undergraduate program in the subject of their choice.

3. Eligibility for Admission: A candidate who has passed the 10+2 Science examination conducted by the State Education Board or any other examination considered as equivalent thereto shall be eligible for admission to this program. Generally a candidate to opt a subject should have studied that subject at the qualifying examination.

A Candidate who passed Diploma in Pharmacy of Government of Maharashtra, as well as the students who passed the XIIth Vocational with Horticulture or Seed Technology or Crop Science or Fishery Science or Dairy Science are eligible for B.Sc. 'B' Group subject such as Chemistry, Botany, Zoology, Dairy Science, Biotechnology and Microbiology.

4. Maximum Period for Completion of the Program

The candidate shall complete the program within the period as prescribed in the regulation governing the maximum period for completing various degree/diploma programs from the dates of admission. It is generally twice the number of years of the program. The term completing the program means passing all the prescribed examinations of the program to become eligible for the degree.

5. Medium of Instruction: The medium of instruction and examination shall be English.

6. Outline of Choice Based Credit System:

An undergraduate program degree in science disciplines may be awarded if a student completes 4 core papers each in three disciplines of choice, 2 Ability Enhancement Compulsory Courses (AECC), minimum 4 Skill Enhancement Courses (SEC) and 2 papers each from a list of Discipline Specific Elective papers based on three disciplines of choice selected.

6.1 Detailed description of courses.

1. **Core courses: (12 courses for General B.Sc.):** A course, which should compulsorily be studied by a candidate as core requirement is termed as Core course. An undergraduate Program degree in Science disciplines may be awarded if a student completes 4 core papers each in three disciplines of choice.
2. **Elective courses:** Generally a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

i. **Discipline Specific Elective (DSE) Course**:(6courses, 2 papers each from a list of Discipline Specific Elective papers based on three disciplines of choice selected above, respectively). Elective courses offered under the main discipline / subject of study is referred to as Discipline Specific Elective.

ii. **Dissertation/Project***:An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project.

iii. **Generic Elective (GE) Course**: An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure beyond discipline/s of choice is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Ability Enhancement Courses (AEC):** The Ability Enhancement Courses may be of two kinds: Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). These are mandatory for all disciplines.

6.1.1 **Ability Enhancement Compulsory Courses (AECC):**

a. English Communication skill/SL

b. Environmental Science

6.1.2 **Skill Enhancement Courses (SEC):** (4 for General B.Sc.). SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

- **Practical's and/Tutorials** (One each with every core and discipline /generic specific elective paper).
- **Introducing Research Component in Under-Graduate Courses**

Project work/Dissertation is considered as a special course involving application of knowledge in solving/analyzing/exploring a real life situation/difficult problem. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

Norms & Procedure for Extra Credit Benefit for NSS, NCC or Sport Participation: - Universities/Institutes may evolve a system/policy about Extra Curricular Activities/ General Interest and Hobby Courses /Sports / NCC / NSS / Vocational courses / related courses on their own. **Evaluation of co-curricular and extension activities shall be as per the procedure evolved by the university from time to time.**

Course Pattern, Credit distribution and Scheme of Examination

The details of course patterns (hours of instruction per week) with course code and the scheme examination are given in A and table no.1 to 6. The syllabi of the course shall be as prescribed by the university.

6.2 **Implementation of core course-** (Combination among the following subject)

Approved combination among the following subjects Biochemistry, Biotechnology, Botany, Chemistry, Computer Science, Electronics, Environmental Science, Genetics, Geology, Home

Science, Instrumentation, Mathematics, Microbiology, Physics, Sericulture, Statistics, Zoology and such other subjects permitted by the university from time to time.

6.3 **Implantation of Ability Enhancement Compulsory Course (AECC):**

For the introduction of AE Courses, they may be divided into two categories:

AE Compulsory Courses: The universities participating in CBCS system may have common curriculum for these papers. There may be one paper each in the 1st four semester's viz. (i) Communication skills in English and SL, & one paper of Environmental Science in IVth semester. Two languages are to be studied out of which one shall be English and other shall be either an Indian language or a Foreign language other than English approved by this University such as, Sanskrit, Hindi, , Marathi, Urdu, etc., and any other language prescribed /approved by the university.

In addition to English, a candidate shall opt for any one of the two languages studied at the 10+2 or equivalent level. However, the candidate may opt for Marathi even if it is not studied at the 10+2 or equivalent level. With the permission of the University, a candidate may opt for any other language listed above even if the candidate has not studied that language at 10+2 or equivalent level.

Note-Speech/hearing/visually impaired/mentally challenged and study disabled students are exempted from studying one of the language prescribed under 1. Above

6.4 Skill Enhancement Courses: Any four skill development courses in the third, fourth, fifth and sixth semesters, one in each semester as prescribed by respective Board of Studies, the concern faculty and approved by the Academic Council. Any one SEC course to be chosen (any one from three optional subjects) from the basket of SEC courses.

a. The SEC consists of lecture course and practical course, as decided by respective B.O.S.

b. All three SEC (Skill Enhancement Courses) have 2 credits in respective semester.

7 Rules and regulation

7.1 Number of Core papers for all Universities has to be same for both UG Honors as well as UG Program.

7.2 Credit score earned by a student for any elective paper has to be included in the student's overall score tally irrespective of whether the paper is offered by the parent university (degree awarding university/institute) or not.

7.3 The university/Institute may plan the number of seats per elective paper as per the facility and infrastructure available.

7.4 Total number of credits required for the completion of programs is 149 credits.

7.5 The credit(s) for each theory paper/practical/tutorial/project/dissertation will be as per the details given in A, and table 1to 6 for B.Sc. Program.

7.6 CGPA will be calculated on the basis of core 149 credits only.

7.7 Each theory credit is equivalent to 15 clock hours of teaching and each practical credit is equivalent to 30 clock hours of teaching in a semester.

7.8 There is 15 weeks of teacher-student interaction during the semester.

7.9 The Universities/Institutes may offer any number of choices of papers from different disciplines under Generic Elective and Discipline Specific Elective as per the availability of the courses/faculty.

7.10 Universities/Institutes may evolve a system/policy about Extra Curricular Activities/ General Interest and Hobby Courses/Sports/NCC/NSS/Vocational courses/related courses on their own.

7.11 A student can opt for more number of Elective and AE Elective papers than proposed under the model curriculum of UGC. However the total credit score earned will not exceed 149credits for UG Program degree.

7.12 The new scheme of UG courses should be given due consideration while framing the admission eligibility requirement for PG/Technical courses in Indian Universities/Institutions to ensure that students following inter and multi-disciplinary format under CBCS are not at a disadvantage. It is suggested that wherever required, obtaining 24 credits in particular discipline may be considered as the minimum eligibility, for admission in the concerned discipline, for entry to PG/Technical courses in Indian Universities/Institutions.

7.13 The student can perform their project any one of the optional subjects.

7.14 The project of the student should be examined by the external examiner at the time of ESE practical course.

7.15 Project work has a weightage of 2 credits as par mentioned in syllabus.

7.16 SL and English Communication are added as "General Interest & Hobby courses" in "AECC''.

7.17 Each theory lecture is of 50 minutes

7.18 There shall be Five (5) lectures/week of 50 minutes each for 3 credits to Ability Enhancement compulsory courses (AECC) "English Communication" to align with existing B.Sc. Pattern.

7.19 There shall be Five (4) lectures/week of 50 minutes each for 3 credits to Ability Enhancement compulsory courses (AECC) "SL " to align with existing B.Sc. Pattern.

7.20 Two credits course of 50 Marks "**Constitution of India"** is mandatory to all faculties as per Dr.Babasaheb Ambedkar Marathwada University Letter Ref. No. SU/Con./I Yr/Cur/2020/7416-25 dated 28.01.2020.

7.21 Compulsory "Computer and information Technology Course "is mandatory for science faculty as per Dr. Babasaheb Ambedkar Marathwada University regulation 1473, Reference No.ACD/NP/COMP.SCI.ENV.SCI./20086587-6786 dated 20.06.2008.This course may be included in SEC course.

7.22 For all faculty environmental studies is mandatory course for all faculties as per Dr. Babasaheb Ambedkar Marathwada University regulation 1473. Reference No.ACD/NP/COMP.SCI.ENV.SCI./20086587-6786 dated 20.06.2008.

8 Attendance and Change of subject:

8.1 A candidate shall be considered to have satisfied the requirement of attendance for a semester if he/she attends not less than 75% of the number of classes actually held up to the end of the semester in each subjects. There shall be no minimum attendance requirement for the Co-curricular and extension activities.

8.2 An option to change a language /subject may be exercised only once within four weeks from the date of commencement of the Ist semester.

8.3 Wherever a change in a subject is permitted the attendance in the changes subject shall be calculated by taking into consideration the attendance in the previous subjects studied.

8.4 If candidate represents his/her institution/university/Maharashtra state/Nation in sports/NCC/NSS/Cultural or any officially sponsored activities he/she may be permitted to claim attendance for actual number of days participated, based on the recommendation of the Head of the Institution concern. If a candidate is selected to participate in national level event such as Republic Day Parade etc., he/she may be permitted to claim attendance for actual number of days participated based on the recommendation of the Head of the Institution concerned.

9 Examination and Assessment rules:-

9.1 Assessment shall consist of End of Semester Examination (ESE) and Continuous Assessment (CA). The CA will be a continuous activity (Internal) conducted by Concern College and ESE will be conducted by University. Each CA & ESE shall have weightages of10:40.There shall be combining passing for CA and ESE.

9.2 **Weightages -** for 2 Credits (50 Marks) paper:

9.3 CA = 10 marks and ESE = 40 marks (MCQ =10 &Subjective & descriptive questions = 30 marks on entire syllabus).

9.4 Continuous Internal Assessment (CA)

9.5 **Methods of assessment for internal examination (CA):**

a. **Theory (10 marks)** – Internal test 5 marks (Two internal tests of 5 marks each and average of two test will be considered) and five marks for assignment/tutorials

(Written test, Field work, Assignment, Internship, Seminar presentation, Industrial Practicum, Case study, Project work (on approval of the Head of the Centre).

b. **Practical**-(10 marks); 7 Marks for internal practical examination and 3 Marks for record book/submission of collection and filed survey report and excursion tour for each semester.

9.6 A student should obtained 40% marks in the combined examination of CA and ESE with a minimum passing of 40%.

9.7 To pass the UG degree program, a student shall have to obtain a minimum aggregate of 40% marks (P and above in the grade point scale) in each course.

9.8 If a student remains absent or fails in an internal assessment examination he/she will have a second chance with the endorsement of the principal in consultation with the concerned teacher and Head of the department. The Principal in the consultation with the concerned teacher and HOD shall decide about the genuineness of the case and decide to conduct special test to such candidate on the date suitable to the concerned teacher but before commencement of the concerned semester end examination. Such a second chance shall not be the right of student.

9.9 The marks of CA shall be published on the notice board of the department/college for information of students.

9.10 The CA marks shall be communicated to the Director, Board of Examination and Evaluation at least 10 days before the commencement of the University examinations.

9.11 CA marks shall not change. A student cannot repeat CA. In case she/he wants to repeat CA, then she/he can do only by registering their names for course during the semester in which the course is conducted and up to 3 years program provided the student has failed in that course.

9.12 Internal assessment marks shall be shown separately in the marks card. Candidate, who has failed or rejected the result, shall retain the internal assessment marks.

10 **Registration for (ESE) Examination:** A candidate shall register for all the papers of a semester when he/she appears for the examination of that semester for the first time.

10.1. Conduct of examination

The 3 years B.Sc. CBCS Program shall consist of 3 years consisting of 2 semesters each. Semester examination for theory papers shall be held at the end of each semester. The practical examination shall be held at the end of each year.

10.2. The outline of the distribution of maximum marks for various aspects / mechanism towards ESE (Theory and Annual practical Examination) is as follows

a. Theory examination: ESE = 40 marks (MCQ =10 &subjective & descriptive questions = 30 marks on entire syllabus)

b. Practical Examination:-

Total marks 80 for each practical paper of B. Sc. For annual examination

1. Experimental Performance: 70 marks

3. Viva-Voce on experiments and submission -10 marks

4. Certified Journal should be produced by the candidate at the time of ESE practical examination.

5. The practical examination shall be conducted by two Examiners (one internal and one external) per batch.

11. The statement of marks sheet and the answer books of practical examination shall be sent to the Director, Board of Examination and Evaluation by the Principal of the respective colleges respectively immediately after the practical examinations.

12. Letter Grades and Grade Points (Completion of degree)

The Dr. Babaseheb Ambedkar Marathwada University, Aurangabad has decided to implement "absolute grading" system. A student who earns 149 credits, shall be considered to have completed the requirement of B.Sc. degree program and CGPA will be calculated for such student. On the basis of only149 credits.

i. The UGC recommends a 10-point grading system with the following letter grades as given below:

Table 1: Grades and Grade Points and description:

Marks obtained	Grade	Grade pints
=> 80	O (Outstanding)	10
70-79	A+ (Excellent)	09
60-69	A (Very Good)	08
55-59	B+ (Good)	07
50-54	B(Above Average)	06
45-49	C (Average)	05
40-44	P (Pass)	04
< 40	F (Fail)	0
---	Ab (Absent)	0

Classification of degree

Classification	**Overall letter Grade**
First-class with Distinction	A+ and Above
First class	A
Higher Second class	B+
Second class	B
Pass	C to P

ii. A student obtaining Grade F shall be considered failed and will be required to reappear in the examination.

iii. For noncredit courses 'Satisfactory' or "Unsatisfactory' shall be indicated instead of the letter grade and this shall not be counted for the computation of SGPA/CGPA.

iv. The statutory requirement for eligibility to enter as assistant professor in colleges and universities in the disciplines of arts, science, commerce etc., is a minimum average mark of 50% and 55% in relevant postgraduate degree respectively for reserved and general category. Hence, it is recommended that the cut-off marks for grade B shall not be less than 50% and for grade B+, it should not be less than 55% under the absolute grading system. Similarly cut-off marks shall be fixed for grade B and B+ based on the recommendation of the statutory bodies (AICTE, NCTE etc.,) of the relevant disciplines.

13. Computation of SGPA and CGPA:-

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

SGPA (Si) = Σ (Ci x Gi) / ΣCi

Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

ii. 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 program, i.e.

CGPA = Σ (Ci x Si) / Σ Ci

Where *Si* is the SGPA of the i^{th} semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

iv. Student who have failed in a course may reappear for ESE only twice in the subsequent period. The student shall be finally declared as failed if He /she does not pass in all credits within a total period of three years. After that such students shall have to seek fresh admission as per the admission rules prevailing at that time.

v. While marks shall be given for all examinations, they shall be converted into grades.

vi. The semester end grade sheets shall have only grades and final grade sheets and transcripts shall have grade points average and total percentage of marks up to two decimal points. The final grade sheet shall also indicate the UG Centre to which the candidate belongs.

vii. A student cannot register for the III/IV semester, if she/he fails to complete 75% credits of the total credits expected to be ordinarily completed within two semesters (I/II). Also a student cannot register their name for V/VI semester if he/she fail to complete 100% credits of the total credits of I& II Semesters.

14. Assessment and Grade Point Average:

a. **The system of evaluation will be as follows:** Each CA and ESE shall be evaluated in terms of marks. The marks for CA and ESE will be added together and then converted into grade and later a grade point average.

b. Result shall be declared for each semester.

c. After gaining minimum number of credits towards a completion of UG program, a student will get a grade sheet with total grads earned and a grade point average.

Final Grade

CGPA	Grade
9.01-10.00	O
8.01- 9.00	A+
7.01-8.00	A
6.01-7.00	B+
5.01-6.00	B
4.01-5.00	C
4.00	P
< 4	F

d. B+ Grade is equivalent to at least 55% of the marks as per circular No. UGC-1298/ [4619] UNI-4 dated December11, 1999.

e. A ten point grade system [guided by the Government of India Ministry of Human resource Development Department of Higher Education, Do No. SECYCHES/2014/139980 dated November 28, 2014].

f. If the CGPA is higher than the indicated upper limit in three decimal digits then higher final grade will be awarded (e. g. a student getting GPA of 6.095 may be awarded B+ grade).

g. For grade improvement a student may reappear for ESE for a minimum 40%credits.

h. Students can appear only once for the grade improvement program only after successful completion of the degree and only within one year of completion of the Degree.

i. The final CGPA will not be printed unless a student earns all credits from courses at UG programs.

j. One credit is equivalent to 25 marks for evaluation purpose.

k. The one credit is equivalent to 15 contact hours for fifteen weeks in a semester.

l. If student failed to obtain a grade other than F in a course then such a course will not be taken into account for calculating CGPA and overall grade. In fact, all the courses in which a student has passed will be taken into account for calculating the CGPA and overall grade.

m. The credit of SEC should be collected by the college appointed coordinator.

n. Collected SEC credits will be communicated to controller of University examinations.

o. The SEC consists of lecture course and practical course as decided by B.O.S

p. The project of the student should be examined by the external examiner at thetime of ESE practical course.

q. There shall be revaluation of the answer scripts of semester-end examination of theory papers only but not internal assessment papers.

15. Promotion:

Once the student is admitted to the concern college/course, he /she will be promoted to the next semester with full carryon; subject to the registration of student in every consecutive semester. Dropout student will be allowed to register for respective semester as and when the concerned course are offered by the college, subject to the condition that his /her tenure should not exceed more than twice the duration of course from the date of first registration at parent college. The admission of concern student will be automatically get cancelled if he/she fails to complete the course in maximum period (six years/twelve semesters)

16. Standard of Passing at B. Sc. Examination

a. For a subject all papers shall from a separate head of passing i.e. Theory, and the Practical.

b. A student shall have to secure 40% of marks in Theory, and Practical examination separately in order to pass in those heads of passing.

c. He shall be declared to have passed the examination if he passes in all heads of passing at I^{st} to VI semester examinations separately.

d. The class will be awarded on the aggregate total of all the subjects of I, II & III years examinations, excluding the marks of English or SL at I^{st} to IV^{th} Semester.

17. Rejection of Results:

a. A candidate may be permitted to reject of the result of the whole examination of any semester. Rejection of result paper wise /subject wise shall be not be permitted. The candidate who has rejected the result shall appear for the immediately following examination.

b. The rejection shall be exercised only once in each semester and the rejection once exercised shall not be revoked.

c. Application for rejection of results along with the payment of the prescribed fee shall be submitted to the Dy. Registrar (Academic) through the college of study together with the original statement of marks within 30 days from the date of publication of the result.

d. A candidate who rejects the result is eligible for only class and not for ranking.

17. Transfer of candidate: Transfer of admission is permissible only for III and V Semester for the students of the other universities and within university.

17.1. Conditions for transfer of admission of students within university.

1. His /her transfer of admission shall be within the intake permitted to the college.
2. Availability of same combination of the subjects studied in the previous college.
3. He/she shall fulfill the attendance requirements as per the University regulation.
4. He/she shall complete the program as per the regulation governing the maximum duration of completing the program.
5. He/she shall complete the program as per the regulation governing the maximum duration of completing the program.

17.2. Conditions for transfer admission of students of other Universities

a. A candidate migrating from any other University may be permitted to join III/V semester of the degree program provided he/she has passed all the subjects of previous semesters/years as the case may be. Such candidates must satisfy all other conditions of eligibility stipulated in the regulations of this University.

b. His/her transfer admission shall be within the intake permitted to the college.

c. He/she shall fulfill the attendance requirements as per the University regulations

d. The candidate who is migrating from other Universities is eligible for overall classes and not for ranking.

e. He/she shall complete the program as per the regulation governing the maximum duration of completing the program as per this regulation.

18. Power to remove difficulties

If any difficulties arises in giving effect to the provisions of these regulations, the Vice-Chancellor may by order make such provisions not inconsistent with the Act, Statutes, Ordinance or other regulations, as appears to be necessary or expedient to remove the difficulty. Every order made under this rule shall be subject to ratification by the appropriate authorities.

19. Grade Card: The University shall issue at the beginning of each semester a grade card for the students, containing the grades obtained by the students in the previous semester and his semester Grade Point Average (SGPA)

The grade card shall contain

1. The title of the courses along with code taken by the students,

2. The credits associated with the course
3. The grade and grade points secured by the student
4. The total credits earned by the student in the semester
5. The SGPA of the student
6. The total credits earned by the student till that semester and
7. The CGPA of the student (at the end of the VI semester)
8. **Cumulative Grade Card:** At the end of the VIth semester, the university shall issue Cumulative Grade Card to the students showing details of Grades obtained by the students in each subject in all semesters along with CGPA and total credits earned.

20. Repeal and Savings: The existing regulation governing three years Bachelor degree programs and shall stand repealed. However, the above regulation shall continue to be enforcing for the students who have been admitted to the course before the enforcement of this regulation.

Course Structure of B.Sc. program (Faculty of Science) under CBCS pattern:

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
Choice Based Credit System (CBCS) Structure & Curriculum
B.Sc. Botany Three Year Undergraduate Degree Program

Semester I

Course	Course Code	Course Title	Periods (Periods /week)	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1A) Core Courses	BOT-111	Diversity of Cryptogams - I (Theory Paper-I)	45(3/week)	02	50	10	40	20
	BOT-112	Morphology of Angiosperms (Theory Paper-II)	45(3/week)	02	50	10	40	20
	BOT-121	Lab Course 1 (Based on BOT-111 and BOT-112)	45(3/week)	1.5	50	10	40	20
Ability Enhancement compulsory courses (AECC-1)	ENG-131	Communication skills in English-I	45(5/week)	03	50	10	40	20
	SL-132	Marathi/Hindi/Additional English/Urdu/Sanskrit A student can opt for any one of these languages (SL-I)	45(4/week)	03	50	10	40	20
Non-Credit Course								
			225	11.5	250	50	200	100
Total Credits for Semester I : 11.5 (Theory : 10 ; Laboratory : 1.5)								

Semester II

Course	Course Code	Course Title	Periods (Periods /week)	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1B) Core Courses	BOT-211	Diversity of Cryptogams -II (Theory Paper-III)	45(3/week)	02	50	10	40	20
	BOT-212	Histology, Anatomy & Embryology (Theory Paper-IV)	45(3/week)	02	50	10	40	20
	BOT-221	Lab course 2 (Based on BOT-211 & BOT-212)	45(3/week)	1.5	50	10	40	20
Ability Enhancement compulsory courses (AECC-2)	ENG-231	Communication skills in English-II	45(5/week)	03	50	10	40	20
	SL-232	Marathi/Hindi/Additional English /Urdu/Sanskrit,A student can opt for any one of these languages (SL-II)	45(4/week)	03	50	10	40	20
Non-Credit Course	COI-213	Constitution of India	45(3/week)	02	50	10	40	20
Non-Credit Course	CCC-214	Compulsory Computer Course	45(3/week)	02	50	10	40	20
			315	15.5	250	50	200	100
Total Credits for Semester II : 15.5 (Theory : 14 ; Laboratory : 1.5)								

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
Choice Based Credit System (CBCS) Structure & Curriculum
B.Sc. Botany Three Year Undergraduate Degree Program

Semester III

Course	Course Code	Course Title	Periods (Periods /week)	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1C) Core Courses	BOT-311	Core Course (Theory Paper-V) Taxonomy of Angiosperms	45(3/week)	2	50	10	40	20
	BOT-312	Core Course (Theory Paper-VI) Plant Physiology	45(3/week)	2	50	10	40	20
	BOT-321	Lab course 3 (Based on BOT -311)	45(3/week)	1.5	50	10	40	20
	BOT-322	Lab course 4 (Based on BOT -312)	45(3/week)	1.5	50	10	40	20
Skill Enhanceme-nt course (SEC-1)	SEC-313	SEC-1 Any one skill to be chosen out of two SEC-1(A) , SEC-1 (B)	45(3/week)	2	50	10	40	20
Ability Enhancemen t compulsory courses (AECC-3)	ENG-331	Communication skills in English-III	45(5/week)	3	50	10	40	20
	SL-332	Marathi/Hindi/ Additional English/Urdu/Sanskrit A student can opt for any one of these languages (SL-III)	45(4/week)	3	50	10	40	20
			315	15	350	70	280	140
Total Credits for Semester III : 15 (Theory : 12 ; Laboratory : 3)								

Semester IV

Course	Course Code	Course Title	Periods (Periods /week)	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSC-1D) Core Courses	BOT-411	Core Course (Theory Paper-VII) Gymnosperms & Utilization of Plants	45(3/week)	2	50	10	40	20
	BOT-412	Core Course (Theory Paper-VIII) Plant Ecology	45(3/week)	2	50	10	40	20
	BOT-421	Lab Course 5 (Based on BOT-411)	45(3/week)	1.5	50	10	40	20
	BOT -422	Lab Course 6 (Based on BOT -412)	45(3/week)	1.5	50	10	40	20
Skill Enhancemen t course (SEC-2)	SEC-413	SEC-2 Any one skill to be chosen out of two SEC-2(C) , SEC-2 (D)	45(3/week)	2	50	10	40	20
AbilityEnha-ncement compulsory courses (AECC-4)	ENG-431	Communication skills in English-IV	45(5/week)	3	50	10	40	20
	SL-432	Marathi/Hindi/ Additional English/ Urdu/Sanskrit A student can opt for any one of these languages (SL-IV)	45(4/week)	3	50	10	40	20
Additional Credits	EVS-413	Environmental Studies	45(3/week)	02	50	10	40	20
			360	17	350	70	280	140
Total Credits for Semester IV : 15 (Theory : 14 ; Laboratory : 03)								

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad
Choice Based Credit System (CBCS) Structure & Curriculum
B.Sc. Botany Three Year Undergraduate Degree Program

Semester V

Course	Course Code	Course Title	Periods (Periods /week)	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSE-1 A) Discipline Specific Elective	BOT-511	DSE-1A(1) (Theory Paper-IX) Cell Biology & Molecular Biology	45(3/week)	2	50	10	40	20
	BOT-512	DSE-1A(2) (Theory Paper-X) (Select any one paper from A1/B1/C1/D1)	45(3/week)	2	50	10	40	20
	BOT-521	Lab course 7(Based on BOT-511)	45(3/week)	1.5	50	10	40	20
	BOT-522	Lab course 8 (Based on BOT-512 A1/B1/C1/D1)	45(3/week)	1.5	50	10	40	20
Skill Enhancement course (SEC-3)	SEC-513	SEC-3 Any one skill to be chosen out of two SEC-3(E) , SEC-3 (F)	45(3/week)	2	50	10	40	20
Non-Credit Course	PEV-514	Professional Ethics and Moral Values	45(3/week)	2				
			270	11	250	50	200	100
Total Credits for Semester V : 11 (Theory : 08 ; Laboratory : 03)								

Semester VI

	Course Code	Course Title	Periods (Periods /week)	Credits	Scheme of Examination			
					Max Marks	CIA	UA	Min Marks
Optional I (DSE-1 B) Discipline Specific Elective	BOT-611	DSE-1B(1) (Theory Paper-XI) Genetics and Evolution	45(3/week)	2	50	10	40	20
	BOT-612	DSE-1B(2) (Theory Paper-XII) (Select any one paper from A2/B2/C2/D2)	45(3/week)	2	50	10	40	20
	BOT-621	Lab course 9(Based on BOT-611)	45(3/week)	1.5	50	10	40	20
	BOT-622	Lab course 10 (Based on BOT-612- A2/B2/C2/D2)	45(3/week)	1.5	50	10	40	20
Skill Enhancement course (SEC4)	SEC-613	SEC-4 Any one skill to be chosen out of two SEC-4(G) , SEC-4 (H)	45(3/week)	2	50	10	40	20
			225	9	250	50	200	100
Total Credits for Semester V : 09 (Theory : 06 ; Laboratory : 03)								

Total Credits for three years : Sem I (11.5) + Sem II (11.5) + Sem III (15) + Sem IV (15) + Sem V (09) + Sem VI (09) = 71 Credits

Important Notes:

i) **Nomenclature**: DSC- Discipline Specific Core course, SEC – Skill Enhancement Course, AECC- Ability Enhancement compulsory course, DSE- Discipline Specific Elective, UA- University Assessment (Semester End), CIA-Continuous Internal Assessment.

ii) **There shall be one skill enhancement course (SEC) IIIrd to VIth Semester (any one SEC course to be chosen (any one from three optional subjects) from the basket of SEC courses for the respective semester.**

iii) **Code description**: BOT code has to be decided by B o S of the respective subject while designing their respective curriculum (e.g. for Botany it will be BOT; for Electronics it will be ELE).

- The codes for first semester courses will start from BOT-111, Second-semester courses will start from BOT-211 and so on.
- BOT-111 : The first digit indicate the Semester Number, the second two digits indicate paper numbers for the first-semester courses and the same analogy is for the remaining semesters.
- The codes for theory courses will start from BOT-111 (for the first semester and the same analogy is for the remaining semesters).
- The codes for practical courses will start from BOT-121 (for the first semester and the same analogy is for the remaining semesters).
- The codes for Ability Enhancement compulsory courses will start from BOT-131 (for the first semester and the same analogy is for the remaining semesters).

iv) **Assessment**: 80% for University Assessment (Semester End Examination) and 20 % for Continuous Internal Assessment (CIA)

v) **Continuous Internal Assessment (CIA): Theory** (10 Marks): Internal Test 05 Marks (Two Internal Tests of 05 marks each and average of the two test will be considered) and 05 Marks for Assignment/tutorials.

vi) **Continuous Internal Assessment (CIA): Practical** 10 Marks for record book/submission of collection and field survey report and excursion report and viva voce.

vii) Practical examination: Annual examination.

Curriculum for Semester I (w.e.f. Academic Year 2022-23)

B. Sc. I Year (Theory) Semester - I

BOT 111 Paper I (Diversity of Cryptogams - I)

Lectures – 45 **Total Credits – 2**

Unit - 1 **Credit – 0.4**

1.1 Viruses: General characters, classification based on host, economic importance, TMV – structure and multiplication (03)

1.2 Mycoplasma: General characters (Little leaf of Brinjal) (01)

1.3 Bacteria: General characters, ultra-structure, classification based on shape, reproduction, economic importance , Citrus Canker. (05)

1.4 Cryptogams: General characters, classification according to G.M. Smith up to class level (01)

Unit – 2 **Credit – 0.7**

2.1 General characters, classification according to F.E. Fritsch (1935) up to the class level, and economic importance of Algae (02)

2.2 Systematic position, occurrence, structure, reproduction (excluding development of sex organs) and graphic life cycle with respect to following types:

a) Cyanophyceae – *Nostoc* (02)
b) Chlorophyceae – *Chara* (03)
c) Xanthophyceae – *Vaucharia* (02)
d) Phaeophyceae – *Sargassum* (03)
e) Rhodophyceae – *Batrachospermum* (03)

Unit – 3 **Credit -0.7**

3.1 General characters, classification according to Alexopoulous and Mims (1979) up to the class level, Economic importance of Fungi. (04)

3.2 Systematic position, occurrence, structure, reproduction and graphic life cycle with respect to the following types:

a) Oomycetes – *Albugo* (02)
b) Zygomycetes – *Mucor* (02)
c) Ascomycetes – *Eurotium* (02)
d) Basidiomycetes – *Agaricus* (03)
e) Deuteromycetes – *Cercospora* (02)

3.3 Lichen: Types of Lichens, *Usnea*, Economic Importance of Lichens. (03)

Unit – 4 **Credit -0.2**

Continuous Internal Assessment (CIA): Tutorials and Assignments (5)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment or Tutorials for 5 marks. In assessment you are free to use different assessment methods.

B. Sc. I Year (Theory) Semester - I
BOT 112 Paper - II (Morphology of Angiosperms)

Lectures – 45 **Total Credits - 2**

Unit – 1 **Credits:01**

1.1- Basic body plan of flowering plant, modular type of growth, diversity of plant forms - Herbs, Shrubs, Trees, Climbers; annuals, biennials and perennials. (04)

1.2 Morphology of vegetative organs:

a) Root: Characteristics, functions, regions of root, types – tap roots and adventitious roots, modification of root for storage, mechanical support and vital functions. (05)

b) Stem: Characteristics, functions, modification – underground, sub-aerial and aerial (05)

c) Leaf: Parts of typical leaf, phyllotaxy, types (simple and compound), diversity in shape and size, venation and modifications of leaf. (09)

Unit – 2 **Credits: 01**

Morphology of reproductive organs:

2.1 Inflorescence: Racemose, Cymose and special types (05)

2.2 Flower: Definition, Parts of typical flower, structure, function and modification of calyx, corolla, androecium, gynoecium, aestivation and placentation (12)

2.3 Fruit: Types of fruits (03)

2.4 Fruit and Seed dispersal strategies. (02)

Unit – 3

Continuous Internal Assessment (CIA): Tutorials and Assignments (5)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment or Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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B. Sc. I Year (Practical) Semester - I
Lab Course I : BOT 121
(Practical Based on Theory Papers – BOT-111 & BOT- 112)

Lectures – 45 **Credits – 1.5**

Practical through temporary mounting, permanent slides, charts, models, microphotographs, and audiovisual aids

1. Electron micrographs/Models of viruses – TMV, Mycoplasma and Types of Bacteria
2. Algae: *Nostoc, Chara*
3. Algae: *Vaucharia, Batrachospermum*
4. Algae: *Sargassum*
5. Fungi: *Albugo, Mucor,*
6. Fungi: *Eurotium, Agaricus*
7. Fungi: *Cercospora* and
8. Lichens – *Usnea*
9. Study of root and Stem with its modifications
10. Study of leaf and its diversity and modification
11. Study of flower (*Hibiscus* and *Datura*) and inflorescence
12. Forms and Aestivation of corolla,
13. Structure of stamen- adhesion and cohesion, Structure of carpel and placentation
14. Study of fruits and seeds
15. **Internal Assessment**

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note for Lab course: Candidate shall submit the following at the time of exam.
1. Certified laboratory course record book.
2. Field note book / Submission of collection and field survey report / excursion /Tour report.
3. Collection of specimens from algae, fungi, leaves, stem, root, flowers, fruits and seeds.

In addition to number of practical prescribed above, the students are required to undertake field excursions to the places of botanical interest and industrial places under the guidance of teacher. There shall be frequent study tours in local areas. T.A. and D.A. be paid to the teachers, peons and field collectors as per university rules. The record book is to be signed periodically by teacher in charge and certified by the Head of Department at the end of the term. Candidate should not be allowed to appear for practical examination without a certified record book or a certificate from the Head of Department.

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B. Sc. I Year (Theory) Semester - I
BOT 111 Paper I (Diversity of Cryptogams - I)

Time: 2 Hour | Max. Marks: 40

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.2. Long answer type question .....(Unit 3) 10

or

Describe in brief:
a. Short answer type .....(Unit 3)
b. Short answer type .....(Unit 3)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 1)
c. Short note (Unit 1)

Q.4 MCQ (10 questions from all units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B. Sc. I Year (Theory) Semester - I
BOT 112 Paper - II (Morphology of Angiosperms)

Time: 2Hour Max. Marks: 40

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 1) 10

or

Describe in brief:
a. Short answer type .....(Unit 1)
b. Short answer type .....(Unit 1)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 2)
c. Short note (Unit 1/2)

Q.4 MCQ (10 questions from all units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Practical Question paper Examination
B. Sc. I Year (Practical) Semester - I
Lab Course Code: BOT 121 (Based on BOT 111& 112)

Time: 2 Hour Max. Marks: 50

Date: _____ Batch No. _____
Center: _____

Q. 1. Identify, classify and describe any two algae from the given mixture 'A', Based on BOT 111(Unit 1). 08.

Q.2. Identify, classify and describe the given specimen of fungi 'B', Based on BOT 111(Unit 2) 08

Q.3. Identify, describe the structure, modification & pollination mechanism in the given flower.(BOT 112) 08

Q.4. Identify & describe the structure / modification in the given specimens 'C' & 'D' (Root, stem, leaf, Flower, Inflorescence, Fruit). 08

Q.5. Identify and describe the specimen E,F,G and H as per the instructions 08

(E- Algae/ Fungi, F Lichens/Bacteria, G- Morphology and H - Economic importance)

Q.4. Submission: 10

a) Record book

b) Tour report, field collection and viva - voce

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Curriculum for Semester II (w.e.f. Academic Year 2022-23)

B. Sc. I Year (Theory), Semester-II
BOT 211 Paper - III (Diversity of Cryptogams - II)

Lectures – 45 **Total Credits - 2**

Unit- 1 **Credit -0.8**

1. Bryophytes:

1.1 General characters of bryophytes, classification as per G. M. Smith (02)

1.2 Systematic position, structure, reproduction (excluding developmental stages) and alternation of generation of the following types:

a) *Marchantia* (05)
b) *Anthoceros* (04)
c) *Funaria* (04)

1.3 Economic Importance of Bryophytes (02)

Unit 2 **Credits -1.2**

2. Pteridophytes:

2.1 General characters of Pteridophytes, classification as per G. M. Smith (03)

2.2 Systematic position, structure and reproduction (excluding developmental stages) and alternation of generations of the following types:

a) Fossil Type- *Rhynia* (02)
b) Psilopsida – *Psilotum* (02)
c) Lycopsida – *Lycopodium*, *Selaginella* (10)
d) Sphenopsida – *Equisetum* (04)
e) Pteropsida – *Marsilea* (05)

2.3 Stelar Evolution in Pteridophyta (02)

Unit – 3

Continuous Internal Assessment (CIA): Tutorials and Assignments (05)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment/Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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B. Sc. I Year (Theory), Semester – II

BOT 212 Paper - IV (Histology, Anatomy and Embryology)

Lectures – 45 **Total Credits - 2**

Unit – 1 **Credit – 0.7**

Histology:

1.1 Types of tissue:

a) Meristematic tissue – Meristem, structure and types based on origin and position. (03)

b) Permanent tissues: Simple, Complex and Secretary (05)

c) Epidermal tissues: Types with examples Trichromes and Stomata (04)

1.2 Histological organization of root and shoot apices (03)

1.3 Various theories of cellular organization (03)

Unit – 2 **Credit -0.7**

Anatomy:

a) Primary structure of root, stem and leaf of Monocot (Maize) and Dicot (Sunflower) (06)

b) Secondary growth in root and stem of Dicot (Sunflower) (03)

c) Anomalous secondary growth in *Dracaena* (01)

c) Wood anatomy: Growth rings, heart wood and sap wood (02)

d) Periderm: Origin, structure and functions. (02)

Unit – 3 **Credit -0.6**

Embryology:

a) Structure of anther, microsporogenesis and development of male gametophyte (02)

b) Structure and types of ovule, megasporogenesis and development of female gametophyte (*Polygonum* type). (03)

c) Pollination -Mechanism, types and agencies. (02)

d) Double fertilization and its significance (01)

e) Development of Dicot embryo (Crucifer type). (01)

f) Structure, development and types of endosperm. (02)

g) Structure of Dicot and Monocot seed types of seed germination (02)

Unit – 4

Continuous Internal Assessment (CIA): Tutorials and Assignments (05)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment/Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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B. Sc. I Year (Practical), Semester - II

Lab Course II, BOT 221

(Based on BOT 211 & 212, Theory Papers – III and IV)

Lectures – 45 **Credits – 1.5**

Practical through temporary mounting, permanent slides, charts, models, photographs, and audiovisual aids

1. Bryophyte: *Marchantia*
2. Bryophyte: *Anthoceros*
3. Bryophyte: *Funaria*
4. Rhynia image study
5. Pteridophyte: *Psilotum*, *Lycopodium*
6. Pteridophyte: *Selaginella*
7. Pteridophyte: *Equisetum*
8. Pteridophyte: *Marsilea*
9. **Internal Assessment**
10. Simple and Complex permanent tissue
11. Secretory and Epidermal tissues (Trichomes and Stomata)
12. Double stained permanent slide preparation of Dicot (Sunflower) and Monocot (Maize) root
13. Double stained permanent slide preparation of Dicot (Sunflower), Monocot (Maize) stem
14. Double stained permanent slide preparation of *Dracaena* stem
15. Double stained permanent slide preparation of Dicot (Sunflower) & Monocot (Maize) leaf
16. Anatomy of anther, Ovule and seed
17. **Internal Assessment**

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note for Lab course: Candidate shall submit the following at the time of exam.

1. Certified laboratory course record book.
2. Field note book, excursion report / Tour report submission.
3. Collection of specimens from Bryophyte and Pteridophyte.

In addition to number of practical prescribed above, the students are required to undertake field excursions to the places of botanical interest and industrial places under the guidance of teacher. There shall be frequent study tours in local areas. T.A. and D.A. be paid to the teachers, peons and field collectors as per university rules. The record book is to be signed periodically by teacher in charge and certified by the Head of Department at the end of the term. Candidate should not be allowed to appear for practical examination without a certified record book or a certificate from the Head of Department.

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B. Sc. I Year (Theory) Semester - I
BOT 211 Paper III (Diversity of Cryptogams - II)

Time: 2Hour Max. Marks: 40

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 1) 10

or

Describe in brief:
a. Short answer type .....(Unit 1)
b. Short answer type .....(Unit 1)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 2)
c. Short note (Unit 2)

Q.4 MCQ (10questions from all units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B. Sc. I Year (Theory) Semester - II
BOT 212 Paper - IV (Histology, Anatomy and Embryology)

Time: 2Hour Max. Marks: 40

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 1) 10

or

Describe in brief:
a. Short answer type .....(Unit 1)
b. Short answer type .....(Unit 1)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 3)
b. Short note (Unit 3)
c. Short note (Unit 3)

Q.4 MCQ (10questions from all units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Practical Question paper Examination
B. Sc. I Year (Practical) Semester - I
Lab Course II, Code: BOT 221 Paper I (Based on BOT 211& 212)

Time: 2Hour Max. Marks: 50.

Date: _____ Batch No. _____
Center: _____

Q. 1. Identify, classify and describe any two algae from the given mixture 'A', Based on BOT 111(Unit 1). 08.

Q.2. Identify, classify and describe the given specimen of fungi 'B', Based on BOT 111(Unit 2)08

Q.3. Identify, describe the structure, modification & pollination mechanism in the given flower.(BOT 112) 08

Q.4. Identify & describe the structure / modification in the given specimens 'C' & 'D' (Root, stem, leaf, Flower, Inflorescence, Fruit). 08

Q.5. Identify and describe the specimen E,F,G and H as per the instructions 08

(E- Algae/ Fungi, F Lichens/Bacteria, G- Morphology and H - Economic importance)

Q.4. Submission: 10

a) Record book

b) Tour report, field collection and viva - voce

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Suggested Readings:

1. Alexopoulos, C.J., C.W. Mims & M. Blackwell. 2007. **Introductory Mycology**. IV Edition. Wiley India (P) Ltd., Daryaganj, New Delhi..
2. Annie Ragland, 1999. **Fundamentals of Botany** Vol.3. Saras publication.
3. Bhojwani, S.S. and Bhatnagar, S.P. 1981. **Embryology of angiosperms.** Vikas Publication Pvt.Ltd. New Delhi. Eames, A.J and Mac Daniel, 1975.
4. Bhojwani. S.S. and Bhatnagar. S.P. 1978. **The Embryology of Angiosperms.** Vikas Publishing Pvt. Ltd., Delhi.
5. Clifton, A. 1958 **Introduction to the Bacteria**. – Mc Graw Hill Co., New York.
6. Dube H.C. 1978, **A Text Book of Fungi, Bacteria & Viruses**, Vikas Pub House, Pvt Ltd, New Delhi & Bangalore.
7. Dube, H. C. 1990. **An Introduction to Fungi** - Vikas Publishing House Pvt. Ltd., Delhi.
8. Eams A.J. and Mac Daniel. **An Introduction to Plant Anatomy.** TMH Edition. Tata MC. Graw Hill Publishing Co.ltd. Bombay - New Delhi.
9. Esau, **Plant Anatomy,** 1965 Wiles Eastern, New Delhi.
10. Fritsch,F.E.1945. **Structure Reproduction of Algae Vol. l&II**, Cambridge Univ Press, London.
11. Johri, B.M, 1984. **Embryology of Angiosperms**. Springer- Verlag.
12. Kumar, H. D. 1988 **Introductory Phycology**, Affiliated East-West Press Ltd.,New York.
13. Maheswari P.1971.**An Introduction to Embryology of Angiosperms**,Tata McGraw Hill, Delhi.
14. Mandahar, C. L. 1998 **Introduction to Plant Viruses** – S. Chand & Ltd., Delhi.
15. Mishra.A & Agarwal R.P.1978, **Lichens-A Preliminary Text.** Oxford-IBH.66 Janapath, New Delhi 01.
16. Pande, B.P. 1979. **Plant Anatomy.** S. Chand & Co, Ram Nagar, New Delhi.
17. Pandey B.P. 1977. **A Text book of Botany Bryophyta, Peridophyta & Gymnosperms** K.Nath & Co. Meerut
18. Pandey, B.P. 2007 **Botany for Degree Students**. S. Chand & Co. New Delhi.
19. Pandey.B.P. 2009. **Taxanomy of Angiosperms**. S. Chand & Co. Ltd. New Delhi.
20. Parihar, N.S.1985, **An Intro to Embryophyta–Bryophytes**. Central Book Depot. Alahabad.
21. Reddy S. M. 1996, University Botany I : (Algae, Fungi, Bryophyta and Pteridophyta) New Age International Publisher's Pvt Ltd
22. Robet Edward Lee.1980, **Phycology,** Cambridge Unversity Press, London.
23. Sambamurthy A.V.2006.**Textbook of Plant Pathology,** I.K. Intnational, Pvt.Ltd, New Delhi
24. Sharma O.P. 2017, Text Book of Algae, Tata Mc Graw Hill Publication.
25. Singh, V. and Jain, D.K - **Taxonomy of Angiosperms** - Rastogi Publications, Meerut.
26. Singh.V., P.C. Pandey and D.K.Jain. 2003. **Embryology of Angiosperms.** Rastogi Publications. Meerut.
27. Smith, G.M. 1972. **Cryptogamic botany Vol. - II** Mc Graw Hill, New Delhi.
28. Sporne, K.R. 1976. **Morphology of Petridophytes,** BI Publications. Pvt. Ltd., New Delhi.
29. Swamy B.G.L. & Krishnamurthy K.V.1950. **From Flower to Fruit.** Tata Mc Graw Hill, Delhi.

30. Turner, P.C. A.G. MC Lennan. A.D. Bates and M.R.H. White. 1998. **Instant Notes in Molecular Biology.** Viva Books Pvt. Ltd. Chennai.
31. Vashishta, B.R. 1990 **Botany for Degree students, Algae**. S. Chand & Co. Ltd., New Delhi.
32. Vashishta. B.R. (1978). **Bryophyta.** S.Chand & Co, Ram Nagar, New Delhi - 110 001
33. Vashishta. B.R., A.K. Sinha & Adarsh Kumar. 2005. **Botany for Degree Students-Bryophyta.** S. Chand & Company Ltd., New Delhi.
34. Vashista.B.R.1981 **Botany for Degree students Fungi.** S. Chand & Co. Ltd., New Delhi.
35. Vasishta, P.C. 1974 **Taxonomy of Angiosperms.** S. Chand & Co., Chennai.
36. Venkateshwaran, V.A. **Text book of Algae.** Marahi Book depot, Guntur.
37. Verma. P. S and Agarwal, V.K. 2007. **Cytology.** S. Chand & Co. Chennai.
38. Wolfe, S. L. 1993. **Molecular and Cellular Biology.** Wadsworth Publishing Co, California.
39. http://herba.msu.ru/shipunov/school/biol_154/textbook/intro_botany.pdf
40. https://ncert.nic.in/textbook/pdf/kebo105.pdf
41. https://www.wikipedia.org/
42. https://www.easybiologyclass.com/topic-botany/
43. https://www.biologyexams4u.com/2011/09/botany-notes.html
44. https://ncert.nic.in/
45. https://www.kew.org/
46. https://bsi.gov.in/bsi-units/en?rcu=140

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Curriculum for Semester III (w.e.f. Academic Year 2023-24)

B. Sc. II Year (Theory), Semester III
Course Code: BOT -311 Paper V (Taxonomy of Angiosperms)

(45L) **Credit: 02**

Unit :1 **Credit : 01**

1.Definition, objectives and importance of taxonomy, Salient features, origin and evolution of Angiosperms. (03)
2. Bentham and Hooker's system of classification upto series level, its merits and demerits. (03)
3. Taxonomy in relation to anatomy, cytology, embryology, palynology, and ecology. (03)
4. Concept of Binomial Nomenclature and its advantages (03)
5. Concept of genus, species and epithet. (02)
6. Herbaria and Botanical Gardens. (03)

Unit:2 **Credit :01**

Studies of the following families: Systematic position as per Bentham and Hooker's System of Classifification, Diagnostic characters of family, Description up to floral formula, floral diagram, common examples and their Economic importance. (28)

i. Annonaceae
ii. Malvaceae
iii. Leguminosae
  Fabaceae (Papilionaceae)
  Caesalpiniaceae
  Mimosaceae
iv. Apocynaceae
v. Solanaceae
vi. Acanthaceae
vii. Lamiaceae (Labiatae)
viii.Nyctaginaceae
ix. Rubiaceae
x. Liliaceae
xi. Poaceae (Gramineae)

Continuous Internal Assessment (CIA): Tutorials and Assignments (5)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment or Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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B. Sc. II Year (Theory) Semester III)

Course Code: BOT-312 Paper VI (Plant Physiology)

45 L **Credit: 02**

Unit:1 **Credit .5**

1. Plant water relations:

a) Diffusion, osmosis, plasmolysis and imbibition. (02)

b) Water absorption and ascent of sap (Transpiration pull theory) (02)

c) Transpiration – Definition, types, cuticular, lenticular and stomatal, structure of stomata, mechanism of opening and closing of stomata (starch–sugar hypothesis) (03)

2. Mineral nutrition: (05)

a) Macro and microelements: Roles and deficiency symptoms of N, P,K, Mg, Ca, Fe, Zn, Bo, and Mo.

b) Mineral uptake – Passive (ion exchange theory) and active (carrier concept).

3. Translocation of solutes: (03)

Mass flow hypothesis, protoplasmic streaming theory, Source and sink relationship.

Unit:2 **Credits .5**

1. **Enzymes:** (06)

Chemical nature – Holoenzyme, apoenzyme, prosthetic group, co-factor & coenzyme. Properties, nomenclature, classification based on type of reactions, mechanism of enzyme action.

2. Growth regulators: (07)

Discovery, structure, types, roles and practical applications of Auxins, Gibberellins, Cytokinins, Abscisic acid and Ethylene.

Unit:3 **Credit 1**

1. Photosynthesis:

Definition, ultra-structure of chloroplast, photosynthetic pigments, Light reactions-Hill reaction, red drop and Emerson enhancement effect, two pigment systems (PS I, PS II), Photophosphorylation – cyclic and non cyclic, Z-scheme; Dark reactions -C3, C4 and CAM Pathways. C3 & C4 Plants & Photoperiodism (10)

2. Respiration:

Definition, Ultra structure of mitochondria, types of respiration, Glycolysis, TCA Cycle, Photorespiration, Electron transport system, alcoholic and lactic acid fermentation. (07)

Continuous Internal Assessment (CIA): Tutorials and Assignments (5)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment or Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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B. Sc. II Year (Practical), Semester - III

Lab Course III, BOT 321 (Based on BOT 311, Theory Papers – V)

Lectures – 45 **Credits – 1.5**

Study of locally available plants of the following families:

1. Annonaceae
2. Malvaceae
3. Leguminosae

a) Fabaceae (Papilionaceae)
b) Caesalpiniaceae
c) Mimosaceae

4. Apocynaceae
5. Solanaceae
6. Acanthaceae
7. Lamiaceae (Labiatae)
8. Rubiaceae
9. Nyctaginaceae
10. Liliaceae
11. Poaceae (Gramineae)
11. Preparation of Herbariums
13. Herbarium Submission (10 specimens)
14. Study Tour and Field Visits

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note for students

Candidate shall submit the following at the time of practical examination: Certified laboratory record book. Submission of field report, tour report and digital specimens with GPS locality. In addition to number of practicals prescribed above, the students are required to undertake field excursions to the places of botanical interest and industrial places under the guidance of teachers. **Collection of rare flowering and non- flowering plants should be avoided during excursion.** There shall be frequent study tours in local areas. T.A. and D.A. be paid to the teachers, peons and field collectors as per university rules by institutes. The record book is to be signed periodically by teacher in charge and certified by the Head of the Department at the end of the term. Candidate should not be allowed to appear for practical examination without a certified record book or a certificate from the Head of the Department.

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B. Sc. II Year (Practical), Semester - III
Lab Course IV, BOT 322 (Based on BOT 312, Theory Papers – VI)

45L **Credits:1.5**

1. Osmosis by egg membrane and potato osmoscope
2. Plasmolysis in *Tradescantia* leaves
3. Effect of different conc. of organic solvents on membrane permeability
4. Determination of water potential of any tuber
5. Detection of mineral elements in plant ash
6. Digestion of starch by amylase
7. Detection of enzyme activity: oxidase, peroxidase, catalase and dehydrogenase
8. Separation of chloroplast pigments by paper chromatography
9. Demonstration of Hill reaction
10. Effect of different intensities of light on photosynthesis
11. Effect of different colors of light on photosynthesis
12. Fermentation by Kuhne's fermentation vessel
13. Isolation of starch
14. Isolation of pectin
15. Estimation of total and reducing sugars in fruit juice by Fehling solution
16. Separation of amino acids by paper chromatography
17. Effect of IAA and Gibberellins on seed germination.

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note for students

Candidate shall submit the following at the time of practical examination: Certified laboratory record book. Submission of field report, tour report and digital specimens with GPS locality. In addition to number of practicals prescribed above, the students are required to undertake field excursions to the places of botanical interest and industrial places under the guidance of teachers. **Collection of rare flowering and non- flowering plants should be avoided during excursion.** There shall be frequent study tours in local areas. T.A. and D.A. be paid to the teachers, peons and field collectors as per university rules by institutes. The record book is to be signed periodically by teacher in charge and certified by the Head of the Department at the end of the term. Candidate should not be allowed to appear for practical examination without a certified record book or a certificate from the Head of the Department.

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B. Sc. II Year (Theory) Semester III)

BOT-313 Skill Enhancement Course-1 SEC 1 (A): Mushroom Cultivation

45L **Credits:02**

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a. THEORY: (1 Credit) Total Hours: 15

Unit 1: Introduction, history. Edible and non-edible mushrooms (Poisonous). Types of edible mushrooms available in India. **(3 Hours)**

Unit 2: Cultivation techniques: Cultivation of Button, Oyster and Paddy straw mushrooms - Collection of raw materials, compost and composting, spawn & spawning, casing, cropping, picking and packing, management of diseases **(5 Hours)**

Unit 3: Post Harvest Technology and storage: Short-term preservation, conventional packaging, Storage of fresh mushrooms (Refrigeration, vacuum cooling) Long term storage (canning, pickles, papads), drying. Transport of fresh mushrooms. **(4 Hours)**

Unit 4: Economics in mushroom cultivation: Cost for site, spawn production, compost unit, machinery for small scale farm. Cost benefit ratio - Marketing in India and abroad, Export Value, Low cost technology **(3 Hours)**

b. PRACTICAL: (1 Credit) Total Hours: 15

Laboratory Exercises (Any 5) (3 Hours for each Practical)

1. Mushroom Cultivation, laboratory requirements and layout.
2. Mushroom morphology – L.S of Basidiocarp (Button mushroom), section through gill and mounting of spores.
3. Preparation of culture medium.
4. Preparation of spawn for oyster mushroom.
5. Cultivation of Oyster mushroom.
6. Mushroom preservation – Drying. Storage in brine and pickle making.
7. Visit to a relevant farm or Institute.

Suggested Readings-

1. Swaminathan, M. (1990). *Food and Nutrition*. Bengaluru: The Bangalore Printing and Publishing Co. Ltd.
2. Tewari, Pankaj Kapoor, S.C. (1988). *Mushroom cultivation*. New Delhi: Mittal Publicatiion.
3. Dubey, R.C (1993). *A textbook of Biotechnology*. New Delhi: S. Chand & Company Pvt. Ltd.
4. Biswas, S., Datta, M., &Ngachan, S.V. (2012). *Mushrooms, a manual for cultivation*. New Delhi: PHI learning Private Limited.
5. Tripathi, D.P. (2005). *Mushroom Cultivation*. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
6. Kannaiyan, S., &Ramasamy, K. (1980). *A handbook of edible mushroom*. New Delhi: Today & Tomorrows printers & publishers.

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B. Sc. II Year (Theory) Semester III)

BOT-313 Skill Enhancement Course-1 SEC 1 (B): Soil Testing and Analysis

45L **Credits:02**

a. THEORY: (1 Credit) Total Hours: 15

Unit 1: Importance of Soil Testing and Analysis, Sample Collection and Processing, Purpose of Soil testing and analysis, precautions during soil collection & processing, Preservation labeling and Storage of soil samples. **(4 Hours)**

Unit 2: Study of Instruments: pH Meter, Conductivity meter, spectrometer, UV-Spectrophotometer, (Calibration, Instrumentation, applications only) use of soil testing kit and mobile soil testing van. **(6 Hours).**

Unit 3: Study of Laboratory requirements, working pattern for soil testing. **(2 Hours).**

Unit 4: Study of various elements, organic and inorganic compounds in soil. **(3 Hours)**

b. PRACTICAL: (1 Credit) Total Hours: 15

Laboratory Exercises (Any 5) (3 Hours for each Practical)

1. Estimation of pH and Electrical Conductivity of soil.
2. Testing of organic carbon in soil.
3. Estimation of available nitrogen in soil.
4. Estimation of available Phosphorus in soil.
5. Estimation of available potassium in soil.
6. Estimation of calcium in soil.
7. Estimation of Magnesium in soil.
8. Visit to Soil Testing Laboratory.

Suggested Readings-

1. Soil Sampling, Preparation and analysis, Marcell Dekker, Inc, New York.
2. Soil Sampling and methods of analysis, carter M.R. and E.G.Gregorich, 2007, 2nd Ed..
3. Methods of soil analysis, Part, American society of Agronomy Inc., Kuete, A.Et.at., 1986
4. Soils and soil fertility, Troch, F.R. And Thompson, L.M. Oxford Press.
5. Fundamentals of soil science, Foth, H.D. Wiley Books.
6. Soil Science and Management, Plaster, Edward J., Delmar Publishers.
7. Principles of Soil Chemistry (2Wed.) Marcel Dekker Inc., New York.
8. Handbook of Agricultural Sciences, S.S.Singh, P.Gupta, A.k.Gupta, Kalyani Publication.

Note: Soil Testing kits are to be made available by the institutions.

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Curriculum for Semester IV (w.e.f. Academic Year 2023-24)

B. Sc. II Year (Theory) Semester IV)

Course Code: BOT-411 Paper VII (Gymnosperms and Utilization of Plants)

45 L **Credit: 02**

Unit:1 **Credits:01**

Gymnosperms:

1. Salient features, classification as per Sporne 1965, Economic importance (02)
2. Geological time scale, fossilization, types of fossils, *Lyginopteris*, fossil fuels (03)
3. Contributions of Prof. Birbal Sahani (01)
4. Study of morphology, anatomy, reproduction (excluding developmental stages) and graphical representation of life cycle of the following types: (15)
   a) Cycadales – *Cycas* (05)
   b) Coniferales – *Pinus* (05)
   c) Gnetales- *Gnetum* (05)
5. Economic importance of Gymnosperms (03)

Unit:2 **Credits:01**

Utilization of Plants:

1. Domestication of plants and their centers of origin (N.I.Vavilov) (02)
2. History, origin, cultivation, harvesting, improved varieties and economic importance of the following plants: (14)
   i. Food plants – Wheat, Jowar
   ii. Sugar – Sugarcane
   iii. Fibers - Cotton, Jute
   iv. Vegetable oils – Groundnut, Sunflower
   v. Beverages – Tea, Coffee
3. Botanical name, family name and economic importanceof the following plants: (05)
   i. Medicinal plants – *Aloe vera, Withania somnifera, Curcuma longa, Vitex negundo*
   ii. Timber and Gum – Teak, Neem, Babul, Sisham
   iii. Cosmetics and Perfumes – Rose, Mogra, Tuberose
   iv. Spices – Clove, Black pepper, Cumin, Coriander, Cinnamon.

Continuous Internal Assessment (CIA): Tutorials and Assignments (05)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment/Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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B. Sc. II Year (Theory) Semester IV)

Course Code: BOT-412 Paper VIII (Plant Ecology)

45 L **Credit: 02**

Unit: 1 **Credit: 0.7**

Plant and Environment:

A) Climatic factors –

a) Light as an ecological factor, global radiation and photosynthetically active radiation (02)

b) Temperature as an ecological factor (02)

c) Water as an ecological factor, physicochemical properties of water (02)

B) Edaphic factors – (07)

Soil formation -soil profile, physicochemical properties of soil, major soil types of India, soil erosion and soil conservation.

C) Pollution factors- (07)

Definition, Types of Pollutions, Consequences of Pollution on Biosphere (Global warming), Bioaccumulation, and Phytoremediation, Function of Pollution Control Board.

Unit:2 **Credit: 0.7**

1. Response of plants to water (10)

Morphological, physiological and anatomical response of plants to water– Hydrophytes, xerophytes, halophytes and epiphytes.

2. Phytogeography: (03)

Biogeographical zones in India in relation to forest types, and Biosphere Reserves in India.

Unit: 3 **Credit: 0.6**

1. Community ecology: (05)

Community characteristics -Frequency, Density, life forms, and Biological spectrum.

1. Ecosystem: (07)

structure -biotic and abiotic components, food chain, food web, ecological pyramids, energy flow, biogeochemical cycles-nitrogen and phosphorus.

Continuous Internal Assessment (CIA): Tutorials and Assignments (05)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment/Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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B. Sc. II Year (Practical), Semester - IV

Lab Course V, BOT 421 (Based on BOT 411, Theory Paper – VII)

45L **Credits:1.5**

Gymnosperms:

a) Cycas

i. Habit, young leaf, bulbils, male cone, microsporophyll, megasporophyll, pollen grains, mature seed.

ii. Study through permanent slides-Normal root (T.S.). Stem (T.S.), Ovule (L.S.)

iii. Study through hand section-Coralloid root (T.S.), Rachis (T.S.), Leaflet (T.S.)

b) Pinus

i. Habit, long and dwarf shoot, scale leaves, foliage leaves, male cone, female cone, pollengrains (W.M.), winged seed.

ii. Study through hand sections and permanent slides Root (T.S.), Stem (T.S.), Needle (T.S.)

iii. Study through permanent slide - T.L.S. & R.L.S. of stem, L.S. of male cone, L.S. of female cone

c) Gnetum

Habit, foliage leaves, male strobilus, female strobilus, pollengrains (W.M.), seed.

ii. Study through hand sections and permanent slides Root (T.S.), Stem (T.S.),

iii. Study through permanent slide - T.L.S. & R.L.S. of stem, \ male strobili, and female strobili

Palaeobotany:

a) Types of fossils (Specimens)

b) *Lygynopteris* (Specimen / Permanent slide)

Utilization of plants:

a) Food plants – Study of the morphology, structure,and histochemical tests of food storing tissue in Jowar & Wheat

b) Histochemical test of lignin and cellulose

c) Vegetable oils – hand section of Groundnut & Sunflower Seed and staining of oil droplets by Sudan III

d) Study of the sources of Timber, Gum, Medicinal plants, Cosmotics and Perfumes

e) Study of Black pepper, Clove, Cinnamon, Cumin, Coriander

f) Field notebook, specimen collection, and tour report.

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note for Lab course: Candidate shall submit the following at the time of exam.

1. Certified laboratory course record book.
2. Field note book / Tour report.

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B. Sc. II Year (Practical), Semester - IV
Lab Course VI, BOT 422 (Based on BOT 412, Theory Paper – VIII)

45L **Credits:1.5**

1. Study of morphological and anatomical adaptations in hydrophytes – *Hydrilla*, *Eichhornia*, *Typha* and *Nymphaea* .
2. Study of morphological and anatomical adaptations in xerophytes -*Aloe*, *Nerium, Casuarina.*
3. Study of morphological adaptations in halophytes - Pneumatophore, Stilt roots
4. Study of morphological and anatomical adaptations in epiphytes
5. Study of vegetation by quadrat method
6. Estimation of Importance Value Index (IVI) of grassland ecosystem on the basis of relative frequency, relative density and relative abundance.
7. Determination of water holding capacity of different soils
8. Study of meteorological instruments -Rain gauge, Hygrometer, Barometer
9. Determination of percent leaf area injury of different infected leaf samples
10. Estimation of salinity of different water samples
11. Determination of pH of different soils by pH papers/universal indicator/pH meter.

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note for Students:

Candidate shall submit the following at the time of practical exams:

Certified laboratory record book, Field note book, Tour report and Collection of specimens.

In addition to number of practical's prescribed above, the students are required to undertake field excursions to the places of botanical interest and industrial places under the guidance of teachers. **Collection of rare flowering and non-flowering plants should be avoided during excursion.** There shall be frequent study tours in local areas. T.A. and D.A. be paid to the teachers, peons and field collectors as per university rules by institutions. The record book is to be signed periodically by teacher in charge and certified by the Head of Department at the end of the term. Candidate should not be allowed to appear for practical examination without a certified record book or a certificate from the Head of Department.

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Suggested Readings

1. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh,J.S.,Singh,S.P.,Gupta,S.(2006). EcologyEnvironment and Resource Conservation. Anamaya Publications, NewDelhi, India.
3. Sharma,P.D.(2010).Ecology andEnvironment.RastogiPublications,Meerut,India.8thedition.
4. Wilkinson,D.M.(2007). FundamentalProcessesinEcology: AnEarthSystems Approach. Oxford University Press. U.S.A.
5. Kormondy,E.J.(1996).Conceptsofecology.PHILearningPvt.Ltd.,Delhi,India.4thedition
6. Balfour Austin(2016). PlantTaxonomy. Syrawood Publishing House
7. Chapman,J.L.and Reiss, M.J.(1998). Ecology: Principles and applications. Cambridge, University Press.
8. Chopra G.L.(1984).Angiosperms: Systematics and Life-Cycle., Pradeep Publications
9. Cooke, Theodore (1903-8). The Flora of the Presidency of the Bombay Vol.I,II,III (Repr.ed), Botanical Survey of India.
10. Cronquist, A. (1968). The Evolution & Classification of Flowering Plants. Thomas Neland Sons Ltd. London.
11. Datta S.C.(1988). Systematic Botany. New Age Publ.
12. Davis P. Hand V.H. Heywood (1963).Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
13. Heywood V.H.(1967).Plant Taxonomy, Hodder & Stoughton Educational, London.
14. Judd Walter S., Campbell, C. S., Kellogg, E. A., Stevens, P.F. and M. J. Donoghue. (2008). Plant Systematics. A Phylogenetic Approach. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.
15. Kormondy Edward (1995).Concepts of Ecology, Pearson Publ.
16. Lawrence G.H.M. (1955). An Introduction to Plant Taxonomy. McMillan, New York.
17. Lawrence, G.H.M.(1951). Taxonomy of Vascular Plants. McMillan, New York.
18. Michael P. (1984). Ecological Methods for field and Laboratory investigations TMHCo.ltd. Bombay.
19. Mondol A.K.(2016)Advanced Plant Taxonomy, New Central Book Agency(NCBA)
20. NaikV.N.(1988) Taxonomy of Angiosperms. Oxford and IBH
21. Odum E.P.,(2004).Fundamentals of Ecology, Publ. Cengage Learning, Australia
22. Pande B.P. (2001)Taxonomy of Angiosperms. S. Chand.
23. Radford A.E.1986. Fundamentals of Plant Systematics, Harper and Row N Y.
24. Santapau H.(1953).The Flora of Khandala on the Western Ghats of India. BSI
25. Sharma O.P.(2011), Plant Taxonomy, Tata Mc Graw Hill.
26. Shivrajan V.V. & N.K.P. Robson (1991). Introduction to Principles of Plant Taxonomy. Cambridge Univ. Press
27. Shukla Priti and Shital Mishra (1982). An introduction to Taxonomy of Angiosperms. Vikas Publ.
28. Simpson, M.G.(2010).Plant Systematics. Elsevier, Amsterdam.
29. SinghGurucharan (2005).Systematics:TheoryandPractice.OxfordIBH.
30. SinghJ.S.,S.P.Singh,and S.R.Gupta(2006).Ecology, Environment and ResourceConservation.Anamaya Publ. New Delhi.
31. Singh N.P.(2001) Flora of Maharashtra Volume-IIBSI, Kolkatta
32. Singh N.P.(2003) Flora of Maharashtra Volume-IIIBSI, Kolkatta
33. SinghN.P.,S. Karthikeyan (1996) Flora of Maharashtra Volume-I, BSI, Kolkatta
34. Singh V. and D.K. Jain, (1981). Taxonomy of Angiosperms. Rastogi Publication, Meerut.
35. Singh,Gurcharan.(2012).PlantSystematics:TheoryandPractice.Completelyrevisedandenlarged 3rd edition. Oxford &IBH,New Delhi.
36. Stuessy,TodF.(2009).PlantTaxonomy:TheSystematicEvaluationofComparativeData,secondedition. Columbia UniversityPress.
37. Bidwell,R.G.S.1974.PlantPhysiology.MacmillanPub.Co.,N.Y.
38. Taiz,L.andZeiger,E.2006.PlantPhysiology.4thEdition.SinnauersAssociates,Saundersland,

Massachusetts, USA
39. SalisburyF.B.andRossC.B.2005.PlantPhysiology.5thEdition.WadsworthPublishingCo. Belmont CA.
40. HelgiOPik,StephenA.Rolfe,ArthurJ.Willis.2005.ThePhysiologyofFloweringPlants,CambridgeUniversityPress, UK
41. Kirkham, M.B. 2004. Principles of Soil and Plant Water Relations. Elsevier, Amsterdam,Netherlands.
42. Dennis,D.T.,Turpin,D.H.,Lefebvre,D.D.andLayzell,D.B.1997.PlantMetabolism.2ndEdition.Longman Group,U.K.
43. Fitter,A.andHay,R.K.M.2001.EnvironmentalPhysiologyofPlants.AcademicPress,UK.
44. Press,M.C.,Barker,M.G.,andScholes,J.D.2000.PhysiologicalPlantEcology,BritishEcologicalSocietySymposium, Volume 39,Blackwell Science, UK.
45. SayyedIliyas,2020.StepsinPlantPhysiology,LambertAcademicPublishing,Mauritius.
46. Devlin,R.M.andF.H.Witham.1983.PlantPhysiology.WillardGrantPress.U.S.A.
47. Hans-WalterHeldt.1997.Plant Biochemistry and Molecular Biology. Oxford University Press, New York.
48. Moore,T.C.1979.BiochemistryandPhysiologyofPlantHormones.SpringerVerlag.Berlin.
49. Raman,K.1997. TransportPhenomenain Plants.NarosaPublishingHouse.New Delhi.
50. Jain,V.K.2000:Fundamentals ofPlantPhysiology, S.Chand&Co,New Delhi.
51. Pandey,S.N.1991:PlantPhysiology,Vikas Publishing House (P)Ltd., New Delhi, India.
52. Verma,V.200):Text Book of Plant Physiology, Ane Books India, New Delhi.
53. Nobel,P.S.2009.PhysicochemicalandEnvironmentalPlantPhysiology.4theditionAcademicPress,

IMPORTANTWEBSITES

1. THE FAMILIES OF FLOWERING PLANTS- L. Watson and M.J.Dallwitz: https://www.delta-intkey.com/angio/index.htm
2. ANGIOSPERM PHYLOGENY WEBSITE, version14.: http://www.mobot.org/MOBOT/research/APweb/
3. THE PLANTS OF THE WORLD ONLINE PORTAL: http://www.plantsoftheworldonline.org/
4. INTERNATIONAL PLANT NAME INDEX (IPNI): https://www.ipni.org/
5. TROPICOS: https://www.tropicos.org/home
6. BIODIVERSITYHERITAGELIBRARY:https://www.biodiversitylibrary.org/
7. BOTANICUSDIGITAL LIBRARY: https://www.botanicus.org/
8. INTERNETARCHIVE-DIGITALLIBRARY: https://archive.org/
9. DATABASEOFPLANTSOFINDIANSUBCONTINENT: https://sites.google.com/site/efloraofindia/
10. BOTANICALSURVEYOFINDIA: https://bsi.gov.in/content/1416_1_FloraofIndia.aspx
11. FLOWERS OF INDIA: http://www.flowersofindia.net/
12. eFLORASOFWORLD: http://www.efloras.org/

B. Sc. II Year (Theory) Semester IV

BOT-413 Skill Enhancement Course-2 SEC 2 (C): Nursery and Gardening

45L **Credits:02**

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a. **THEORY: (1 Credit) Total Hours: 15**

Unit 1: Nursery: Definition, objectives and scope, nursery layout **(2 Hours)**

Unit 2: Vegetative propagation: Methods of vegetative propagation-Layering, grafting, budding, division, offset, suckers, runners, bulbs, corms, bulbils, Cuttings. Hardening of plants **(3 Hours)**

Unit 3: Gardening: Definition, objectives and scope, different types of gardens – landscape, avenue plantation and home gardening, different features of a garden –fencing, steps, drives and paths, hedge, lawns**(4 Hours)**

Unit 4: Routine Garden Operations – Preparation of soil, manuring, watering, pruning, staking, defoliation, pinching, etc., management of pests and diseases and harvesting **(4 Hours)**

Unit 5: Kitchen garden:; classification of vegetables, vegetables in different seasons; Study of cultivation of different vegetables **(2 Hours)**

b. **PRACTICAL: (1 Credit) Total Hours: (15Hours)**

Laboratory Exercises (Any 5) (3 Hours for each Practical)

1. Different methods of vegetative propagation – Grafting, layering, cutting, budding, division, runners, suckers, corms, bulbs, bulbils, tubers.
2. Study of some nursery operations - raising seedlings in trays, preparation of potting mix, transplantation of seedlings in pots, care and maintenance of plants till flowering or fruiting.
3. To prepare a garden in bowls, urns, tubs, troughs, hanging baskets, jars, bottles, terrarium gardening
4. To prepare a sketch of Kitchen garden layout / Nursery layout plan
5. To prepare a Landscape design plan for a small home ground
6. Cultivation of any five local vegetables. (2P)
7. Identification and description of avenue plants, hedge plants, flower beds (any 3), lawn (any 2), ornamental shrubs (any 3) and trees (any 3)
8. Field visit to a plant nursery / landscaped public place / kitchen garden / local vegetable cultivation.

Suggested Readings-

1. Gardening in India, Bose T.K. & Mukherjee, D., Oxford & IBH Publishing Co., New Delhi.
2. Plant Propagation, Sandhu, M.K., Wile Eastern Ltd., Bangalore, Madras.
3. Introduction to Horticulture, Kumar, N., Rajalakshmi Publications, Nagercoil.
4. Textbook of Horticulture, (2nd Ed.), Rao, K. Manibhushan, Macmillan India Limited.
5. Home Gardening, Trivedi P.P., Indian Council of Agricultural Research, New Delhi.
6. Vegetable Crops Production, Rao, P.S., Sonali publications, New Delhi.

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B. Sc. II Year (Theory) Semester IV

BOT-413 Skill Enhancement Course-2 SEC 2 (D): Medicinal Botany

45L **Credits:02**

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a. THEORY: (1 Credit) Total Hours: 15

Unit 1: History, Scope and Importance of Medicinal Plants. Indigenous Medicinal systems-Introduction and Scope-Ayurveda, Siddha, Unani **(4 Hours)**

Unit 2: Conservation of endangered and endemic medicinal plants, In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex-situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens **(5 Hours)**

Unit 3: Propagation of Medicinal Plants: Propagation methods- sowing, cuttings, layering, grafting and budding **(3 Hours)**

Unit 4: Study of Folk medicines.in India. Application of natural products to cure certain diseases like Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases**(3 Hours)**

b. PRACTICAL: (1 Credit) Total Hours: (15 Hours)

Laboratory Exercises (Any 5) (3 Hours for each Practical)

1. Study of Locally available medicinal plants.
2. Study of plants used in Siddha medicine.
3. Study of Unani system of medicine.
4. Study of plants used to treat Jaundice.
5. Study of plants used to treat cardiac diseases.
6. Study of plants used to treat infertility.
7. Study of plants used to treat diabetics, Blood pressure and skin diseases.
8. Study of plants used to treat Blood pressure.
9. Study of plants used to treat skin diseases.
10. Ex-situ conservation of important medicinal plants.

Suggested Readings:

1. Medicinal Plants: Ethnobotanical Approach, Trivedi P. C.,Agrobios, India.
2. Medicinal Plant Cultivation: A Scientific Approach, Purohit and Vyas, Agrobios, India.
3. Ethno botany, Trivedi P.C. The Diamond printing press, Jaipur.
4. Marathwadyatil SamanyaVanaushadhi, Naik V.N., Amrut Prakashan, Aurangabad, (M.S.), India.
5. Practical Pharmacognosy techniques and experiment, Kokate C.K. and Ghokhale S.B., NiraliPrakashan, Pune, Maharashtra.
6. The practical Pharmacognocy, Kokate C.K., Vallabh Prakashan, Delhi, India.
7. Indian Medicinal plants, Kirtikar K.R. and Basu B.D., Lalit Mohan BasuPublication , Allahabad.

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. II YEAR (BOTANY) Semester III
Course Code: BOT -311 Paper V (Taxonomy of Angiosperms)

Time: 2Hour Max. Marks: 40

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 1) 10

or

Describe in brief:
a. Short answer type .....(Unit 1)
b. Short answer type .....(Unit 1)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 2)
c. Short note (Unit 2)

Q.4 MCQ (10 questions from all units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. II YEAR (BOTANY) Semester III
Course Code: BOT -312 Paper VI (Plant Physiology)

Time: 2Hour Max. Marks: 40

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.2. Long answer type question .....(Unit 3) 10

or

Describe in brief:
a. Short answer type .....(Unit 3)
b. Short answer type .....(Unit 3)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 1)
c. Short note (Unit 1)

Q.4 10 MCQ from all units 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Practical Question paper Examination
B.Sc. II YEAR (BOTANY) Semester III
Lab Course Code: BOT -321 (Based on BOT -311, Taxonomy of Angiosperms)

Time: 2Hour Max. Marks: 50

Date: _____ Batch No. _____
Center: _____

Q. 1. Identify, classify giving reasons and describe the specimen 'A'.Give floral formula and floral diagram. 12

Q.2. Identify, classify giving reasons and describe the specimen 'B'.Give floral formula and floral diagram. 12

Q.3. Identify and describe the specimen C, D, E and F as per the instructions 10

(C- and D - Morphology, E- and F - Economic importance)

Q4. Describe Key Characters or Diagnostic Characters of given specimen. 06

Q.5. Submission: 10

a) Record book

b) Tour report, field collection and viva - voce

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Practical Question paper Examination
B.Sc. II YEAR (BOTANY) Semester III
Lab Course Code: BOT -322 (Based on BOT -312, Plant Physiology)

Time: 2Hour Max. Marks: 50
Date: _____ Batch No. _____
Center: _____

Q. 1. Make a list of materials required for the physiological experiment allotted to you.

Show it to the examiner, write the procedure and record the readings. 12

(Expt No. 2, 3, 4,5, 6,7 as per practical syllabus)

Q. 2. Make a list of materials required for the experiment allotted to you.

Show results to the examiner. 12

(Expt No. 8,10,11,13,14,15,16 as per practical syllabus)

Q.3. Identify and describe the principle and working in the given experiment

(Experiment No. 1, 9, 12, 17) 16

Q.4. Submission: 10

a) Record book

b) Tour report and collection

c) Viva - voce

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. II YEAR (BOTANY) Semester IV
Course Code: BOT -411 Paper VII (Gymnosperms and Utilization of plants)

Time: 2 Hour Max. Marks: 40

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 1) 10

or

Describe in brief:
a. Short answer type .....(Unit 1)
b. Short answer type .....(Unit 1)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 2)
c. Short note (Unit 1 and 2)

Q.4 MCQ (10 questions from all the units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B.Sc. II YEAR (BOTANY) Semester IV
Course Code: BOT -412 Paper VIII (Plant Ecology)

Time: 2Hour Max.Marks: 40

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.2. Long answer type question .....(Unit 3) 10

or

Describe in brief:
a. Short answer type .....(Unit 3)
b. Short answer type .....(Unit 3)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 1)
c. Short note (Unit 1).

Q.4 MCQ (10 questions from all the units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Practical Question paper Examination
B.Sc. II YEAR (BOTANY) Semester IV
Lab Course Code: BOT -421 (Based on BOT -411, Gymnosperms and Utilization of plants)

Time: 2Hour Max. Marks:50
Date: _____ Batch No. _____
Center: _____

Q.1. Make a double stained permanent preparation of the given specimen 'A'

(Gymnosperm). Identify and describe with a well labelled diagram. 12

Q.2. Histochemical tests in given material 'B'

(Protein / Carbohydrate /Lipid / cellulose / Lignin) 10

Q.3. Identify and describe the specimen C, D, E and F as per the instructions 12

(C- and D - Gymnosperms, E- and F- Utilization of plants)

Q.4. Economic importance of any two plants 06

Q.4. Submission: 10

a) Record book

b) Tour report, collection and viva - voce

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Practical Question Paper Examination
B.Sc. II YEAR (BOTANY) Semester IV
Lab Course Code: BOT -422 (Based on BOT -412, Plant Ecology)

Time: 2 Hour Max. Marks: 50
Date: _____ Batch No. _____
Center: _____

Q.1. Identify and describe morphological and anatomical adaptations in the given specimen. Make a temporary preparation of the given specimen. 12

Q.2.Conduct the ecological experiment, record the principle, observation and result (Experiment No. 5,6,7,9,10,11) 12

Q.3. Identify and describe the specimens A, B, C, and D, as per the instructions (Experiment No. 1, 2, 3, 4, 8) 16

Q.4. Submission: 10

a) Record book

b) Tour report, and collection

c) viva - voce

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Curriculum for Semester V (w.e.f. Academic Year 2023-24)

B. Sc. III Year (Theory) Semester V

Course Code: BOT-511 Paper IX (Cell Biology and Molecular Biology)

45 L **Credit: 02**

Unit I: Cell Biology (12)

1. The cell

i. Cell as a unit of structure and function.

ii. Characteristics of prokaryotic and eukaryotic cells.

iii. Origin of eukaryotic cell.

2. Cell wall and plasma membrane

i. Chemistry, structure and function of Plant cell wall.

ii. Overview of membrane function;fluid mosaic model; Membranes chemical composition.

iii. Membrane transport–Passive, active, facilitated transport, endocytosis and exocytosis.

3. Cell organelles

i. Cytoskeleton: Role & structure of microtubules, microfilaments & intermediary filament.

ii. Chloroplast, Mitochondria and Peroxisomes: Structural organization;

iii. Function; Semiautonomous nature of mitochondria and chloroplast.

iv. Endomembrane system: Endoplasmic Reticulum: Structure, targeting & proteins insertion in ER, protein folding, processing; smooth ER, lipid synthesis, export of proteins & lipids.

v. Golgi Apparatus organization, protein glycosylation, protein sorting & export from Golgi Apparatus; Lysosomes.

vi. Nucleus: Structure-nuclear envelope, nuclear pore, nuclear lamina, and nucleolus.

Unit II : **Cell division and its behaviour:** (11)

i. Cell division: - Cell cycle, Mitosis and Meiosis; significance.

ii. Chromosomes: Morphology, Classification, Chemical Composition & organization, molecular organization of chromatin.

iii. Special types of chromosomes– Polytene chromosomes, and Lampbrush chromosomes.

iv. Chromosomal changes: Structural aberrations: deletion, duplication, inversion, translocation - their meiotic consequences and significance.

v. Numerical aberration: Definition, Basic chromosome number (Genomic Number) Aneuploidy, Haploidy & Polyploidy - their meiotic behaviour & significance.

Unit III: **Molecular Biology** (12)

1. Nucleic acids: -

i. DNA– the genetic material; the discovery of DNA as the genetic material.

ii. Bacterial transformation(Griffith's & Avery's experiments);Hershey & Chase experiment.

iii. Structure of DNA, Watson & Crick's Model, Types of DNA- (A,B,Z).

2. Replication: -

i. Semi conservative replication–Meselson and Stahl's experiment;

ii. Molecular mechanism of Replication,

3. RNA: - Structure, types and properties.

Unit IV: (10)

1. Transcription: -

i. Transcription in prokaryotes and eukaryotes.

ii. Transcription regulation in prokaryotes e.g. Lac operon

iii. Transcription regulation in eukaryotes.

2. Translation: -

i. Translation in prokaryotes and eukaryotes.
ii. Various steps in protein synthesis. Charging of tRNA, aminoacyl tRNA synthetases. Proteins involved in initiation, elongation and termination of polypeptides.
iii. Translation regulation.

Unit V : Assignments and Tutorials (05 Lectures)

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Continuous Internal Assessment (CIA): Tutorials and Assignments (05)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment/Tutorials for 5 marks. In assessment you are free to use different assessment methods.

Suggested Reading: -

1. Arumugham. N. (2014) Cell Biology. Sara Publication, Nagercoil
2. Avinash Upadhyaya & Kakoli Upadhayayo (2005). Basic Molecular Biology. Himalaya Publishers.
3. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco
4. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
5. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
6. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
7. Malathi, V. (2010). Essentials of Molecular Biology, Pearson Education Inc.
8. Powar C.B. (1988) Essentials of Cytology, Himalaya Publishing House.
9. Rastogi S.G. Cell Biology. Tata Mc Graw Hill Publishing Company New Delhi
10. Rastogi. V.B. (2008) Fundamentals of Molecular Biology, Ane Books India

B. Sc. III Year (Practical), Semester - V
Lab Course VII, BOT 521 (Based on BOT 511, Theory Paper – IX)

45L **Credits:1.5**

1. Study of plant cell structure with the help of epidermal peel mount of Onion/Rhoeo/Crinum
2. Measurement of cell size by the technique of micrometry.
3. Preparation of cytological (AA, FAA etc.) fixatives and stains (acetocarmine, aceto-orcein).
4. Study of plant cell and its organelles with the help of electron micrographs.
5. Study of electron micrographs of viruses, bacteria and cyanobacteria
6. Mitosis - Acetocarmine squash preparation of Onion root tip.
7. Meiosis in Rhoeo/ Chlorophytum/ Maize and identification of different stages of Meiosis.
8. Observation of giant chromosomes in Chironomous larvae.
9. Preparation of wool/ Chart models of mitosis, meiosis, cell structure, Chromosome, DNA and RNA.
10. Preparation of idiogram from the given micrograph of karyotype (Maize, Onion)

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

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Suggested Reading: -

11. Arumugham. N. (2014) Cell Biology. Sara Publication, Nagercoil
12. Avinash Upadhyaya & Kakoli Upadhayayo (2005). Basic Molecular Biology. Himalaya Publishers.
13. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009) The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco
14. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
15. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
16. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
17. Malathi, V. (2010). Essentials of Molecular Biology, Pearson Education Inc.
18. Powar C.B. (1988) Essentials of Cytology, Himalaya Publishing House.
19. Rastogi S.G. Cell Biology. Tata Mc Graw Hill Publishing Company New Delhi
20. Rastogi. V.B. (2008) Fundamentals of Molecular Biology, Ane Books India

B. Sc. III Year (Theory) Semester V

Elective Course Code: BOT-512(A) Paper X (Diversity of Angiosperms-I)

45 L **Credit: 02**

Unit: 1 Biodiversity (03)

1. Definition, concept, origin and evolution

2. Types of biodiversity: (05)

Species, genetic, ecological, agricultural diversity; Biodiversity status in India; endemism and its types, hot spots of biodiversity in India; IUCN categories of threatened species, threats to biodiversity, Climate change and its consequences with examples.

3. Conservation of biodiversity: (07)

Major causes for loss of biodiversity, listing of threatened ecosystems; Conservation measures: - *ex-situ*: Botanic Garden, Seed bank, Cryobank, Gene bank; *in-situ*: Establishment, aims and objectives of Wild Life Sanctuaries, National Parks, Mangroves, Reserve forests. Biodiversity Act, 2002.

Unit -2 (04)

Taxonomy: Study of classification of angiosperms with special reference to Bentham and Hooker's system. Study of diversity of following families with reference to the APG IV system of classification. Study of families: (26)

(Ref:https://academic.oup.com/botlinnean/article/181/1/1/2416499)

1 Nymphaeaceae
2 Magnoliaceae
3 Amaryllidaceae
4 Papaveraceae
5 Amaranthaceae
6 Portulacaeae
7 Cucurbitaceae
8 Euphorbiaceae
9 Rhamnaceae
10 Brassicaceae
11 Myrtaceae

Continuous Internal Assessment (CIA): Tutorials and Assignments (05)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment/Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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B. Sc. III Year (Practical), Semester - V
Lab Course VIII, BOT 522(A) (Based on BOT 512(A), Theory Paper – XA)

45L **Credits:1.5**

Unit: 1 **(45 L)**

1. Study of Herbarium
2. Analytical Characters of floral features of closely related species.
3. Preparation and use of indented and bracketed keys

4. Study of following families with suitable example available in your area.

(Ref: https://academic.oup.com/botlinnean/article/181/1/1/2416499)

1. Nymphaeaceae
2. Magnoliaceae
3. Amaryllidaceae
4. Papaveraceae
5. Amaranthaceae
6. Portulacaeae
7. Cucurbitaceae
8. Euphorbiaceae
9. Rhamnaceae
10. Brassicaceae
11. Myrtaceae

4. Studies of various pollen grains (acetolysis method).

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note: Students should undertake Botanical excursion, field visits to ecologically different areas for plant study and submission of list and soft /hard copy photographs of wild plants at the time of practical examination.

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B. Sc. III Year (Theory) Semester V

Elective Course Code: BOT-512 (B) Paper X (Plant breeding and Seed technology)

45L **Credits:02**

Unit –I

Plant Breeding :- (24)

a) Introduction, History Aims And Objectives (02)
b) Domestication, Plant Introduction and acclimatization (02)
c) Hybridization, history, Procedure (03)
d) Selection methods – Mass selection pureline selection with suitable Example (02)
e) Hybridization in self pollinated crops eg. Brinjal, Chilly, Tomato. etc. (02)
f) Hybridization in cross pollinated Plants : Eg . Onion, Gourds etc. (02)
g) Hybridization programme in Chilly and Cotton. (02)
h) An overview of (Marker assisted selection , diploids technique (DH), (02)
i) Speed breeding, CRISPR technique, use of IOT and AI). (03)
j) Experimental designs and biometrical technique in plant breeding, RBD, Latin square design analysis and variance assessment and variability simple measure and variability (04)

Unit 2: (21)

a) Seed technology – History, aims and objectives. (02)
b) Importance and process of seed multiplication (10)
    i. Nucleus seed
    ii. Breeder seed
    iii. Foundation seed
    iv. Certified seed
    v. Registered seed
    vi. Truthful seed
c) Seed certification process, standards and agencies involved in it. (02)
d) An overview of Seed production programme between farmers and (National seed corporation and Mahabeej) process and benefits. (02)
e) An overview of Seed production programme (Field crops and vegetables) between farmers and private seed companies (Benefits and risks associated with it). (03)
f) Harvesting, seed processing (Drying, cleaning, dressing, cold storage,Transport etc) (01)
g) Brief introduction of ISTA and its standardized tests. (01)

Continuous Internal Assessment (CIA): Tutorials and Assignments (05)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment/Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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B. Sc. III Year (Practical), Semester - V
Lab Course VIII, BOT 522(B) (Based on BOT 512(B), Theory Paper – XB)

45L **Credits:1.5**

Unit: 1 **(45 L)**

Plant Breeding

1) Study of floral biology of Chilly and Cotton.
2) Artificial emasculation in Chilly and Cotton
3) Demonstration of hybridization technique in Chilly and Cotton.
4) Visit to Seed production plots of Chilly and other crops.
5) Floral biology of Onion.
6) Emasculation

Seed technology:

1) Study of different germination methods (TP, BP and Sand).
2) Determination moisture content in seeds.
3) Methods of breaking seed dormancy.
4) Physical purity determination.
5) Study of various seed processes like drying, cleaning, dressing, marking .
6) Visit to Seed Testing laboratory and Seed company

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note: Students should undertake Botanical excursion, field visits to ecologically different areas for plant study and submission of list and soft /hard copy photographs of wild plants at the time of practical examination.

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B. Sc. III Year (Theory) Semester V

Elective Course Code: BOT-512 (C) Paper X (Mycology and Plant Pathology)

Lectures – 45 **Total Credits – 2**

Unit 1: Applied Mycology **Credit – 0.4**

1. Importance of mycology in agriculture, fungi in human affairs, Mushroom cultivation (03)
2. Mycorrhizal associations- definition, types, methods to study arbuscular Mycorrhizal Fungi (03)

Unit-2Fundamentals of plant pathology **Credit – 0.6**

1. Plant pathology – history Scope, importance, and advancement of plant pathology, classification of plant diseases on the basis of causal organism and symptoms (04)
2. Field and laboratory diagnosis of plant disease - Koch's postulates (02)
3. Seed pathology – concept and importance of seed pathology, seed borne pathogens, methods to study seed borne pathogens (02)
4. Study of air borne pathogens: methods and applications (02)

Unit-3: Plant Diseases **Credit –1.0**

Study of the following diseases with respect to symptoms, causal organism, disease cycle and control measures:

1) **Cereals**: a. Black stem rust of wheat, b. Grain smut of jowar. Ergot of bajra (05)
2) **Pulses**: a. Wilt of pigeon pea b. Rust of gram (04)
3) **Vegetables**: a. Late blight of potato b. Black rot of onion (*Aspergillus*) (04)
   c. Yellow vein mosaic of bhendi.
4) **Oil seeds**: a. Tikka disease of groundnut b. charcoal rot of soybean (05)
5) **Cash crops**: a. Red rot of sugarcane b. Downy mildew of grapes (06)
   c. Angular leaf spot of cotton d. Citrus canker
6) **Ornamentals**: a. Powdery mildew of rose (01)
7) **Weeds:** a. Rust of Euphorbia (01)
8) **Fruits**: a. Black spot of pomegranate b. Anthrcanose of mango (02)

Continuous Internal Assessment (CIA): Tutorials and Assignments (5)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment or Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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B. Sc. III Year (Practical), Semester - V

Lab Course VIII, BOT 522(C) (Based on BOT 512(C), Theory Paper – XC)

45L **Credits:1.5**

1. Study of Koch's postulates – isolation, inoculation and diseasedevelopment (**2 Practical)**
2. Study the Techniques of root staining for AMF colonization
3. Demonstration of Mushroom cultivation
4. Study of symptoms and causal organisms of black stem rust of wheat, grain smut of jowar and Ergot of bajra **(2 Practical)**
5. Study of symptoms and causal organisms of Wilt of pigeon pea and rust of gram
6. Study of symptoms and causal organisms of Late blight of potato, black rot of onion (*Aspergillus*) and Yellow vein mosaic of bhendi **(2 Practical)**
7. Study of symptoms and causal organisms of tikka disease of groundnut and charcoal rot of soybean
8. Study of symptoms and causal organisms of red rot of sugarcane and downy mildew of grapes
9. Study of symptoms and causal organisms of angular leaf spot of cotton and citrus canker
10. Study of symptoms and causal organisms of powdery mildew of rose
11. Study of symptoms and causal organisms of rust of *Euphorbia*
12. Study of symptoms and causal organisms of black spot of pomogranate
13. Internal Assessment

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note: Students should undertake Botanical excursion, field visits to ecologically different areas for plant study and submission of list and soft /hard copy photographs of wild plants at the time of practical examination.

Note for Lab course: Candidate shall submit the following at the time of exam.

1. Certified laboratory course record book.
2. Field note book / Tour report.
3. Collection of diseased samples from field. In addition to number of practical prescribed above, the students are required to undertake field excursions to the places of botanical interest and industrial places under the guidance of teacher. There shall be frequent study tours in local areas. T.A. and D.A. be paid to the teachers, peons and field collectors as per university rules. The record book is to be signed periodically by teacher in charge and certified by the Head of Department at the end of the term. Candidate should not be allowed to appear for practical examination without a certified record book or a certificate from the Head of Department.

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B. Sc. III Year (Theory) Semester V

Elective Course Code: BOT-512 (D) Paper X (Biotechnology)

Lectures – 45 **Total Credits – 2**

Unit- 1 (10)

1. **Introduction:**
   - i. Definition, scope and multidisciplinary nature
   - ii. Biotechnology in India

2. **DNA structure, replication and recombination:**
   - i. Structure of DNA
   - ii. Replication of DNA, Role of DNA polymerase
   - iii. Denaturation and renaturation of DNA
   - iv. Recombination

Unit II **Recombinant DNA technology**: (10)
- i. Introduction, principles and procedure
- ii. Enzymes involved in recombinant DNA technology
- iii. Vectors
- iv. Southern and Northern blotting technique
- v. Techniques in gene mapping
- vi. DNA fingerprinting
- vii. PCR
- viii. DNA sequencing
- ix. Genomics and DNA libraries

Unit III **Genetic engineering:** (10)
- i. Introduction to transgenic plants
- ii. Reporter genes
- iii. Indirect method of gene transfer
- iv. Direct methods for gene transfer in plants
- v. Role of agriculture in crop biotechnology
- vi. Achievements in plant biotechnology

Unit IV (10)

1. **Plant tissue culture:**
   - i. Principles of tissue culture
   - ii. Terminology in tissue culture
   - iii. Cellular differentiation and totipotency
   - iv. Organogenesis and embryogenesis
   - v. Protoplast isolation and culture
   - vi. Suspension culture
   - vii. Meristem culture
   - viii. Anther culture
   - ix. Applications of tissue culture

2. **Research projects:** **(05)**
   - i. Human genome project
   - ii. Plant genome project
   - iii. DBT Ministry of Science and Technology.

Unit V : Assignments (05)

Continuous Internal Assessment (CIA): Tutorials and Assignments(10 marks)

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Suggested Books

1. Dubey, R. C. (2005). A text book of Biotechnology. S. Chand & Co. New Delhi, India
2. Kumaresan, V. (2005). Biotechnology. Saras Publication, New Delhi, India.
3. Bhojwani, S.S. &Razdan, M.I. Plant Tissue Culture: Theory and Practise, Elsevier
4. Rajdan, M.K. An Introduction to Plant Tissue Culture, Latest Ed., Oxford & IBH
5. Jha, T.B. & Ghosh, B. Plant Tissue Culture, 2003, Universities Press
6. Singh, B.D. Biotechnology Latest ed., Kalyani Publishers.
7. Mascarenhas, A.F. Handbook of Plant Tissue Culture, ICAR
8. Kar, D.K. & Halder, S. Plant Breeding, Biometry & Biotechnology, 2010, New Central Book Agency
9. Gupta, P.K. Biotechnology & Genomes, latest Ed., Rastogi Publications
10. Slatter, A., Scott, N. & Fowler, N. Plant Biotechnology, 2003, Oxford University Press

B. Sc. III Year (Practical), Semester - V
Lab Course VIII, BOT 522(D) (Based on BOT 512(D), Theory Paper – XD)
45L **Credits:1.5**

(Biotechnology)

1. Principle and working of instruments in biotechnology laboratory - Autoclave / Pressure Cooker, Centrifuge, Hot plate, Water bath, Laminar Air flow, Oven, Microscope, pH Meter, Refrigerator, Magnetic Stirrer, Shaker, Agarose Gel Electrophoresis, Green House etc.
2. Sterilization of glasswares
3. Preparation of sterile media, M.S. medium, B5 medium, White medium
4. Demonstration of callus culture
5. Demonstration of meristem culture
6. Demonstration of anther culture
7. Demonstration of suspension culture
8. Demonstration of PCR
9. Demonstration of DNA Sequencer

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note: Students should undertake Botanical excursion, field visits to ecologically different areas for plant study and submission of list and soft /hard copy photographs of wild plants at the time of practical examination.

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B. Sc. III Year (Theory) Semester V

BOT-513 Skill Enhancement Course-3 (E) SEC 3 (E): Vermicomposting and Biofertilizers

45L **Credits:02**

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a.Theory (1 credit) **Total hours 15**

Unit 1: Vermicomposting: Introduction and Scope, Types of Earthworm & Classification Epigeic, Endogeic, Diageic, Life history of Earthworms (Earthworm Species *Eiseniafoetida*) **(5 hours)**

Unit 2: Vermicompost: Objectives, Production: Establishment of Vermicomposting and Vermiwash unit, Different Methods of Vermicomposting: Small and large scale Bed method, Pit method, Harvesting the Compost, Storing and packing of Vermicompost,
(5 hours)

Unit 3: Biofertilizers –Definition, importance and advantages.
Sources of Biofertilizers -Bacteria, Cyanobacteria, Mycorrhiza and PSM.
Outlines of production technology of biofertilizers- isolation, selection of strain, preparation of mother culture, starter culture, mass culturing. **(5 hours)**

b.Practical: (1 Credit) **Total hours 15**

Laboratory exercises (Any 5) (3 hours for each practical)

1. Study of external morphology of Earhworm- *Eisenia foetida*
2. Study of habit and habitat of Earhworm- *Eisenia foetida*
3. Establishment of vermicomposting unit Pit method
4. Establishment of vermicomposting unit Bed method
5. Vermicompost production, harvesting and packaging.
6. Study of equipment for production of bio-fertilizers.
7. Visit to research centers and firms making Biofertilizers

Suggested readings:

1. The Textbook of Vermicompost, Vermiwash and Biopesticides :Keshavsingh and et al
Publisher: Biotech Books
2. The Book Hand Book of Biofertilizers &Vermiculture
Publisher: Engineers India Research Institute
3. Handbook of Organic Farming and Organic Foods With Vermicomposting Neem
Publisher: Engineers India Research Institute
4.A textbook of Biotechnology: R. C. Dubey

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B. Sc. III Year (Theory) Semester V

BOT-513 Skill Enhancement Course-3 (F) SEC 3 (F): Ethnobotany

45L **Credits:02**

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a.THEORY: (1 Credit) **Total Hours: 15**

Unit 1: Ethnobotany**:** Introduction, concept, scope and objectives; Ethnobotanyas an interdisciplinary science; Tribal's of India, and their life styles **(3 Hours)**

Unit 2: Methodology of Ethnobotanical studies**:** Field work, Herbarium, Ancient Literature, Archaeological findings **(5 Hours)**

Unit 3: Role of Ethnobotany in Community: **(7 Hours)**

i. Food plants: Vegetables, Fruits and Seeds
ii. Spices – Clove, Black pepper, Cumin, Coriander, Cinnamon.
iii. Beverages- Tea and Coffee
iv. Timber and Gum – Teak, Neem, Babul, Sisham.
v. Medicinal plants:Significance of the following plants in ethnobotanicalpractices (along with their habitat and morphology)- *Ocimum sanctum,, Vitexnegundo, Withaniasomnifera, Asparagus racemosus, Curcuma longa, Aloe vera, Adhathodavasica*

b.PRACTICAL: (1 Credit) **Total Hours: 15**

Laboratory Exercises (Any 5) (3 Hours for each Practical)

1. To study the locally available plants used by the natives to cure the arthritis
2. To study the locally available plants used by the natives to cure the Jaundice
3. To study the locally available plants used by the natives to cure the Diabetes
4. To study the locally available plants used by the natives to cure Fever
5. To study morphology and medicinal uses of *Aloe vera*(Korphad)
6. To study morphology and medicinal uses of *Withania somnifera* (Ashwagandha)
7. To study morphology and medicinal uses of *Asparagus racemosus* (Shatavari)
8. To study morphology and medicinal uses of *Adhatodavasica*(Adulsa)

Suggested Readings:

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. S.K. Jain (ed.) Glimpses of Indian. Ethnobotany, Oxford and I B H, New Delhi – 1981
Lone et al, Palaeoethnobotany.
3. S.K. Jain (ed.) 1989. Methods and approaches in Ethnobotany. Society of Ethno botanists, Lucknow, India.
4. S.K. Jain, 1990. Contributions of Indian Ethnobotany, Scientific publishers, Jodhpur.
5. Colton C.M. 1997. Ethnobotany – Principles and applications, John Wiley and sons – Chichester.

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B. Sc. III Year (Botany) Semester V
Course Code: BOT-511 Paper IX (Cell Biology and Molecular Biology)

Time: 2Hour **Max. Marks: 40**

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 1) 10

or

Describe in brief:
a. Short answer type .....(Unit 1)
b. Short answer type .....(Unit 4)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 3)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 3)
b. Short note (Unit 3)
c. Short note (Unit 4)

Q.4 MCQ (10 questions from all units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD

Faculty of Science

Pattern of Practical Question paper Examination

B. Sc. III Year (Botany), Semester - V

Lab Course VII, BOT 521 (Based on BOT 511, Theory Paper – IX)

Time: 2Hour Max. Marks: 50

Date: _____ Batch No. _____

Center: _____

Q1. Prepare a temporary squash / smear of the given material. Identify and describe any two stages (Mitosis / Meiosis). 10

Q2. Prepare a temporary slide of the given material. Identify and describe giant chromosome (*Chironomous* larvae). 08

Q3. Prepare an idiogram of the given karyotype and comment. 08

Q4. Identify and describe (Electron micrograph) 07

Q5. Prepare a temporary preparation of given material (Onion /*Tradescantia* leaf) 07

Q6. Submission: 10

a) Record book, viva - voce

b) Tour report and wool models

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B. Sc. III Year (Botany) Semester V
Elective Course Code: BOT-512(A) Paper XA (Diversity of Angiosperms-I)

Time: 2Hour **Max. Marks: 40**

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 1) 10

or

Describe in brief:
a. Short answer type .....(Unit 1)
b. Short answer type .....(Unit 1)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 1)
c. Short note (Unit 1)

Q.4 MCQ from all units (10Questions) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Practical Question paper Examination
B. Sc. III Year (Practical), Semester - V
Lab Course VIII, BOT 522(A) (Based on BOT 512(A), Theory Paper – X)

Time: 2Hour Max. Marks: 50

Date: _____ Batch No. _____
Center: _____

Q. 1. Identify, classify giving reasons and describe the specimen 'A'. Upto family level, give floral formula and floral diagram. 12

Q.2. Identify, classify giving reasons and describe the specimen 'B'. Upto family level, give floral formula and floral diagram. 12

Q.3. Identify and describe the specimen C, D, E,F and G as per the instructions 10

(C- and D - Morphology, E- and F - Economic importance G- Inflorescence/ Fruit)

Q.4. Analytical Characters of given two close related species. 06

Submission: 10

a) Record book

b) Tour report, field collection and viva - voce

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B. Sc. III Year (Botany) Semester V
Elective Course Code: BOT-512 (B) Paper X (Plant breeding and Seed technology)

Time: 2Hour **Max. Marks: 40**

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 1) 10

or

Describe in brief:
a. Short answer type .....(Unit 1)
b. Short answer type .....(Unit 1)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 1)
c. Short note (Unit 1)

Q.4 MCQ (10 questions from all units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Practical Question paper Examination
B. Sc. III Year (Botany), Semester - V
Lab Course VIII, BOT 522(B) (Based on BOT 512(B), Theory Paper – X)

Time: 2Hour Max. Marks: 50

Date: _____ Batch No. _____
Center: _____

Q.1.Explain hybridization technique in given plant.	12
Q.2. Viability test of given seeds.	12
Q.3. Preparation of seed certification tag.	05
Q.4. Designing of field experiment.	05
Q.5. Comments on one of techniques used in Hybridization	06
Q.6. Submission:	10
a) Record book, viva - voce	
b) Project report / Tour report and collection	

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B. Sc. III Year (Botany) Semester V
Elective Course Code: BOT-512 (C) Paper X (Mycology and Plant Pathology)

Time: 2Hour **Max. Marks: 40**

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 3) 10

or

Describe in brief:
a. Short answer type .....(Unit 3)
b. Short answer type .....(Unit 3)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 1)
c. Short note (Unit 1)

Q.4 MCQ (10 questions from all units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD

Faculty of Science

Pattern of Practical Question paper Examination

B. Sc. III Year (Botany), Semester - V

Lab Course VIII, BOT 522(C) (Based on BOT 512(C), Theory Paper – X)

Time: 2Hour Max. Marks: 50

Date: _____ Batch No. _____

Center: _____

Q.1. Identify and describe the symptoms and causal organisms of the specimen 'A' 10

Explain on the basis of external and internal characters.

Q.2.Identify and describe the symptoms and causal organisms of the specimen 'B'.

Explain on the basis of external and internal characters. 10

Q.3.Identify and describe specimens as per instructions (Five spots) 15

Q. 4. Comment on laboratory techniques you studied. 05

Q.6. Submission: 10

a) Record book, viva - voce

b) Project report / Tour report and collection

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Faculty of Science

Pattern of Theory Question Paper

B. Sc. III Year (Theory) Semester V

Elective Course Code: BOT-512 (D) Paper X (Biotechnology)

Time: 2Hour **Max. Marks: 40**

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question ……..……(Unit 2) 10

or

Describe in brief:
a. Short answer type ……(Unit 2)
b. Short answer type ……(Unit 1)

Q.2. Long answer type question ……..……(Unit 3) 10

or

Describe in brief:
a. Short answer type ……(Unit 3)
b. Short answer type ……(Unit 1)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 4)
b. Short note (Unit 4)
c. Short note (Unit 1)

Q.4 MCQ (10 questions from all units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD

Faculty of Science

Pattern of Practical Question paper Examination

B. Sc. III Year (Botany), Semester - V

Lab Course VIII, BOT 522(D) (Based on BOT 512(D), Theory Paper – X)

Time: 2Hour Max. Marks: 50

Date: _____ Batch No. _____

Center: _____

Q.1. Identify the experiment and describe principle and procedure

(Meristem Culture / Anther Culture / Protoplast Culture) 10

Q.2. Separation of amino acids by gel electrophoresis 10

Q.3. Identify contaminating bacteria and fungi from the given culture 10

Q.4. Identify and describe the given specimens A, B, C, D as per instructions. 10

Q.5. Submission: 10

a) Record book, viva - voce

b) Project report and Tour report

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Curriculum for Semester VI

B. Sc. III Year (Theory) Semester VI

Elective Course Code: BOT-611 Paper XI (Genetics and Evolution)

45 L **Credit: 02**

Unit : I **(10)**

1. Mendelism:

i. Introduction -G.J. Mendel

ii. Mendelian principles –Law of Dominance , law of segregation, law of independent assortment, back cross and test cross

2. Interaction of genes:

i. Allelic interaction: incomplete dominance, co dominance, lethal genes and blood group inheritance

ii. Non allelic and non epistatic -comb shapes in fowls

iii. Non allelic and epistatic:

a) Complementary genes or duplicate recessive epistasis (9:7)

b) Supplementary genes or recessive epistasis (9:3:4)

c) Dominant epistatic genes or dominant epistasis (12:3:1)

d) Duplicate genes or duplicate dominant epistasis (15:1)

Unit II **(10)**

1. Sex determination:

i. Chromosomal theory of sex determination

ii. Mechanism of sex determination in man (xx -xy), Drosophila (xx and xy), birds (zz-zw), grasshopper (xx-xo) and genic balance theory in Drosophila

iii. Sex determination in plants – *Melandrium*

2. Sex linked inheritance:

X, XY and Y linked inheritance:

i) Colourblindness and hemophilia in man

ii) Holandric genes

iii) White eye colour in Drosophila,

iv) Gynandromorphs,

3. Linkage

i. History and concept

ii. Complete and incomplete linkage, Bridges Experiment

iii. Linkage maps based on two or three factors

Crossing over concept and significance

Unit III **(10)**

1. Structure and function of gene:

i. Fine structure of gene (Seymour Benzer)

ii. One gene one enzyme hypothesis

iii. Genes and related diseases – phenylketonuria, and alkaptonuria

iv. Detection of genetic diseases –amniocentesis Genetic counselling

2. Quantitative inheritance

i. Multiple factor hypothesis

ii. Characters of multiple genes

iii. Example of quantitative inheritance : kernel colour in wheat, Cob lenght in maize

iv. Significance of quantitative inheritance

Unit IV **(15)**

1. **Emergence of evolutionary thoughts**
   - **i.** Lamarckism, Darwinism, Neo Darwinism
   - **ii.** concepts of variation, adaptation, struggle, fitness and natural selection
2. **Population genetics**
   - i. populations, gene pool, gene frequency
   - ii. Hardy-Weinberg law,
   - iii. Migration and random genetic drift
   - iv. Adaptive radiation and modifications
   - v. Isolating patterns and mechanisms
   - vi. Convergent evolution; sexual selection; co-evolution.
3. **Speciation**
   - i. Defination and Types (Allopatric, Sympatric, Parapatric,Peripatric)
   - ii. Factors affecting speciation

Unit- V : **Assignments** **(05)**

Continuous Internal Assessment(CIA): Tutorials and Assignments (5)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment or Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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Continuous Internal Assessment (CIA): Tutorials and Assignments (5)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment or Tutorials for 5 marks. In assessment you are free to use different assessment methods.

Suggested reading

Gardener. J., Simmons. H.J. and Snustad. D.P. 1991. Principles of Genetics(8th Edition). John Wiley & Sons, New York.

Gupta.P.K. 1994. Genetics Rastogi Publications. Shivaji Road, Meerut.

Gupta.P.K. 1995. Gytogenetics. Rastogi Publications, Meerut.

Hartl.D.L. and Jones.E.W. 1998. Genetics: Principles and Analysis (4th Edition) Jones & Barlett Publishers. Massachusetts. USA.

Snustad. D. P. and Simmons. M.J. 2000. Principles of Genetics (2ndEdition).John Wiley & Sons Inc., USA.

Russel. P.J. 1998. Genetics (5th Edition). The Benjamin/Cummings Publishing Co., Inc., USA.

Singh B.D. Genetics 2017 , Kalyani publication

Brian, K. Hall and Benedikt, Hallgrimsson (2008). Strickberger's Evolution, 4th Edition. Jones and Bartlett Publishers Intenational, London

Rastogi Veerbala Evolutionary Biology

Stickberger, M. W (1990) Jones and Bartlett, Boston.Evolution -

Futuyma. D (1997) Evolutionary Biology 3rd edition, Sinauer Associates.

Verma P.S. and Agrawal V.K. (2020) Cell biology,genetics,molecular biology evolution and ecology, S.Chand publication.

B. Sc. III Year (Practical), Semester - VI
Lab Course IX, BOT 621 (Based on BOT 611, Theory Paper – XI)

45L **Credits:1.5**

1. Quizzes on Various related aspects (05 Practicals)
2. Working out laws of inheritance by using seed mixtures (03 Practicals)
3. Various Problems based on gene interaction (03Practicals)
4. Different Problems based on sex linked inheritance (03Practicals)

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note: Students should undertake Botanical excursion, field visits to ecologically different areas for plant study and submission of list and soft /hard copy photographs of wild plants at the time of practical examination.

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B. Sc. III Year (Theory) Semester VI

Elective Course Code: BOT-612 (A) Paper XII (Diversity of Angiosperms-II)

45 L **Credit: 02**

Unit: 1

a. Plant identification: Construction and use of keys, herbaria and botanical gardens (04)

b. Origin of angiosperms: place and time of origin, probable ancestors: Pteridospermales-Angiosperms, Bennettitalean, Caytonialean and Gnetales- Angiosperms theory. Hutchinson's principles of angiosperms origin. (06)

c. Binomial nomenclature: Principles and rules, Shenzhen code 2018 (03)

d. Modern trends in taxonomy: Cytotaxonomy, chemotaxonomy, and molecular systematics and Phylogeny (03)

Unit: 2

a. Taxonomy: APG IV system of classification of plants (03)

b. Study of diversity of families as per APG IV system: (26)

1. Lytheraceae
2. Rutaceae
3. Oleaceae
4. Verbenaceae
5. Asteraceae
6. Combretaceae
7. Cucurbitaceae
8. Anacardiaceae
9. Meliaceae
10. Orchidaceae
11. Papaveraceae

Continuous Internal Assessment (CIA): Tutorials and Assignments (5)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment or Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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B. Sc. III Year (Practical), Semester - VI
Lab Course X, BOT 622(A) (Based on BOT 612(A), Theory Paper – XII)
45L (Diversity of Angiosperms-II) Credits:1.5

1 . Study of following families with suitable examples available in your area:

1. Liliaceae
2. Orchidaceae
3. Arecaceae
4. Commelinaceae
5. Zingiberaceae
6. Poaceae
7. Papaveraceae
8. Malvaceae
9. Apocynaceae
10. Solanaceae
11. Acanthaceae

2. Study of different types of stomata and Trichomes.

3. Identification of plants up to species by using flora (Flora of Bombay Presidency/ Flora of Marathwada / Flora of Maharashtra / Keys)

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note: Students should undertake Botanical excursion, field visits to ecologically different areas for plant study and submission of list and soft /hard copy photographs of wild plants at the time of practical examination.

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B. Sc. III Year (Theory) Semester VI

Elective Course Code: BOT-612(B) Paper XII (Economic Botany)

45 L **Credit: 02**

Unit -1 : Origin, morphology, production data, cultivation practices, improved varieties, harvesting and uses of crop plants. (15)

a) **Cereals:** Rice, Wheat, Jowar, Maize, Jowar and Pearl millet.

b) **Pulses:** Mung, Urad, Chick pea and Pigeon pea,

c) **Oil seed crops:** Soyabean, Groundnut, Sunflower and Safflower

Unit -2. : Origin, morphology, production data, cultivation practices, improved varieties, harvesting and uses of crop plants. (15)

a) **Fibre crops:** Jute, Sunhemp and Cotton

b) **Horticultural crops:** Banana, Orange, Mango, Pomogranate, Sapota and Custard apple,

c) **Ornamentals:** Rose, Orchids, Gerbera, Geranium and Chrysanthemum

Unit -3.: Botanical name, Family, Vernacular name, Improved varieties and economic impoertance of followings. (15)

a) **Beverages:** Alcoholic beverages: Gape wines, fruit wines; Non alcoholic beverages: Tea and Coffee

b) **Forage crops (in brief):** Maize, Sugarcane, Jowar and Lucerne

c) **Vegetable crops (in brief):** Brinjal, Spinach, Fenugreek, Dill, Potato, Tomato, Guards, Cauliflower, Cabbage, Lablab, Cluster bean,

d) **Condiments and Spices (in brief)**: Green Cardamom, Black cardamom, Cinnamon, Clove, Nutmeg and Mace, Asafoetida, Black pepper, Garlic, Onion, Ginger, Chilli,

e) **Medicinal plants (in brief):** Ashwagandha, Shatavari, Gulvel, Adulsa, Long pepper, Hirda, Beheda, Amla, Arjun, Safedmusli

f) **Invasive plants (in brief):** *Glyricidia, Parthenium, Ipomoea carnea* sub.sp. *fistulosa.*

Continuous Internal Assessment (CIA): Tutorials and Assignments (5)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment or Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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B. Sc. III Year (Practical), Semester - VI

Lab Course X, BOT 622(B) (Based on BOT 612(B), Theory Paper – XII)

45L **(Economic Botany)** **Credits:1.5**

1)Study of morphology,structure,and simple histochemical tests of food storing tissues in Maize,Rice, Jowar,Gram,pigeonpea,Potato.

1) Study of histochemical tests of lignin and cellulose (Jute ,Cotton, and Sunhemp).
2) Hand section of Groundnut, sunflower and staining of oil droplets.
3) Study of condiments and spices.(Cardamom, Blackpepper, and Chillies).
4) Study of horticultural crops (Banana, Sapota, Mango, Citrus and Custard apple)
5) Study of vegetable crops (Brinjal, Tomato, Guards, Onion and Potato).
6) Study of Rose, Gerbera and Marigold.
7) Study of any 4 medicinal plants
8) Study of any 1 harmful plants

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note: Students should undertake Botanical excursion, field visits to ecologically different areas for plant study and submission of list and soft /hard copy photographs of wild plants at the time of practical examination.

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B. Sc. III Year (Theory) Semester VI

Elective Course Code: BOT-612(C) Paper XII (Microbiology & Disease Management)

45 L **Credit: 02**

Unit-1 Microbiology **Credit – 0.8**

1. Definition, scope, importance and classification of microorganisms (05)
2. Microbial techniques:

a. Microscopy – simple, compound and electron microscope

b. Micrometry – Principle, ocular and stage micrometre, working and uses

c. Common stains used in pathology with special reference tocotton blue, lactophenol and Gram's Stain

d. Sterilization of glassware and different culture media (PDA,MRB,CZA,NA) (06)

2. Industrial application of microorganisms -Organic acid (citric acid or glutamic acid), alcohol (Ethanol) and antibiotic (Penicillin) milk products and bio pesticides (05)

Unit-2: Disease management: **Credit – 1.2**

1. Preventive methods: field sanitation, use of clean planting material, crop rotation, trap crops, time of sowing, planting distance and tillage (03)
2. Control methods –

a. Seed treatment: concept, objective, traditional and modern methods of seed treatment (02)

b. Soil sterilization: concept, objectives and methods (02)

c. Fungicides: Definition, classification, general accounts of applications and uses (06)

i. Sulphur fungicides – Inorganic –sulphur, Organic – Ziram

ii. Copperoxychloride

iii. Mercuric chloride – Agrosan – GN

iv. Heterocyclic nitrogenous compounds – Iprodine

v. Benzene compounds – Dexon

vi. Antibiotics – Streptomycin and Aureofungin

vii. Systemic – Benomyl and Propiconazole

d. Pesticides: Nicotin,Neem and pyrethrum (01)

e. Rhodenticides – Zinc phosphoid (01)

f. Nematicides- Nemagon, Propoxar (01)

g Weedicides- Atrazine (01)

h. Biological control with special reference to *Trichoderma* & *Rhizobium* (02)

3. Plant quarantine: definition, Importance & Principle (01)
4. Control measures and environment: pollution due to chemicals, residual effects, toxicity, safe measures, colour code, antidote, symptoms of poisoning, precautions in using pesticides (02)
5. Pesticide application equipment's: principle and working –pneumatic air pump knapsack sprayer, mist blower and duster, types of nozzles (02)
6. Plant disease clinic: Concept, objective and need (02)
6. Recent techniques in plant pathology: Genetically modified organisms (GMO's), B.T. Cotton, Pheromones, PCR protocol (03)

Unit – 3

Continuous Internal Assessment(CIA): Tutorials and Assignments (5)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment or Tutorials for 5 marks. In assessment you are free to use different assessment methods.

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B. Sc. III Year (Practical), Semester - VI

Lab Course X, BOT 622(C) (Based on BOT 612(C), Theory Paper – XII)

45L (Microbiology and Disease Management) Credits:1.5

1. Study of fungicides as per theory syllabus
2. Preparation of Bordeaux mixture
3. Study of insecticides as per theory syllabus
4. Isolation and preparation *Trichoderma* culture
5. Isolation and preparation *Rhizobium* culture
6. Study of plant protection equipments –pneumatic air pump, knapsacks prayer, mist blower cum duster
7. Principle and working of autoclave, BOD incubator, Oven, laminar air flow, Tilak air sampler
8. Demonstration of aerobiological techniques to study fungal spores by Tilak air sampler
9. Calibration of microscope and measurement of fungal spores
10. Study of pathogens in fruits from local market
11. Study of fungi from locally available seed sample
12. Preparation of sterile media - nutrient agar, potato dextrose agar, MRB, Czapeak agar
13. Preparation of stains and mounting media - cotton blue, lacto phenol and gram stain.
14. Study of some important fungal species
15. Isolation and identification of seed-borne pathogen by blotter and agar plate method
16. Detection of soil mycoflora from any crop plant
17. Internal Assessment

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note: Students should undertake Botanical excursion, field visits to ecologically different areas for plant study and submission of list and soft /hard copy photographs of wild plants at the time of practical examination.

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B. Sc. III Year (Theory) Semester VI

Elective Course Code: BOT-612(D) Paper XII (Bioinformatics)

45 L **Credit: 02**

Unit I **(10)**

i. Scope of Bioinformatics – Internet basics, www, protocols – FTP – Telnet – HTTP, Elementary commands in UNIX,
ii. Introduction to PERL (Basic commands, pattern and string matching), BIOPERL (Programme, to transcribe and translate nucleotide sequences).
iii. Installation of bioperl and its applications.

Unit II **(12)**

i. Introduction of databases, Biological databases and their use
ii. Databanks – nucleotide databanks– Genebank, NCBI, EMBI, DDBJ
iii. Protein databanks – PIR, SWISSPROT, TrEMB
iv. Structural databases –PDB, SCOP, CATH, SSEP, CADB, Pfam and GDB
v. Data base search, sequence submission , Sequin, Bankit, Sakura
vi. FASTA-BLAST.

Unit III **(10)**

i. Sequence alignment, Pairwise alignment Dynamic programming
ii. Multiple sequence alignment. Methods of MSA, Clustal W
iii. Phylogenetic analysis. Tree building methods – Distance, Parsimony, Maximum likelihood, Phylogenetic Software, Phylip.

Unit IV **(13)**

i. Special topics in bioinformatics Methods for prediction of secondary and tertiary structures of proteins knowledge based structure prediction: fold recognition, ab initio methods for structure prediction, Protein structure visualization.
ii. Comparative protein modeling, Gene predictions, Genscan, Precustes, Grail,
iii. DNA Mapping and sequencing. Map alignment – Shotgun DNA sequencing – Sequence assembly.

Unit V Assignments **(05)**

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Continuous Internal Assessment(CIA): Tutorials and Assignments (5)

Note: Internal assessment lectures should be used to assess student's credibility and knowledge of the above topics. Conduct two internal tests of five marks and average it for 5 marks and Assessment or Tutorials for 5 marks. In assessment you are free to use different assessment methods.

Suggested Books:

1. Introduction to Bioinformatics: T K Attwood & D J Parry Smith
2. Dan E Krane, Michael L Raymer. Fundamental concepts of Bioinformatics, Benjamin
3. Cummings
4. Andreas D.Baxevanis, B.F.Francis Oouellette, Bioinformatics,Wiley.
5. Dam Gusfield. Algorithms on Strings Trees and Sequences, Cambridge University Press.
6. D.Mount, Bioinformatics Sequence Analysis. Cold Spring Harbor Laboratory.
7. Vittal R Srinivas Bioinformatics, A modern Approach, PHI Learning Pvt Ltd
8. Rastogi, Mendiratta, & Rastogi, Bioinformatics Methods & Applications, PHI Learning Pvt Ltd

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B. Sc. III Year (Practical), Semester - VI
Lab Course X, BOT 622(D) (Based on BOT 612(D), Theory Paper – XII)
45L (Bioinformatics) Credits:1.5

1. Browsing information from Nucleotide database
2. Browsing information from Protein database
3. Browsing information from Structural database
4. Pairwise sequence alignment
5. Multiple sequence alignment
6. Generation of phylogentic tree by using phylip

Continuous Internal Assessment (CIA): 07 marks for internal practical examination and 03 marks for Record Book / Submission of collection and field survey report / excursion report.

Note: Students should undertake Botanical excursion, field visits to ecologically different areas for plant study and submission of list and soft /hard copy photographs of wild plants at the time of practical examination.

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B. Sc. III Year (Theory) Semester VI

BOT-613 Skill Enhancement Course-4 (G) SEC 4 (G): Horticulture

45L **Credits:02**

a.Theory (1 credit) **Total hours 15**

Unit 1: Concept, Objectives, Branches of Horticulture, Carrier opportunities in the horticulture. Soil and its preparation: Physical texture and composition of soil, soil types, soil pH, preparation of beds and preparation of soil mixtures / garden soil.

Fertilizers, Organic Manures and Substrates: Fertilizers; Farm Yard Manure (FYM), compost, leaf mold, bone meal, Oilcakes, wood ash, charcoal, peat moss, Sphagnum Moss, shredded bark, Sawdust and wood shavings; Vermiculite and Vermicompost

Potting, Repotting and Transplantation: Types of pots, Plants suitable for pot culture, Potting, Repotting and Transplantation

Pruning: Introduction, objectives; Types and season of pruning, special pruning techniques, differential pruning technique, pruning of flowering and fruit plants

Training: Introduction, systems of pruning-leader and modified leader systems, training of plants requiring support of Structures, training of plants do not requiring support of Structure and training of ornamental plants. **(10 hours)**

Unit 2: Introduction to Horticultural Plants

Classification of Horticultural crops: classification on the basis of growth habit, shedding of leaves, life span, climatic requirement, use of plant part, ecology

Types of Horticultural Plants: Annuals, Perennials, climbers, shrubs and trees (at least two examples with morphology and horticultural use and applications from each type). **(5 Hours)**

b.Practical: (1 Credit) **Total hours 15**

Laboratory exercises (Any 5) (3 hours for each practical)

1. Study of tools and implements in Horticulture.
2. Study of soil texture and pH
3. Study of fertilizers-organic manures and substrates.
4. Preparation of soil mixture for potting and pots.
5. Demonstration of Potting, Repotting and Transplantation.
6. Demonstration of Pruning and Training techniques.
7. Study of Horticultural Crops.
8. Visit to Horticulture University/Research station.

Suggested readings:

1. Prasad S (1999) Agros Dictionary of Horticulture. Agrobios, Jodhpur
2. Rao KM (2005) Textbook of Horticulture. McMillan India Ltd, New Delhi.
3. Sanders TW (2006) Encyclopedic Dictionary of Horticulture. Bio Green Books, Delhi.
4. Sheela VL (2011) Horticulture. MJP Publishers, New Delhi.
5. Kaul GL (1989) Horticulture crop in India.
6. Arora JS (2014) Introductory Ornamental Horticulture. Kalyani Publishers, New Delhi
7. Prasad and Kumar ,2014.: Principles of Horticulture 2nd Edition Agribios India
8. Jithendra Singh, 2002. Basic Horticulture. Kalyani Publishers, Hyderabad

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B. Sc. III Year (Theory) Semester VI

BOT-613 Skill Enhancement Course-4 (G) SEC 4 (G): Greenhouse Technology

45L **Credits: 02**

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a.THEORY: (1 Credit) **Total Hours: 15**

Unit 1: Introduction; General scope and classification of greenhouses, construction of greenhouse, Net- poly houses **(4 Hours)**

Unit 2: Plant selection and Management of Fertilizers, Irrigation in Green Houses **(4 Hours)**

Unit 3: Management of diseases and pests in in Green Houses **(4 Hours)**

Unit 4: Applications of Green House Technology; Importance of Greenhouse technology **(3 Hours)**

b.PRACTICAL: (1 Credit) **Total Hours: 15**

Laboratory Exercises (Any 5) **(3 Hours for each Practical)**

1. Study of Green House with the help of Models/Charts.
2. Demonstration of various types of green houses with the help of Models/Charts.
3. Study of Green House effect for understanding working principle of Green House.
4. Study of standard requirements for construction of a green house.
5. Study of Green House diseases.
6. Study of Plant selection for Green House.
7. Vegetative Propagation in Green House Plants.
8. Visit to a Green House.

Suggested Readings-

1. Pant V. and Nelson. 1991. Green House Operation and Management. Bali Publication. New Delhi.
2. Dubey R.C. 2006. A text book of Biotechnology. S.Chand and Company. New Delhi.
3. Prasad S., Kumar U. 2012. Green House Management for Horticultural Crops. Agrobios India.
4. Sheela V.L. 2011. Horticulture.MJP Publishers. Chennai.
5. https://en.wikipedia.org/wiki/Greenhouse.html
6. https://aggie-horticulture.tamu.edu/ornamental/greenhouse-management/greenhouse-structures.html

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Faculty of Science

Pattern of Theory Question Paper

B. Sc. III Year (Botany) Semester VI

Elective Course Code: BOT: 611 Paper XI (Genetics and Evolution)

Time: 2Hour **Max. Marks: 40**

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 1) 10

or

Describe in brief:
a. Short answer type .....(Unit 1)
b. Short answer type .....(Unit 4)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 3)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 3)
b. Short note (Unit 3)
c. Short note (Unit 4)

Q.4 MCQ (10 Questions from all the units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Faculty of Science

Pattern of Practical Question paper Examination

B. Sc. III Year (Botany), Semester - VI

Lab Course:IX, BOT 621 (Based on BOT 611, Theory Paper XI)

Time: 2Hour Max. Marks: 50

Date: _____ Batch No. _____

Center: _____

Q.1.Quiz based on genetics and biotechnology.	07
Q.2. Working out laws of inheritance using seed mixture	09
Q.3. Problem based on gene interaction	12
Q.4.Problem based on sex-linked inheritance	12
Q.5. Submission:	10
a) Record book ,	
b) viva - voce	

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B. Sc. III Year (Botany) Semester VI
Elective Course Code: BOT: 612 (A) Paper XII (A) (Diversity of Angiosperms-II)

Time: 2Hour **Max. Marks: 40**

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 1) 10

or

Describe in brief:
a. Short answer type .....(Unit 1)
b. Short answer type .....(Unit 1)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 2)
b. Short note (Unit 1)
c. Short note (Unit 1)

Q.4 MCQ (10 Questions from all the units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Practical Question paper Examination
B. Sc. III Year (Botany), Semester - VI
Lab Course: X (A), BOT 622 (A) (Based on BOT 612A, Theory Paper – XII (A))

Time: 2Hour Max. Marks: 50

Date: _____ Batch No. _____
Center: _____

Q. 1. Identify, classify giving reasons and describe the specimen 'A'. Give floral formula and floral diagram. 10

Q.2. Identify, classify giving reasons and describe the specimen 'B'. Give floral formula and floral diagram. 10

Q.3. Identify genus and species of the given plant by using flora 05

Q.4. Determine analytical and synthetic characters between specimens provided 05

Q.5. Identify and describe the specimen C, D, E and F as per the instructions 10

(A and B – morphology, C- Eco.Imp. D-pollen/trichome/stomata)

Q.6. Submission: 10

a) Record book

b) Tour report, field collection and viva - voce

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B. Sc. III Year (Botany) Semester VI
Elective Course Code: BOT 612(B)Paper: XII (B) (Economic Botany)

Time: 2Hour **Max. Marks: 40**

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 1) 10

or

Describe in brief:
a. Short answer type .....(Unit 1)
b. Short answer type .....(Unit 1)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 3)
b. Short note (Unit 3)
c. Short note (Unit 3)

Q.4 MCQ (10 Questions from all the units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Practical Question paper Examination
B. Sc. III Year (Botany), Semester - VI
Lab Course: X(B), BOT 622 (B) (Based on BOT 612B, Theory Paper – XII (B))

Time: 2Hour Max. Marks: 50

Date: _____ Batch No. _____
Center: _____

Q.1. Histochemical tests in given materials 'A' and 'B'
(Starch / Proteins / lipids / cellulose / Lignin) 10

Q.2. Identify and describe the specimens C, D, E, F and G as per the instructions 20

Q.3. Economic Importance of two given plants with Botanical name, family and useful parts. 10

Q.4 Submission: 10

a) Record book, viva - voce

b) Project report / Tour report and collection

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B. Sc. III Year (Botany) Semester VI
Elective Course Code: BOT 612(C)Paper: XII (C) (Microbiology and Disease Management)

Time: 2Hour **Max. Marks: 40**

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 1)
b. Short answer type .....(Unit 1)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 1)
b. Short note (Unit 1)
c. Short note (Unit 2)

Q.4 MCQ (10 Questions from all the units) 10

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,AURANGABAD
Faculty of Science
Pattern of Practical Question paper Examination
B. Sc. III Year (Botany), Semester - VI
Lab Course: X (C), BOT 622 (C) (Based on BOT 612, Theory Paper – XII (C))

Time: 2Hour Max. Marks: 50

Date: _____ Batch No. _____
Center: _____

Q.1. Calibrate the microscope, measure the given spore and sketch with camera lucida technique. 10

Q.2. Detect of organic acids / amino acids from infected and healthy leaves by circular paper chromatography 10

Q.3. Identify, and describe specimens as per instruction (Four spots) 10
(2 apparatus, 2 pesticide / fungicide)

Q.4. Comment on the working of instrument in the laboratory. 10

Q.5. Submission: 10

a) Record book, viva - voce

b) Project report / Tour report and collection

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DR.BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD
Faculty of Science
Pattern of Theory Question Paper
B. Sc. III Year (Botany) Semester VI
Elective Course Code: BOT 612(D)Paper: XII (D) (BIOINFORMATICS)

Time: 2Hour **Max. Marks: 40**

N.B.: i) Attempt all questions
ii) All questions carry equal marks
iii) Draw neat and well-labelled diagrams wherever necessary

Q.1. Long answer type question .....(Unit 1) 10

or

Describe in brief:
a. Short answer type .....(Unit 1)
b. Short answer type .....(Unit 1)

Q.2. Long answer type question .....(Unit 2) 10

or

Describe in brief:
a. Short answer type .....(Unit 2)
b. Short answer type .....(Unit 2)

Q.3. Write short notes on: (Any two) 10
a. Short note (Unit 3)
b. Short note (Unit 3)
c. Short note (Unit 3)

Q.4 MCQ (10 Questions from all the units) 10

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Pattern of Practical Question paper Examination

B. Sc. III Year (Botany), Semester - VI

Lab Course: X (D), BOT 622 (D) (Based on BOT 612D, Theory Paper – XII (D))

Time: 2Hour Max. Marks: 50

Date: _____ Batch No. _____

Center: _____

Q.1. Calculate mean, standard deviation, coefficient of variation and standard error of the provided data. 10

Q.2. Prepare of a job using - word processor / spread sheet /presentation / database. 10

Q.3. Represent given data by graphical method. 10

Q.4. Computation of chi-square/ t-test. 10

Q.5. Submission: 10

a) Record book, viva - voce

b) Project report and Tour report

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Suggested Reading:

1. Principles and Procedures of Plant Protection –S.B. Chattopadhyay.
2. A Hand book of Plant Protection - D. Seshagiri Rao.
3. Chemistry of Insecticides and Fungicides – U.S. Sreeramulu.
4. Plant Protection - Mukundan
5. Systemic Fungicide - S.C. Was
6. Fungicides by- Nene & Thapliyal.
7. Fungi and Plant diseases –B.B. Mundkur.
8. Text book of Modern Plant Pathology - K.S. Bilgrami and H.C. Dube.
9. Plant diseases - R.S. Singh
10. Essentials of Plant Pathology – V.N. Pathak.
11. Plant Pathology –R.S. Mehrotra.
12. Introduction to principle of Plant Pathology- R.S. Singh.
13. Plant Pathology – Agrios.
14. Principles of Plant breeding – H.K. Choudhary.
15. Weed Science – Thakur.
16. Modern Weed Science – O.F. Gupta & P.S. Lamba.
17. Principles of Weed Science - V.S.Rao.
18. Manual of Weed Science – N.C. Joshi.
19. Elements of Economic entomology– Vasantraj Devid and T. Kumar swami.
20. Agricultural Pests of India and South East Asia – A.S. Atwal.
21. General and applied Entomology – K.E. Nayar, B. V. David
22. Crop protection recommendations published by Department ofAgriculture.M.S.Pune
23. Plant protection recommendations for Horticulture crops-Directorate ofHorticulture M. S. Pune 05
24. Plant diseases in India- G. Rangaswami.
25. Diseases of cereals and millets – T.S. Ramkrishna.
26. Principles of Plant disease control- S.A. J. Tarr,1971.
27. Scientific principles of crop protection–Mortin, Hubert & David Woodcock –Edward Ashold USA.
28. Entomogrow nematodes- Ficheer G. O. Jr.
29. Applied plant Biotechnology – Rao, Dr. S. Ignacimlie, Tak Maegrere.
30. Advances in Mycology & Plant Pathology – R. Chaudhar
31. Text book of Fungi O.P. Sharma – Tata McGraw
32. Elements of Economic Entomology-David & Kumar Swami.
33. Text book of toxicology – Shrivastava.
34. Toxicology of Insecticides – Matsmura
35. Plant orgin insecticides.
36. Recent Advances in Host Plant Resistance –S. S. Dhahiliwa
37. Introduction to In Pest management – G.S. Ahaliwal.
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10. Sporne, K. R. 1991. The Moropology of Gymmosperms. B. I. PublicationsPvt.,Bombay, Calcutta, Delhi.
11. Wilson, N. S. and Rothwell, G. W. 1983 Palaeobotany and the EvolutionofPlants (2nd Edition). Cambridge University Press U.K.

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21. Bridge. P. et.al 1998. Molecular Variability of Fungal Pathogens. CABInternational UK.
22. Bridge. P. et. al. 1999. Application of PCR in Mycology CABInternational,UK.
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24. Persley, G.J. 1996. Biotechnology and Integrated Pest ManagementCABInternational, UK.
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105. Microbiology life – W.R. Sustrom.
106. Morphology of vascular Plant (lower groups) – A. J. Eames.
107. Introduction pteridophtya – A Rashid.
108. Morphology of Gymnosperms – J. M. Coulter and C. J. Chamberlain.
109. Gymnosperms – Structure & Evolution – C. J. Chamberlain.
110. Press – P. Macheshwari and V. Vasid.
111. Morphology of Gymnosperms – K. R. Sporne.
112. An Introduction to Palaeobotany – C. A. Arnold.
113. Studies in Palaeobotany – H. N. Andrews.
114. Essentials of Palaeobotany – A. C. Shukla and S. P. Mishra.
115. The flora I, II & II – T. Cooke.
116. Taxonomy of the Angiosperms – A. J. Eames.
117. Text book of systematic botany – R. N. Sutar.
118. Methods of Descriptive systematic Botany – A. S. Hitchcock.
119. Taxonomy of the Angiosperms – U. N. Naik.
120. Methods of Desriptive systems Botany – A. S. Hitchcock.
121. Flora of Khandala – H. Santapan.
122. An Introduction to Embryology of Angiosperms–P. Maheshwari.Hand Book of Agriculture –I.C.A. R.
123. Field Crops of India – A. K. Aiyer.
124. An Introduction to plant Anatomy – A. J. Eames and M. C. Danialls.
125. Physiolgoy Plant Anatomy – G. Haberlandf.
126. Forest Production andf wood Science – J. G. Naygreen & Bowyer.
127. Pollen granis of Westen Himalayan plants. P.K.K. Nair.
128. Essentials of Palynology – P. K. K. Nair.
129. Pollen morphology of Angiosperms – P. K. K. Nari.
130. Pollen morphology and plant Taxonomy – G. Erdtman.
131. Fundamentals of Cytology – L. W. Sharp.
132. Cytology Cytogenetics – C. P. Swanson.
133. Cytogenetics and Plant Breeding.
134. -S N. Chandrashekharan and S. V. Partha Sarathy.
135. The Physiology of flowering – W.S. Hiiman.
136. Phytochemical Methods – Hartoren.
137. Plant growth substances – H. N. Krishnamurty.
138. Introduction to Practical Biochemistry – D. T. Plummee.
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153. Plant tissue and Organ culture – UNESCO and University of Delhi.
154. Plant Ecoloy – J. E. Weaver and F. E. Clements.
155. Botanical Micro technique – Sags.
156. Plant Micro Technique – D. A. Johanson.159 Biometry – Dr.A.M.Mungikar
160 Plant resource development – Mungikar and Bhuktar

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