M.Sc. Sem-I to IV (Botany)  Prospectus No. 2017126

SANT GADGE BABA AMRAVATI UNIVERSITY

विज्ञान विभाग (FACULTY OF SCIENCE)

PROSPECTUS

OF

M. SC. EXAMINATION

IN

BOTANY

Semester - I & III, Winter 2016
Semester - II & IV, Summer 2017,

2016

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**M.Sc. Part-I & Part-II (Semester I to IV) Examinations in Botany**  
(Prospectus No.2017126)

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SANT GADGE BABA AMRAVATI UNIVERSITY
SPECIAL NOTE FOR INFORMATION OF THE STUDENTS

(1) Notwithstanding anything to the contrary, it is notified for general information and guidance of all concerned that a person, who has passed the qualifying examination and is eligible for admission only to the corresponding next higher examination as an ex-student or an external candidate, shall be examined in accordance with the syllabus of such next higher examination in force at the time of such examination in such subjects papers or combination of papers in which students from University Departments or Colleges are to be examined by the University.

(2) Be it known to all the students desirous to take examination/s for which this prospectus has been prescribed should, if found necessary for any other information regarding examinations etc., refer the University Ordinance Booklet the various conditions/provisions pertaining to examination as prescribed in the following Ordinances.

Ordinance No. 1 : Enrolment of Students.
Ordinance No. 2 : Admission of Students
Ordinance No. 4 : National cadet corps
Ordinance No. 6 : Examinations in General (relevent extracts)
Ordinance No. 18/2001 : An Ordinance to provide grace marks for passing in a Head of passing and Improvement of Division (Higher Class) and getting Distinction in the subject and condonation of deficiency of marks in a subject in all the faculties prescribed by the Statute NO.18, Ordinance 2001.

Ordinance No. 9 : Conduct of Examinations (relevent extracts)
Ordinance No. 10 : Providing for Exemptions and Compartments
Ordinance No. 19 : Admission of Candidates to Degrees.
Ordinance No. 109 : Recording of a change of name of a University student in the records of the University.

Ordinance No.19/2001 : An Ordinance for Central Assessment Programme, Scheme of Evaluation and Moderation of answerbooks and preparation of results of the examinations, conducted by the University, Ordinance 2001.

Dr. Ajay P. Deshmukh
Registrar
Sant Gadge Baba Amravati University.

PATTERN OF QUESTION PAPER ON THE UNIT SYSTEM.

The pattern of question paper as per unit system will be broadly based on the following pattern

(1) Syllabus has been divided into units equal to the number of question to be answered in the paper. On each unit there will be a question either a long answer type or a short answer type.

(2) Number of question will be in accordance with the unit prescribed in the syllabi for each paper i.e. there will be one question on each unit.

(3) For every question long answer type or short answer type there will be an alternative choice from the same unit. However, there will be no internal choice in a question.

(4) Division of marks between long answer and short answer type question will be in the ratio of 40 and 60.

(5) Each short answer type question shall contain 4 to 8 short sub question with no internal choice.
%ORDINANCE NO. 4 of 2008

Examinations leading to the Degree of विज्ञान पारंगत (Master of Science)(Four Semesters Degree Course), Ordinance, 2008.

Whereas it is expedient to provide an Ordinance regarding Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semesters Degree Course), in the faculty of Science. The Management Council is hereby pleased to make the following Ordinance.

1. This Ordinance may be Called, "Examinations leading to the Degree of विज्ञान पारंगत (Master of Science) (Four Semesters Degree Course), Ordinance, 2008".

2. This Ordinance shall come into force w.e.f. the date of its approval by the Management Council.

3. The duration of the course shall be two academic years,

(a) M.Sc. Course is divided into Semester-I, Semester-II, Semester-III & Semester-IV.

(b) University shall hold examinations in Winter and in Summer every year for all semesters.

(c) The main examination of odd semesters shall be held in Winter and the main examination of even semesters shall be held in Summer every year. The supplementary examination for odd semesters shall be held in Summer and the supplementary examination for even semesters shall be held in Winter every year.

4. The period of Academic Session/Term shall be such as may be notified by the University and the Examination shall be held at such places and on such dates as may be fixed by the Board of Examinations.

5. Subject to their compliance with the provisions of this Ordinance and of other Ordinances in force from time to time, the following persons shall be eligible for admission to the examinations, namely:-

(A) For विज्ञान पारंगत भाग-१ प्रथम सत्र M.Sc.Part-I:-

(a) A collegiate candidate admitted to the Degree of Bachelor of Science who has prosecuted a regular course of study in a college or a University Department.

(b) a teacher admitted to the Degree of Bachelor of Science and eligible under Ordinance No. 18;

(c) a woman candidate admitted to the Degree of Bachelor of Science, who has not pursued a course of study in the University or a College;

Provided that, applicants eligible under clauses (b) and (c) above shall, if laboratory work is prescribed in the subject which they offer for examination, attend the full course of laboratory instruction in the University Department or a College or a recognised Institution imparting instruction up to the standard of the examination;

Provided further, that in the case of applicants under clauses (b) and (c) above, not less than one academic year shall have elapsed since the date of their passing the examination for the Degree of विज्ञान स्नातक (Bachelor of Science);

(d) Candidate who has passed B.Sc. Examination of Sant Gadge Baba Amravati University with Chemistry as one of the optional subjects and has also passed the Diploma of Associateship of Institution of Chemists (India) Calcutta and is working as Jr/Sr. Laboratory Asstt. in National Environmental Engineering Research Institute, Nagpur (NEERI) or Council of Scientific and Industrial Research (CSIR), Nagpur or Indian Bureau of Mines (IBM) will be eligible to appear at M.Sc. Semester-I in Chemistry only, without prosecuting a regular course of study in a College/Department in the University.

Provided he produces certificate of completion of practical course prescribed for M.Sc. Part-I (Semester-I & Semester-II) Examination in Chemistry from his employer.

(e) any other graduate in Science not eligible under clause (a) (b) or (c) above, shall be eligible for admission to the examination in Mathematics only, after a lapse of not less than one academic year since the date of his passing the examination for the Degree of विज्ञान स्नातक (Bachelor of Science);

(f) an applicant holding the बैरोमेट्रिक स्नातक (B.Pharm) or the विज्ञान स्नातक कृषि (B.Sc.Agri.) Degree shall be eligible for admission to the विज्ञान पारंगत (M.Sc.) Course in Biochemistry only;

(Note: The विज्ञान स्नातक (B.Sc.) Degree referred to in clause (a) above, shall include the विज्ञान स्नातक (B.Sc.) Degree of the University or an equivalent Degree of any other Statutory University)

% As approved by Management Council on dated 30.5.2008, Vide Item No. 196, and latest amended vide Ordinance No. 14 of 2009 (M.C. dated 25.5.09)
(g) an applicant holding the B.Sc. (Ind.Chem.) Degree of the Banaras Hindu University;

(h) an applicant holding B.A./B.Sc. with Mathematics/Statistics or Bachelor of Computer Science Degree for admission to M.Sc. Course in Statistics or Mathematics;

(i) i) for admission to M.Sc. Microbiology a candidate shall have offered Microbiology or Industrial Microbiology or Biochemistry as a subject of study and examination at the B.Sc. degree.

   ii) for admission to M.Sc. Biochemistry a candidate shall have offered Microbiology or Industrial Microbiology or Biochemistry as a subject of study and examination at the B.Sc. degree.

   For admission to M.Sc. Biochemistry, in case of vacancies, a student offering Chemistry along with Biological Science shall be admitted.

(j) i) for admission to M.Sc. Electronics (Instrumentation) a candidate shall have offered Physics or Electronics (Instrumentation) or Electronics or Electronics Science or Computer Maintenance as subjects of study and examination at the B.Sc. level and B.C.S. degree of this University or any other equivalent Degree of Statutory University.

   ii) a person passing B.E. (Electronics & Telecommunication or Industrial Electronics) Examination of Sant Gadge Baba Amravati University is eligible to take admission directly at second year of M.Sc. Electronics (Instrumentation). Such a student who is admitted to second year of M.Sc. Electronics (Instrumentation) shall be awarded M.Sc. degree on the basis of his performance at M.Sc. Part-II only.

(k) for admission to (M.Sc.) Geography a candidate shall have offered Geography as a subject to study and examination at the B.Sc. Degree.

(l) for admission to (M.Sc.) Petrochemical Science, a candidate shall have offered Petrochemical Science subject to study and examination at the B.Sc. Degree.

(m) i) for admission to M.Sc. Part-I (Environmental Science) a candidate shall have offered one of the optional subjects as Environmental Science or Botany or Zoology or Life Sciences or Microbiology or Biochemistry or Biotechnology at B.Sc. degree.

   ii) Sixty percent seats of the total intake shall be reserved for students who have passed B.Sc. with Environmental Science. If students having Environmental Science as an optional subject are not available then students having other optional subjects be considered.

(n) for admission to M.Sc. Geoinformatics or Remote Sensing and GIS, a candidate shall have passed B.Sc. in any discipline of Life Sciences. Preference shall be given to graduates having offered Geology at undergraduate level.

(o) for admission to M.Sc. Bioinformatics a candidate shall have passed B.Sc. in any discipline of Life Sciences, Bio Sciences or Bachelor Degree in Agriculture, Veterinary and Fishery Sciences, Pharmacy, or Medical Sciences - Bachelor of Medicine and Bachelor of Surgery, Bachelor of Dental Surgery, B.A.M.S., B.H.M.S. or any equivalent examination recognised by Sant Gadge Baba Amravati University.

(B) For विज्ञान पारंपरिक मान (M.Sc. Part-II) Examination:-

(a) a student who has been admitted to the Degree of विज्ञान स्नातक (Bachelor of Science) and who has since passing the M.Sc. Part-I (Semester-I & II) Examinations, prosecuted a regular course of study for not less than one academic year in the University or in the College in the subject in which he offers himself for the M.Sc. Part-II Examinations;

(b) a teacher admitted to the Degree of विज्ञान स्नातक (Bachelor of Science) and eligible under Ordinance
No. 18 and who has not less than one academic year previously, passed the M.Sc. Part-I Examination in the subject in which he offers himself for M.Sc. Part-II Examinations;

(c) a woman candidate admitted for the Degree of विज्ञान स्नातक (Bachelor of Science) and who has not less than one academic year previously, passed the M.Sc. Part-I Examination in that subject in which she offers herself for the M.Sc. Part-II Examinations;

(d) a candidate who has been admitted under Para 3 (A) (d) above and who has not less than one academic year previously, passed M.Sc. Part-I Examination in the subject Chemistry in which he offers himself for the M.Sc. Part-II Examination.

Provided he produces a certificate of completing of practical course prescribed for M.Sc. Part-II Examination in Chemistry from his employer;

(e) any other Graduate in Science not eligible under clause (a) (b) or (c) who has not less than one academic year previously, passed the M.Sc. Part-I (Semester-I & Semester-II) Examinations in the subject which he offers himself for the Part-II Examination;

6. Subject to his / her compliance with the provisions of this Ordinance and other Ordinances (Pertaining to Examination in General) in force from time to time, the applicant for admission, at the end of the course of study of a particular term shall be eligible to appear at it, if,

(i) He / She satisfied the conditions in the table and the provisions thereunder.

(ii) He / She has prosecuted a regular course of study in the university / college affiliated to the university.

(iii) He / She has in the opinion of the Head of the Department / Principal shown satisfactory progress in his / her study.

7. Without prejudice to the provisions of Ordinance No.6 relating to the Examinations in General, the provisions of Paragraphs 8, 10, and 31 of the said Ordinance shall apply to every collegiate candidate.

8. The fee for each Semester Examination shall be as prescribed by the University time to time.

Provided that a non-collegiate candidate, other than an ex-student shall also pay a registration fee as prescribed by the University time to time.

9. Every candidate for admission to the examination shall offer one of the following subjects for his examination, namely-

   (1) Mathematics,
   (2) Physics,
   (3) Chemistry,
   (4) Botany,
   (5) Zoology,
   (6) Geology,
   (7) Statistics,
   (8) Biochemistry,
   (9) Microbiology,
   (10) Electronics (Instrumentation),
   (11) Geography,
   (12) Geoinformatics,
   (13) Remote Sensing & GIS,
   (14) Environmental Science, and
   (15) Bioinformatics.
Provided firstly, that an examinee who has passed Part-II Examination in one of the subjects listed above from 1 to 15 and is desirous of appearing.

(a) in any other subject, or
(b) in a new paper or a combination of papers in the subject in which he has passed, may, without prosecuting a regular course of study present himself in any subsequent academic year for Part-I of the Examination in that other subject or that new paper or new combination of papers, and after not less than one academic year after passing the said Part-I Examination, for Part-II Examination in the said new paper or the said new combination of papers.

Provided secondly, that a candidate eligible for appearing at an examination under the first proviso shall, in the subject or a new paper or the new combination of papers which he is offering for the examination, attend the full course of practical Training, wherever such training is prescribed in the University Department or a College or a recognised Institution imparting instruction upon the standard of the Examination.

Provided thirdly, that an examination successful under clause (b) of the first proviso shall not be awarded division nor shall he be eligible for any scholarship, medal or prize of the University.

10. An examinee at the M.Sc. Part-I or the M.Sc. Part-II Examination shall have the option of not being declared successful at the examination in case he does not secure a minimum of Second Division marks /Higher Second Division marks fifty five percent marks (55%) at the Examination. The option will have to be exercised everytime an application is submitted to any of the three examinations and shall be on the proforma printed on the application form itself. Once exercised the option shall be binding upon the examinee, and shall not be revoked under any circumstances.

11. Any person who has obtained a Third Division at the M.Sc. Examination of this University shall be eligible to take the examination again under this Ordinance in the same subject or group of subjects as the case may be for improving his division. In such a case the provisions of Ordinance No.138 relating to Improvement of Division shall apply.

12. The scope of the subject shall be as indicated in the syllabus.
   (2) The medium of instruction and examination shall be English.

13. The number of papers and marks allotted to each subject and the minimum marks which an examinee must obtain in order to pass the examination shall be as indicated in Appendix.

14. Examinees who are successful in the M.Sc. Semester-I, II, III & IV Examination and have obtained not less than 60% marks in the aggregate of the M.Sc. Semester-I, II, III & IV Examinations taken together shall be placed in the First Division, those obtained less than 60% but not less than 55% marks, in the Higher Second Division, those obtained less than 55% but not less than 48% marks, in the Second Division, and all other successful examinees, in the Third Division.

15. Provision of Ordinance No. 18 of 2001 relating to the an Ordinance to provide grace marks for passing in a Head of passing and improvement of division (higher class) and getting distinction in the subject and Condonation of Deficiency of Marks in a subject in all the faculty prescribed by the Statute No.18, Ordinance, 2001, shall apply to the examinations under this ordinance.

16. As soon as possible after the examination, but not later than 30th, June next following, the Management Council shall publish a list of successful examinees arranged in Three Divisions. The names of examinees passing the examination as a whole in the minimum prescribed period and obtaining the prescribed number of places in each subject in the First or Second Division, shall be arranged in Order of Merit as provided in the Examinations in General Ordinance No.6.

17. Save as provided in Paragraph 11 of this ordinance, no person shall be admitted to an examination under this ordinance, if he has already passed the same examination of this University or an equivalent examination in M.Sc. Part-I (Semester-I & II), and M.Sc. Part-II (Semester-III & IV) of any other Statutory University.

18. Examinees successful at the M.Sc. Part-I (Semester-I & II), and M.Sc. Part-II (Semester-III & IV) shall on payment of the prescribed fees, be entitled for the award of the respective Degree in the prescribed form, signed by the Vice-Chancellor.

*****

(Note :- "P.G. Workload in the faculty shall be as per Ordinance No.131.")
APPENDIX-A
SCHEME OF EXAMINATION FOR M.Sc. PART-I & II.
(For All Subjects)

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<td>50 Marks</td>
<td>Internal Assessment</td>
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<td>Paper-XVIII</td>
<td>50 Marks</td>
<td>Internal Assessment</td>
<td>10 Marks</td>
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Notes:

1. Minimum pass marks for theory and practical examination including internal assessment shall be 36% separately.

2. (a) Topic of project work shall be given by concerned supervisor with prior approval of Head of Department.

   There shall be no duplication of the topic of the project work. Project work shall be based on research in the laboratory and / or field work. Project work shall be allotted at the beginning of third semester and the student shall have to submit it at least 15 days before commencement of practical examination of the fourth semester. Project work will be evaluated by external and internal examiners.

   (b) There should be at least 2 to 3 external examiner for a batch of 10 students or 3 to 5 external examiner for a batch more than 10 students.

3. There shall be separate exemption in theory and/or practical on getting minimum pass marks.

4. Internal Assessment marks for all semesters shall be granted on the basis of - performance of students in any of the following activities:-
   (i) Study tour, (ii) Seminar, (iii) field visits, (iv) Industrial visits, (v) visit to research institute / organisation.
   (vi) Assignments, (vii) Unit test and any other co-curricular activities.

5. The concerned Department or College shall have to maintain the record of award of internal assessment marks.

*****
Now, therefore, I, Dr. Kamal Singh, Vice Chancellor of Sant Gadge Baba Amravati University, in exercise of powers conferred upon me under subsection (8) of section 14 of the Maharashtra Universities Act, 1994, do hereby direct as under:

1. This Direction may be called "Examinations leading to the Degree of विद्यांत परम्परा (Master of Science) (Four Semester Degree Course), Direction, 2009.

2. This direction shall come into force from the date of its issuance.

3. Eligibility criteria for admission to M.Sc. Computer Software shall be as given below.

   A person who has passed the Degree of Bachelor of Science with Computer Science/Vocational Computer Application Subjects
   OR

   A person who has passed the Degree of Bachelor of Science with Post Graduate Diploma in Computer Science of this University
   OR

   An Examination Recognised as an equivalent of this University or of any other statutory University.

4. The Scheme of Examination for M.Sc. Computer Software shall be as per Ordinance No.4 of 2008 as other Science subjects, as it is.

Amravati
Date : 29/6/2009
(Dr.Kamal Singh)
Vice-Chancellor

*****
Whereas, it is necessary to frame the Regulation regarding the Scheme for Choice Based Credit System (CBCS) and Awarding Grades to the Post Graduate Students in the Faculty of Science which is to be implemented from the Academic Session 2010-11 of M.Sc. Semester-I & onwards to all subjects in the faculty of Science and framing of Regulation for the above examination is likely to take some time.

AND

Whereas, the admission of students in the above pattern at M.Sc. Part-I (Semester-I) of all subjects in the faculty of Science are to be made in the Academic Session 2010-11.

Now, therefore, I, Dr. Kamal Singh, Vice Chancellor of Sant Gadge Baba Amravati University, in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act., 1994, do hereby direct as under:

1. This Direction may be called "Scheme for Choice Based Credit System (CBCS) and Awarding Grades to the Post Graduate Students in the Faculty of Science, Direction, 2010.

2. This Direction shall come into force with effect from the examination as shown below for all subjects for the Examinations leading to the Degree of Master of Science in the faculty of Science-
   (i) Winter 2010 examination for M.Sc. Part-I, Semester-I,
   (ii) Summer-2011 examination for M.Sc. Part-I, Semester-II,
   (iii) Winter-2011 examination for M.Sc. Part-II, Semester-III,
   (iv) Summer-2012 examination for M.Sc. Part-II, Semester-IV.

3. The detailed Scheme for Choice Based Credit System (CBCS) and Awarding Grades to the Post Graduate students in the Faculty of Science is as given below-

I. The CBCS System

   All Programmes (named after the Core subject) mentioned in para 9 of Ordinance No.4 of 2008 shall be run on Choice Based Credit System (CBCS) and the grades in 7 point scale will be awarded to the students. It is an instructional package developed to suit the needs of students to keep pace with the developments in higher education and the quality assurance expected of it in the light of liberalization and globalization in higher education.

II. Credits and Degrees

   i) A candidate who has successfully completed all the core courses Compulsory, Elective/ Specialised courses and project prescribed and optional approved by the University for the programme and accumulated not less than 72 (52 core and elective) Credits and who has put in the minimum residence time shall be eligible to receive the degree.

   ii) One Credit shall mean one teaching period per week for one semester (of 16 weeks) for theory courses and one laboratory session of two periods / week for one semester. One teaching period shall be of 60 minutes duration including 10 minutes for discussion / movement.

III. Courses

   i) Core Course :- A core course is a course that a student admitted to a particular programme must successfully complete to receive the degree. There may be two kinds of core courses: The hard-core courses which cannot be substituted by any other course and which must be successfully completed and soft-core courses which may be substituted by equivalent courses from the same department. In all P.G. programmes a project with 03 credits shall be included. The project may include a viva-voce examination with a credit of 1. Normally no theory course shall have more than 4 credits.

   ii) Elective Course : Means a optional course from the basic subject or specialization.

      The core credits for any P.G. programme (inclusive of hard-core, soft-core and project) shall not exceed 60 credits and shall not be less than 48 credits. Each Board of Studies shall specify the core-credit load for their respective programme apart from approving syllabi for all the courses offered by the department.

   iii) General Interest Course (GIC)

      The General Interest Course shall be the choice of student. The student who choose the GIC shall have to register for it on payment of fees as prescribed by the University.

      The Departmental Committee shall follow a selection procedure on a first come first served basis, fixing the maximum number of students, after counselling to the students etc. to avoid overcrowding to particular course(s) at the expense of some other courses.

   iv) Each Course is designed such that it includes lectures / tutorials / laboratory or field work / Seminar / Practical training / Assignments / Term paper / Report writing or review of literature and any other innovative practice etc., to meet effective teaching and learning needs.
(v) **Attendance** :- Students must have 75% of attendance in each Core and Elective course for appearing the examination. However, student having attendance less than 75% may apply to the H.O.D. for condonation of attendance up to 15% under the provision of para 6-A (i) of Ordinance No.6.

**IV. Registration for General Interest Course :-**

i) Each student, on admission shall be assigned to a faculty advisor who shall advise the student about the academic programme and counsel him on the choice of courses listed in Appendix-Q depending on his general interest, academic background and objective.

ii) With the advice and consent of the faculty advisor the student shall register for courses he plans to take for the semester before classes start. No student shall be permitted to register for courses exceeding 30 credits per semester including those of repeat courses nor shall any student be permitted to register for any course without satisfactorily completing the prerequisites for the course except with the permission of the concerned teacher in the prescribed format.

iii) If the student feels he has registered for more courses than he can handle, he shall have the option of dropping one or more of the courses he has registered for, with the consent of his advisor before the end of 3rd week of the semester. However, a student, to retain his status, should have registered at least for core course and elective course of that semester.

iv) Students, other than those freshly admitted, shall register for the courses of their choice in the preceding semester by filling in the prescribed forms.

v) The University shall prescribe the maximum number of students in each General Interest Course taking into account the teachers and physical facilities available in the Department.

vi) The University may make available to all students a listing of all the courses offered in every semester specifying the credits, the prerequisites, a brief description or list of topics the course intends to cover, the instructor who is giving the courses, the time and place of the classes for the course. This information shall be made available on the University website.

vii) Normally no course shall be offered unless a minimum of 10 students are registered.

viii) The student shall have to pay the prescribed fee per course for the registration.

**V. Programme Committee :-**

There shall be the programme committee at the University level constituted as under-

i) Dean of the faculty (Chairman)

ii) Heads of all the Departments (Member)

iii) Three teachers from the affiliated colleges having post graduate courses other than University Department nominated by the Vice-Chancellor. (Member)

iv) Deputy Registrar (Acad) (Secretary)

**Duties and responsibilities of the Programme Committee shall be as under:-**

i) To identify the General Interest Courses (GIC) as per the need of the student and availability of teachers in the Departments.

ii) To approve the time table of GIC and make it available to the students before the commencement of respective semester. This time table also be made available on the University website.

iii) To consider and approve the report of grievance redressal committee.

iv) To remove the difficulties if any faced during implementation of the CBCS and report it to Hon'ble Vice-Chancellor for further action.

v) Any other matter as it think fit for the effective implementation of CBCS.

**VI. Departmental Committee**

1. Every P.G. programme of the University/College shall be monitored by a committee constituted for this purpose by the Department.

   The Committee shall consist of H.O.D. as a Chairman and all the teachers of the Deptt. of its members including one student members per class. There shall be at least one student member on the committee.

**VII. Grievances Redressal Committee**

The University or College shall form a Grievance Redressal Committee for each course in each department with the Course Teacher and the HOD. This Committee shall solve all grievances relating to the Internal Assessment marks of the students.
VIII. Total credits per semester :-

Table-I
For all subjects other than Mathematics, Biotechnology & Computer Science

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sem-I</td>
<td>Sem-II</td>
</tr>
<tr>
<td>Core</td>
<td>12</td>
<td>12</td>
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<tr>
<td>Elective</td>
<td>04</td>
<td>04</td>
</tr>
<tr>
<td>GIC</td>
<td>00</td>
<td>04</td>
</tr>
<tr>
<td>Lab. Course</td>
<td>06</td>
<td>06</td>
</tr>
<tr>
<td>I.A.</td>
<td>04</td>
<td>04</td>
</tr>
<tr>
<td>Project</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>26 or 30</td>
</tr>
</tbody>
</table>

Table-II
For Mathematics

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sem-I</td>
<td>Sem-II</td>
</tr>
<tr>
<td>Core courses</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Elective Courses</td>
<td>08</td>
<td>08</td>
</tr>
<tr>
<td>GIC</td>
<td>δ</td>
<td>04</td>
</tr>
<tr>
<td>Internal Assessment</td>
<td>05</td>
<td>05</td>
</tr>
<tr>
<td>Project</td>
<td>δ</td>
<td>δ</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>25 or 29</td>
</tr>
</tbody>
</table>

Table-III
For Biotechnology

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sem-I</td>
<td>Sem-II</td>
</tr>
<tr>
<td>Core courses</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>Elective Courses</td>
<td>δ</td>
<td>9</td>
</tr>
<tr>
<td>Lab courses</td>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td>Seminar</td>
<td>δ</td>
<td>01</td>
</tr>
<tr>
<td>Project</td>
<td></td>
<td>06</td>
</tr>
<tr>
<td>Assignment</td>
<td></td>
<td>02</td>
</tr>
<tr>
<td>Internal Assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

IX. Grade Awards :-

(i) A seven point rating scale is used for the evaluation of the performance of the student to provide letter grade for each course and overall grade for the Master’s Programme. Grade points are based on the total number of marks obtained by him/her in all the heads of examination of the course. These grade points and their equivalent range of marks are shown separately in Table-I. The performance of the student in theory, practical, internal assessment, subjects shall be evaluated in accordance with following Table-I.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Range of Marks obtained out of 100 or Equivalent fraction</th>
<th>Grade Points</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>90-100</td>
<td>10</td>
<td>Outstanding</td>
</tr>
<tr>
<td>A+</td>
<td>80-89</td>
<td>9</td>
<td>Excellent</td>
</tr>
<tr>
<td>A</td>
<td>70-79</td>
<td>8</td>
<td>Very Good</td>
</tr>
<tr>
<td>B+</td>
<td>60-69</td>
<td>7</td>
<td>Good</td>
</tr>
<tr>
<td>B</td>
<td>55-59</td>
<td>6</td>
<td>Fair</td>
</tr>
<tr>
<td>C+</td>
<td>50-54</td>
<td>5</td>
<td>Average</td>
</tr>
<tr>
<td>C</td>
<td>40-49</td>
<td>4</td>
<td>Below Average</td>
</tr>
<tr>
<td>F</td>
<td>Below 40</td>
<td>0</td>
<td>Fail</td>
</tr>
</tbody>
</table>
X. Computation of SGPA & CGPA

Every student will be awarded points out of maximum 10 points in each subject. (based on 7 Points Scale). Based on the Grade points obtained in each subject the Semester Grade Point Average (SGPA) and then Cumulative Grade Point Average (CGPA) are computed. The computation of SGPA & CGPA, is as under:

Semester Grade Point Average (SGPA) is the weighted average of points obtained by a student in a semester and is computed as follows:

$$SGPA = \frac{U_1 \times M_1 + U_2 \times M_2 + \ldots + U_n \times M_n}{U_1 + U_2 + \ldots + U_n}$$

Where $U_1, U_2, \ldots$ are subject credit of the respective course and $M_1, M_2, \ldots$ are the Grade Points obtained in the respective subject (out of 10)

The Semester Grade Point Average (SGPA) for all the four semesters is also mentioned at the end of every semester.

The Cumulative Grade Point Average (CGPA) is used to describe the overall performance of a student in the course and is computed as under:

$$CGPA = \frac{\sum_{n=1}^{4} SGPA(n) \times C_n}{\sum_{n=1}^{4} C_n}$$

Where $SGPA(n)$ is the nth Semester SGPA of the student and $C_n$ is the nth Semester total credit. The SGPA and CGPA are rounded off to the second place of decimal.

XI. Internal Evaluation Method :-

(i) At the beginning of each course, every teacher shall inform his/her students unambiguously the method he/she proposes to adopt for the continuous assessment. Normally the teacher concerned may conduct three written sessional examinations spread periodically during the semester and select best two for contributing to the final marks.

(ii) At the end of each semester the Departmental Committee shall assign grades to the students.

(iii) The Departmental Committee shall prepare the copies of the result sheet in duplicate.
Every student shall have the right to scrutinize answer scripts of sessional/end-semester examinations and seek clarifications from the teacher regarding evaluation of the scripts immediately thereafter or within 3 days of receiving the evaluated scripts.

The Department shall display the grade points and grades for the notice of students.

The department shall send all records of evaluation, including sessional evaluation, for safekeeping to the Controller of Examinations as soon as all the formalities are over.

XII. Grade Card

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

The grade card shall list:
(a) the title of the courses along with code taken by the student
(b) the credits associated with the course,
(c) the grade and grade points secured by the student,
(d) the total credits earned by the student in that semester.
(e) the SGPA of the student,
(f) the total credits earned by the students till that semester and
(g) the CGPA of the student (At the end of the IVth Semester)

XIII. At the end of the IVth semester, the University shall issue the statement of marks to the Students showing details of marks obtained by the student in each Head in each semester along with grade total marks.

XIV. Power to modify and remove difficulties :-

1. Not withstanding anything contained in the foregoing, Hon’ble V.C. in consultation with the Dean of the faculty shall have the power to issue directions or orders to remove any difficulty.

2. Nothing in the foregoing may be construed as limiting the power of the University to amend, modify or repeal any all of the above.

sd/-

Amravati (Dr. Kamal Singh)

Date: 2/6/2010

Vice-Chancellor
## Appendix-C

Examination Scheme under C.B.C.S. for the subject other than Mathematics, Biotechnology and Computer Science in the faculty of Science

**M.Sc. Part-II**  
**Semester-III**

SA-Subject abbreviation; C-Core; E-Elective; GIC-General Interest Course

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Paper / Code</th>
<th>Course</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Code</td>
<td>Max. Marks (Credits)</td>
<td>Min. Pass Marks (Min. Grade Pt.)</td>
<td>Int. (Credits)</td>
</tr>
<tr>
<td>1</td>
<td>2SA-1 C</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
</tr>
<tr>
<td>2</td>
<td>2SA-2 C</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
</tr>
<tr>
<td>3</td>
<td>2SA-3 C</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
</tr>
<tr>
<td>4</td>
<td>2SA-4 E or</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
</tr>
<tr>
<td></td>
<td>2GIC-X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2SA-5 Lab-III</td>
<td>δ</td>
<td>δ</td>
<td>δ</td>
</tr>
<tr>
<td>6</td>
<td>2SA-6 Lab-IV</td>
<td>δ</td>
<td>δ</td>
<td>δ</td>
</tr>
</tbody>
</table>

Total Marks : 600; Minimum Total Credits : 26

**Note:**
1. If the student has scored minimum marks or minimum grade points mentioned in Column No.8 out of the sum of total marks of theory and internal assessment taken together then he/she will be declared to have cleared with (04+01) 05 credits.
2. If the student has scored minimum marks or minimum grade points in either theory or in internal assessment then he/she will be declared to have cleared in that particular head.

## Appendix-B

Examination Scheme under C.B.C.S. for the subject other than Mathematics, Biotechnology and Computer Science in the faculty of Science

**M.Sc. Part-I**  
**Semester-II**

SA-Subject abbreviation; C-Core; E-Elective; GIC-General Interest Course

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Paper / Code</th>
<th>Course</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Code</td>
<td>Max. Marks (Credits)</td>
<td>Min. Pass Marks (Min. Grade Pt.)</td>
<td>Int. (Credits)</td>
</tr>
<tr>
<td>1</td>
<td>2SA-1 C</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
</tr>
<tr>
<td>2</td>
<td>2SA-2 C</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
</tr>
<tr>
<td>3</td>
<td>2SA-3 C</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
</tr>
<tr>
<td>4</td>
<td>2SA-4 E or</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
</tr>
<tr>
<td></td>
<td>2GIC-X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2SA-5 Lab-III</td>
<td>δ</td>
<td>δ</td>
<td>δ</td>
</tr>
<tr>
<td>6</td>
<td>2SA-6 Lab-IV</td>
<td>δ</td>
<td>δ</td>
<td>δ</td>
</tr>
</tbody>
</table>

Total Marks : 600; Minimum Total Credits : 26

**Note:**
1. If the student has scored minimum marks or minimum grade points mentioned in Column No.8 out of the sum of total marks of theory and internal assessment taken together then he/she will be declared to have cleared with (04+01) 05 credits.
2. If the student has scored minimum marks or minimum grade points in either theory or in internal assessment then he/she will be declared to have cleared in that particular head.
Appendix-D

Examination Scheme under C.B.C.S. for the subject other than Mathematics, Biotechnology and Computer Science in the faculty of Science

M.Sc. Part-II
Semester-IV

SA-Subject abbreviation;  C-Core;  E-Elective;  GIC-General Interest Course

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Paper / Code</th>
<th>Course</th>
<th>Max. Marks (Credits)</th>
<th>Min Pass Marks (Min. Grade Pt.)</th>
<th>Int. Ass. (Credits)</th>
<th>Min. Pass Marks (Min. Grade Pt.)</th>
<th>Th + Int. Ass. Min Pass Mar (Grade Pt.)</th>
<th>Max. Marks (Credit)</th>
<th>Min. Marks marks (Min. Grade Point)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4SA-1</td>
<td>C</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
<td>08 (04)</td>
<td>40 (04)</td>
<td>80</td>
<td>40</td>
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<td>4SA-2</td>
<td>C</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
<td>08 (04)</td>
<td>40 (04)</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>4SA-3</td>
<td>C</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
<td>08 (04)</td>
<td>40 (04)</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>4SA-4</td>
<td>E</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
<td>08 (04)</td>
<td>40 (04)</td>
<td>400</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Or 4GIC-Z</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>4SA-5</td>
<td>Lab-V</td>
<td>δ</td>
<td>δ</td>
<td>δ</td>
<td>δ</td>
<td>δ</td>
<td>100</td>
<td>40 (04)</td>
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<tr>
<td>6</td>
<td>4SA-6</td>
<td>Project</td>
<td>δ</td>
<td>δ</td>
<td>δ</td>
<td>δ</td>
<td>δ</td>
<td>100</td>
<td>40 (04)</td>
</tr>
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</table>

Total Marks : 600;   Minimum Total Credits : 26

Note :- (1) If the student score Minimum Marks or Minimum Grade Points mentioned in Column No.8 out of the sum total marks of theory and internal assessment taken together then he/she will be declared to have clear (04+01) 05 credits.

(2) If the student has score minimum marks or minimum grade points in either theory or in internal assessment then he/she will be declared to have cleared in that Particular head.

Appendix-E

Examination Scheme under C.B.C.S. for the subject Mathematics in the faculty of Science

M.Sc. Part-I
Semester-I

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Paper / Code</th>
<th>Course</th>
<th>Max. Marks (Credits)</th>
<th>Min Pass Marks (Min. Grade Pt.)</th>
<th>Int. Ass. (Credits)</th>
<th>Min. Pass Marks (Min. Grade Pt.)</th>
<th>Th + Int. Ass. Min Pass Mar (Grade Pt.)</th>
<th>Max. Marks (Credit)</th>
<th>Min. Marks marks (Min. Grade Point)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1MTH-1</td>
<td>C</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
<td>08 (04)</td>
<td>40 (04)</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>1MTH-2</td>
<td>C</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
<td>08 (04)</td>
<td>40 (04)</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>1MTH-3</td>
<td>C</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
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<td>40 (04)</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>1MTH-4</td>
<td>E</td>
<td>80 (04)</td>
<td>32 (04)</td>
<td>20 (01)</td>
<td>08 (04)</td>
<td>40 (04)</td>
<td>400</td>
<td>100</td>
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<tr>
<td></td>
<td>Or 4GIC-Z</td>
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<tr>
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<td>1MTH-5</td>
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<td>08 (04)</td>
<td>40 (04)</td>
<td>80</td>
<td>40</td>
</tr>
</tbody>
</table>

Total Marks : 500;   Total Credits : 25

Note :- (1) If the student score Minimum Marks or Minimum Grade Points mentioned in Column No.8 out of the sum total marks of theory and internal assessment taken together then he/she will be declared to have clear (04+01) 05 credits.

(2) If the student score Minimum Marks or Minimum Grade Points in either theory or internal assessment then he/she will be declared to have clear either of the head.
# Appendix-G

## Examination Scheme under C.B.C.S. for the subject Mathematics in the faculty of Science

### M.Sc. Part-II

#### Semester-III

<table>
<thead>
<tr>
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<th>Paper / Code</th>
<th>Course</th>
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<th>Min. Pass Marks (Min. Grade Pt.)</th>
<th>Int. (Credits)</th>
<th>Min. Pass Marks (Min. Grade Pt.)</th>
<th>Th + Int. Ass. Min.Pass Mar (Grade Pt.)</th>
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Total Marks : 500; Total Credits : 25

**Note :-**

1. If the student score Minimum Marks or Minimum Grade Points mentioned in Column No.8 out of the sum total marks of theory and internal assessment taken together then he/she will be declared to have clear (04+01) 05 credits.

2. If the student score Minimum Marks or Minimum Grade Points in either theory or internal assessment then he/she will be declared to have clear either of the head.

## Appendix-F

### Examination Scheme under C.B.C.S. for the subject Mathematics in the faculty of Science

#### M.Sc. Part-I

#### Semester-II

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<th>Int. (Credits)</th>
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Total Marks : 500; Total Credits : 25

**Note :-**

1. If the student score Minimum Marks or Minimum Grade Points mentioned in Column No.8 out of the sum total marks of theory and internal assessment taken together then he/she will be declared to have clear (04+01) 05 credits.

2. If the student score Minimum Marks or Minimum Grade Points in either theory or internal assessment then he/she will be declared to have clear either of the head.
Appendix-H

Examination Scheme under C.B.C.S. for the subject
Mathematics in the faculty of Science

M.Sc. Part-I
Semester-IV

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Total Marks : 500; Min. Total Credits : 25

Note :-  
(1) If the student score Minimum Marks or Minimum Grade Points mentioned in Column No.8 out of the sum total marks of theory and internal assessment taken together then he/she will be declared to have clear (04+01) 05 credits.

(2) If the student score Minimum Marks or Minimum Grade Points in either theory or internal assessment then he/she will be declared to have clear either of the head.
### Appendix-I

**Scheme of Teaching and Examination under C.B.C.S. for the Subject Biotechnology**

**M.Sc. (Biotechnology) SEMESTER PATTERN**

**M Sc Part-I (Semester-I)**

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Total Credits: 40

### Appendix-J

**Scheme of Teaching and Examination under C.B.C.S. for the Subject Biotechnology**

**M.Sc. (Biotechnology) SEMESTER PATTERN**

**M Sc Part-I (Semester-II)**

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Total Credits: 40
### Scheme of Teaching and Examination under C.B.C.S. for the Subject Biotechnology

**M.Sc. (Biotechnology) SEMESTER PATTERN**

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**Total Credits:** 35

### Scheme of Teaching and Examination under C.B.C.S. for the Subject Biotechnology

**M.Sc. (Biotechnology) SEMESTER PATTERN**

**M.Sc. Part-II (SEMESTER-IV)**

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**Total Credits:** 35
### Scheme of Teaching and Examination under C.R.C.S. for the subject Computer Science

**M.Sc. (Computer) SEMESTER PATTERN**

**M.Sc. Part-I (SEMESTER-I)**

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| 1   | 1MCS-1       | I     | C      | 5        | -       | 3 Hrs | 100 | -    | 100 | 40 | 4.00 |
| 2   | 1MCS-2       | II    | C      | 5        | -       | 3 Hrs | 100 | -    | 100 | 40 | 4.00 |
| 3   | 1MCS-3       | III   | C      | 5        | -       | 3 Hrs | 100 | -    | 100 | 40 | 4.00 |
| 4   | 1MCS-4       | IV    | C      | 5        | -       | 3 Hrs | 100 | -    | 100 | 40 | 4.00 |
| 5   | 1MCS-5       | V     | C      | 5        | -       | 3 Hrs | 100 | -    | 100 | 40 | 4.00 |
| 6   | 1MCS-6       | Lab-I | -      | 7        | -       | -     | -   | -    | -   | -  | -    |
| 7   | 1MCS-7       | Lab-II| -      | 7        | -       | 0.3   | -   | -    | -   | -  | -    |
|     | Total        |       |        | 25       | 14      | 25    | 06  |       |       |     |       |

Total Credits: 40

### Scheme of Teaching and Examination under C.R.C.S. for the subject Computer Science

**M.Sc. (Computer) SEMESTER PATTERN**

**M.Sc. Part-I (SEMESTER-II)**

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| 1   | 2MCS-1       | VI    | C      | 5        | -       | 3 Hrs | 100 | -    | 100 | 40 | 4.00 |
| 2   | 2MCS-2       | VII   | C      | 5        | -       | 3 Hrs | 100 | -    | 100 | 40 | 4.00 |
| 3   | 2MCS-3       | VIII  | C      | 5        | -       | 3 Hrs | 100 | -    | 100 | 40 | 4.00 |
| 4   | 2MCS-4       | IX    | C      | 5        | -       | 3 Hrs | 100 | -    | 100 | 40 | 4.00 |
| 5   | 2MCS-5       | X     | C or  | 5        | -       | 3 Hrs | 100 | -    | 100 | 40 | 4.00 |
|     |              |       | GIC    |          |         |       |       |       |       |     |       |
| 6   | 2MCS-6       | Lab-III| -     | 7        | -       | -     | -   | -    | -   | -  | -    |
| 7   | 2MCS-7       | Lab-IV| -     | 7        | -       | 0.3   | -   | -    | -   | -  | -    |
|     | Total        |       |        | 25       | 14      | 25    | 06  |       |       |     |       |

Total Credits: 40
### Scheme of Teaching and Examination under C.B.C.S. for the subject Computer Science

**Appendix-O**

1. **Lectures, P: Practical, TU: Tutorial/Assignment; G.I.C.: General Interest Course**

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**Total Credits: 35**

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### Scheme of Teaching and Examination under C.B.C.S. for the subject Computer Science

**Appendix-P**

1. **Lectures, P: Practical, TU: Tutorial/Assignment; G.I.C.: General Interest Course**

<table>
<thead>
<tr>
<th>S N</th>
<th>Subject Code</th>
<th>Paper</th>
<th>Course</th>
<th>Hrs/ Week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4MCS-1</td>
<td>XVI</td>
<td>C</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>4MCS-2</td>
<td>XVII</td>
<td>C</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>4MCS-3 Or 4GIC-Z</td>
<td>AVIII</td>
<td>E or GIC</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>4MCS-4</td>
<td>Lab-VII</td>
<td>-</td>
<td>7</td>
<td>03</td>
</tr>
<tr>
<td>5</td>
<td>4MCS-5</td>
<td>Project Seminar</td>
<td>-</td>
<td>7</td>
<td>03 11</td>
</tr>
<tr>
<td>6</td>
<td>4MCS 6</td>
<td>Internal Assessment</td>
<td>-</td>
<td>02</td>
<td>02 11</td>
</tr>
<tr>
<td>7</td>
<td>4MCS 7</td>
<td></td>
<td></td>
<td>06 14 15 11</td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits: 35**
### List of General Interest Courses (GIC) to be opted by the student/s in Semester-II

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Subject</th>
<th>Subject Code</th>
<th>Elective</th>
<th>Equivalent General Interest Course Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chemistry</td>
<td>2CHE3</td>
<td>3</td>
<td>2GIC-1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2CHE4</td>
<td></td>
<td>2GIC-2</td>
</tr>
<tr>
<td>2</td>
<td>Physics</td>
<td>2PHY3</td>
<td></td>
<td>2GIC3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2PHY4</td>
<td></td>
<td>2GIC4</td>
</tr>
<tr>
<td>3</td>
<td>Mathematics</td>
<td>2MTH4</td>
<td></td>
<td>2GIC5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2MTH5</td>
<td></td>
<td>2GIC6</td>
</tr>
<tr>
<td>4</td>
<td>Zoology</td>
<td>2ZOO3</td>
<td></td>
<td>2GIC7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2ZOO4</td>
<td></td>
<td>2GIC8</td>
</tr>
<tr>
<td>5</td>
<td>Botany</td>
<td>2BOT3</td>
<td></td>
<td>2GIC9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2BOT4</td>
<td></td>
<td>2GIC-A</td>
</tr>
<tr>
<td>6</td>
<td>Statistics</td>
<td>2SCA3</td>
<td></td>
<td>2GIC-B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2SCA4</td>
<td></td>
<td>2GIC-C</td>
</tr>
<tr>
<td>7</td>
<td>Biotechnology</td>
<td>2BTB3</td>
<td></td>
<td>2GIC-D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2BTB4</td>
<td></td>
<td>2GIC-E</td>
</tr>
<tr>
<td>8</td>
<td>Computer Science</td>
<td>2CMS3</td>
<td></td>
<td>2GIC-F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2CMS4</td>
<td></td>
<td>2GIC-G</td>
</tr>
<tr>
<td>9</td>
<td>Microbiology</td>
<td>2MCB3</td>
<td></td>
<td>2GIC-H</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2MCB4</td>
<td></td>
<td>2GIC-I</td>
</tr>
<tr>
<td>10</td>
<td>Electronics</td>
<td>2ELE3</td>
<td></td>
<td>2GIC-J</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2ELE4</td>
<td></td>
<td>2GIC-K</td>
</tr>
<tr>
<td>11</td>
<td>Biochemistry</td>
<td>2BMC3</td>
<td></td>
<td>2GIC-L</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2BMC4</td>
<td></td>
<td>2GIC-M</td>
</tr>
<tr>
<td>12</td>
<td>Geology</td>
<td>2GEO3</td>
<td></td>
<td>2GIC-N</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2GEO4</td>
<td></td>
<td>2GIC-O</td>
</tr>
<tr>
<td>13</td>
<td>Bioinformatics</td>
<td>2BIT3</td>
<td></td>
<td>2GIC-P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2BIT4</td>
<td></td>
<td>2GIC-Q</td>
</tr>
<tr>
<td>14</td>
<td>Environmental Science</td>
<td>2ENV3</td>
<td></td>
<td>2GIC-R</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2ENV4</td>
<td></td>
<td>2GIC-S</td>
</tr>
<tr>
<td>15</td>
<td>Geoinformatics</td>
<td>2GIT3</td>
<td></td>
<td>2GIC-U</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2GIT4</td>
<td></td>
<td>2GIC-V</td>
</tr>
<tr>
<td>16</td>
<td>Computer Software</td>
<td>2CSW3</td>
<td></td>
<td>2GIC-W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2CSW4</td>
<td></td>
<td>2GIC-1A</td>
</tr>
<tr>
<td>17</td>
<td>Remote Sensing and GIS</td>
<td>2RSG3</td>
<td></td>
<td>2GIC-1B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2RSG4</td>
<td></td>
<td>2GIC-1C</td>
</tr>
<tr>
<td>18</td>
<td>Pharmaceutical Chemistry</td>
<td>2PCH3</td>
<td></td>
<td>2GIC-1D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2PCH4</td>
<td></td>
<td>2GIC-1E</td>
</tr>
</tbody>
</table>

**Note:** Title of the paper shall prescribed in the respective prospectuses.
(a) for admission to M.Sc. Pharmaceutical Chemistry a candidate shall have offered Chemistry or Industrial Chemistry or Biochemistry as a subject of study and examination at the B.Sc. Degree.

(b) following shall be the eligibility for admission to M.Sc. Semester-I (Biotechnology) -
(i) B.Sc. in any discipline of Life Sciences, Bio Sciences or Bachelor of Degree in Agriculture, Veterinary and fishery Sciences, Pharmacy, or Bachelor of Medicine and Bachelor of Surgery (M.B.B.S.) or Bachelor of Dental Surgery or equivalent examination recognized by Sant Gadge Baba Amravati University are eligible to appear in entrance test as given in para (iii) below.  
(ii) The student should have minimum 50% marks as aggregate in the degree course.
(iii) The student will have to pass entrance examination for admission in M.Sc. Semester-I (Biotechnology) as per the Sant Gadge Baba Amravati University rules.

(c) following shall be the eligibility for admission to M.Sc. Semester-I (Computer Science) -

i. A person who has passed the Degree of Bachelor of Science of this university with Computer Science / Computer Application (Vocational) as on the subjects.

OR

ii. A person who has passed B.A. / B.Sc. with Mathematics plus Post Graduate Diploma in Computer Science of this University.

OR

iii. A person who has passed a Degree of Bachelor of Computer Science.

6. The following subject be inserted in para 9) of the Ordinance after Sr.No. 5. Bioinformatics
6. Computer Software,
17. Computer Science
18. Biotechnology, and

7. A person who desire to improve the division obtained by him/her at M.Sc. examination shall be eligible for improvement of division under the provision of Ordinance No.6 of 2008. However, for improvement of division he/she shall have to offer the core courses only. In no case he/she shall be allowed for improvement of division/grade/CGPA by offering General Interest Course.

8. The number of papers and marks allotted to each subject and the minimum marks which an examinee must obtained in order to pass the examination shall be as indicated in Appendices, appended with the Regulation.

9. The classification in reference to the class/division/grade to be awarded to the examinee shall be as per the Table-III (Equivalence to Class / Division to CGPA) of para No.IX, appended to the Regulation.

10. As soon as possible after the examination, but not later than 30th June following, the B.O.E. shall publish a list of successful examinees arranged in Division as mentioned in Table-III (Equivalence to Class / Division to CGPA) of para No.IX, appended to the Regulation. The names of examinees passing the examination as a whole in the minimum prescribed period and obtaining the prescribed number of places in each subject in the division as per Table-III of the Regulation shall be arranged in order of merit as provided in the Examinations in General Ordinance No.6.

Sd/-

Amravati

Date : 21/6/2010

Vice-Chancellor

*****
DIRECTION


Subject : Corrigendum to Direction No. 26/2010

Whereas, the Direction No.26 of 2010 in respect of Scheme of Choice Based Credit System (CBCS) and awarding Grades to the Post Graduate students in the faculty of Science is in existence.

AND

Whereas, the Academic Council in its emergent meeting held on 28.5.2010 vide item No.36 has approved the decision regarding introduction of scheme for C.B.C.S. and Awarding grades to the P.G. students in the faculty of Science under Ordinance No.4 of 2008.

AND

Whereas, in sub-para V of para 3, under Direction No.26 of 2010, there shall be Programme Committee and the duties of the Programme Committee shall be to remove the difficulties if any faced during implementation of C.B.C.S. and report it to Hon'ble Vice-Chancellor for further action and any other matter as it think fit for the effective implementation of C.B.C.S.

AND

Whereas, the Programme Committee in its meetings held on 14.7.2011, 20.7.2011, 30.7.2011 & 9.8.2011 has recommended necessary corrections in the above Direction which will be effective from the academic session 2011-12. The minutes of the Programme Committee was accepted by Hon'ble Vice-Chancellor on dated 22.8.2011.

AND

Whereas, it is necessary to carry out the corrections in the above said Direction immediately.

Now, therefore, I, Dr. Mohan K. Khedkar, Vice Chancellor of Sant Gadge Baba Amravati University, in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act., 1994, do hereby direct as under:

1. This Direction may be called "Corrigendum to Direction No.26/2010.
2. This direction shall come into force from the date of its issuance.
3. (A) In Direction No.26/2010 in respect of Scheme of Choice Based Credit System (CBCS) and awarding Grades to the Post Graduate students in the faculty of Science following paras be corrected as follows:
   i) In para I, sub para (i) of para 3 in the fifth line after the words "less than" the figure, sign, and words "2 (52 core and elective) be substituted by the figures, sign, and words "8(64 core and elective)"
   ii) In para VI: the title "Departmental Committee" be replaced as "Programme Monitoring" and Para 1 be completely deleted. Instead of this, the new para should be Every P.G. programme of the University/College shall be monitored by the Head of the Department of the University/College of the concerned subject.
   iii) The para VII shall be substituted as given below -
      VII. Grievance Redressal
      All the grievances regarding Internal Assessment shall be settled by H.O.D. or the teacher of the department nominated by H.O.D. / Principal.
   iv) In para IX: Table I: the grades in column No.2 shall be substituted as under -
      O by AA
      A by AB
      B by BB
      B by BC
      B by CC
      C by CD
      C by DD
   v) In para X:
      i) In the first line the word "Grade" be added after the word "awarded" and before the word "points"
      ii) In third line the words "obtained in each subject" be substituted by the words "obtained in Core and Elective courses of the subject"
   vi) In para XI:
      • In sub para (i) in the first line the word "Head of the Department" be inserted after the words & sign "each course," and before the words "every teacher"
      • The sentence "Normally the teacher concerned may conduct three written sessional examinations spread periodically during the semester and select best two for contributing to the final marks shall be deleted.
      • Sub para (ii) & (iii) be deleted completely.
Sub para (iv) be renumbered as sub para (ii) and the word "teacher" in the second line of the original sub para (iv) be substituted by the words "Head of Departments".

Sub para (v) be renumbered as sub para (iii). In original sub para (v) the words "grade points and grades" be deleted.

Sub para (vi) be deleted completely.

vii) The word "Minimum" printed below the table in Appendix A, B, C, D, G, and H, shall be deleted.

viii) Following special explanatory Note be added below the table in Appendix-D, H, L, and P respectively.

(Special Explanatory Note) - At the end of IVth semester, the students/examinee who accumulated at least 88 credits (out of these 88 credits, 64 credits must be on core and elective course) and who has put in the minimum residence time shall be eligible to receive the degree in the subject he/she has admitted.

(B) The students should have accumulated 28 credits of M.Sc. Part-I, Sem-I & II taken together for admission to III Semester and should have completed the term of M.Sc. Part-I (Semester-I & II) satisfactorily.

Sd/-

Amravati

(Mohan K. Khedkar)

Date : 22/8/2011

Vice-Chancellor
3. In Direction No.26/2010 in respect of Scheme of Choice Based System (CBCS) and awarding Grades to the Post Graduate Students in the faculty of Science, following corrections shall be carried out-

A) i) In para 5th, the words and brackets "Degree of विज्ञान स्नातक (Bachelor of Science)" shall be substituted as "Degree of विज्ञान पारंपरिक (Master of Science)"

ii) The clause (i), of sub-para (II) of para 3 shall be deleted.

iii) The clause (i), of sub-para (II) of para 3 shall be renumbered as para (i) and new para (ii) shall be added as follows.

Minimum total credits that students shall have to accumulate in all four semesters for receiving the M.Sc. degree core subject shall be as shown in the table given as under:

<table>
<thead>
<tr>
<th>Subject/s</th>
<th>Minimum total credits (Core Elective and GIC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All subjects other than Mathematics, Computer Science &amp; Biotechnology</td>
<td>104</td>
</tr>
<tr>
<td>Computer Science</td>
<td>119</td>
</tr>
<tr>
<td>Biotechnology</td>
<td>150</td>
</tr>
<tr>
<td>Mathematics</td>
<td>100</td>
</tr>
</tbody>
</table>

B) i) Under Table-III (Equivalence of Class/Division of CGPA) of Para IX.

(a) the figures shown "9.49\(\) 9.99\(\) and 9.49\(\) against Sr.Nos.3, 4 & 5 in Column No.2 (CGPA) be substituted by the figures "9.50\(\) 6.00\(\) and 9.50\(\) respectively.

(b) Following sub-para be added before the para "Maximum total credits that students shall have to accumulate in all four semesters for receiving the M.Sc. degree core subject shall be as shown in the table given as under:

ii) Special Explanatory note shown under Appendix-D, H, I, L and P shall be deleted.

The note No.(2) printed under Appendix-A, B, C, D, E, F & H shall be substituted as follows-

The student has not scored minimum marks or minimum grade points mentioned in column No. 8 and if the student scores minimum marks or minimum grade points in either theory or internal assessment then he/she will be declared to have cleared either of the head.

4. In Direction No.39 of 2011, under para IX), in Table-I & II, under column No.2, i.e. "Grade Points" and "Final Grade" shall be substituted respectively as under.

<table>
<thead>
<tr>
<th>Grade</th>
<th>by</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>AB</td>
</tr>
<tr>
<td>A+</td>
<td>AB</td>
</tr>
<tr>
<td>A</td>
<td>BB</td>
</tr>
<tr>
<td>B</td>
<td>BC</td>
</tr>
<tr>
<td>B+</td>
<td>BC</td>
</tr>
<tr>
<td>B</td>
<td>CC</td>
</tr>
<tr>
<td>C</td>
<td>CD</td>
</tr>
<tr>
<td>C+</td>
<td>DD</td>
</tr>
</tbody>
</table>

5. As the revised syllabi has been accepted by the Academic Council, for the subject Computer Science of four theory papers to each semester therefore the Scheme of Examination for M.Sc. Semester-I to IV shall be as per Appendices-A, B, C & D appended to Direction No.26 of 2010, which is to be implemented for Semester-I from Winter-2012, Semester-II from Summer-2013, Semester-III from Winter-2013 & Semester-IV from Summer-2014 respectively.

6. The students passing B.Sc. Agriculture with specialization Antomology and Fisheries shall be eligible for admission to M.Sc. Zoology with specialization Antomology and Fisheries respectively.

7. The student having Degree of M.Sc. (Computer Software) shall be eligible for directly admission to M.Sc. Part II (Semester III) (Computer Science) in the faculty of science within the jurisdiction of sant Gadge Baba Amravati University, Amravati. The average percentage of Marks of M.Sc. (Computer software) and percentage of marks of M.Sc. (Computer Science) shall be considered to award class / Grade for awarding the degree of M.Sc. (Computer Science).

Sd/-
Amravati
(Mohan K.Khedkar)
Date : 28/6/2012
Vice-Chancellor
SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI
DIRECTION
No. : 7 of 2014 Date: 07/05/2014

Subject : Corrigendum to Direction No.25 of 2012

Whereas, Direction No.25 of 2012 in respect of Corrigendum to Direction No.26/2010 and 39/2011 in the Faculty of Science is in existence in the University.

AND

Whereas, the Academic Council in its meeting held on 17.2.2014 vide item No.22 2) E) R-2 while considering the recommendations of Faculty of Science has approved the recommendation regarding award of M.Sc. (Computer Science) degree.

AND

Whereas, the matter is required to be regulated by framing the Ordinance and making of an Ordinance may likely to take some time.

AND

Whereas, the changes are to be made applicable from the Academic Session 2014-15.

Now, therefore, I, Dr.J.A.Tidke, Vice-Chancellor of Sant Gadge Baba Amravati University, Amravati in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act, 1994, do hereby direct as under:

1) This Direction may be called, “Corrigendum to Direction No.25 of 2012, Direction, 2014”

2) This Direction shall come into force w.e.f. the date of its issuance.

Sd/-
(Dr.J.A.Tidke)
Vice-Chancellor
Sant Gadge Baba Amravati University

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI
DIRECTION
No. : 8 of 2014 Date: 07/05/2014

Subject : Corrigendum to Direction No. 14 of 2009 in respect of Examinations leading to the Degree of बिज्ञान पारंपरिक (Master of Science) (Four Semester Degree Course).

Whereas, Ordinance No.4/2008 in respect of Examinations leading to the Degree of बिज्ञान पारंपरिक (Master of Science) (Four Semester Degree Course), Ordinance, 2008, in the Faculty of Science is in existence in the University.

AND

Whereas, Direction No. 14 of 2009 in respect of Examinations leading to the Degree of बिज्ञान पारंपरिक (Master of Science) (Four Semester Degree Course) in the Faculty of Science is in existence in the University.

AND

Whereas, the Academic Council in its meeting held on 17.2.2014 vide item No.22 2) E) R-1 while considering the recommendations of Faculty of Science has approved the B.C.A. degree holders of this University are eligible for admission to M.Sc. (Computer Software) course.

AND

Whereas, the matter is required to be regulated by framing the Ordinance and making of an Ordinance may likely to take some time.

AND

Whereas, the changes are to be made applicable from the Academic Session 2014-15.

Now, therefore, I, Dr.J.A.Tidke, Vice-Chancellor of Sant Gadge Baba Amravati University, Amravati in exercise of powers conferred upon me under sub-section (8) of section 14 of the Maharashtra Universities Act, 1994, do hereby direct as under:

1) This Direction may be called, “Corrigendum to Direction No. 14 of 2009 in respect of Examinations leading to the Degree of बिज्ञान पारंपरिक (Master of Science) (Four Semester Degree Course) Direction 2014.6”

2) This Direction shall come into force w.e.f. the date of its issuance.
3) In Direction No. 14 of 2009 in respect of Examinations leading to the Degree of Master of Science (Four Semester Degree Course), in para 3., after the lines “A person who has passed the Degree of Bachelor of Science with Post Graduate Diploma in Computer Science of this University OR following lines be inserted

The Candidates having B.C.A. degree of this University shall be eligible to take admission to M.Sc. Part-I (Computer Software) course OR

Date: 3/5/2014

Sd/-
(Dr. J. A. Tidke)
Vice-Chancellor
Sant Gadge Baba Amravati University
SYLLABUS PRESCRIBED FOR M.Sc. PART-I BOTANY

SEMESTER – I

PAPER-I: CELL BIOLOGY, CYTOLOGY AND GENETICS

Unit-I 1.1 Cell wall and Plasma membrane: Structural organization and function.
1.2 Cell organelles: Golgi bodies, Lysosomes, Endoplasmic Reticulum and Ribosomes: Structural organization and their functions
1.3 Techniques in Cell Biology: Confocal microscopy, Phase Contrast microscopy, Flow Cytometry: Principle and working.

Unit-II 2.1 Cell Cycle and Apoptosis: Mechanism of Cell division; Regulation, Roles of Cyclins and Cyclin dependent kinases, Cell Plate formation, PCD.
2.2 Cell to cell Interaction and Signal transduction: Intercellular junctures, Hormones and neurotransmitter signalling, receptors, G-proteins, kinases and messengers.
2.3 Protein sorting: Targeting of proteins to nucleus, chloroplasts and secretory pathways of leader polypeptides.

Unit-III 3.1 Chromosome Organisation: Eukaryotic chromosome structure and DNA packaging, Nucleoproteins, Organisation of centromeres and telomeres, nucleolus and r-RNA Genes, Euchromatin and heterochromatin.
3.2 Specialised Chromosomes: Polytene, Lampbrush, B-Chromosomes, Sex Chromosomes.
3.3 Structural aberrations of Chromosomes: Origin, Meiosis and breeding behaviour of duplication, deficiency, inversions and translocation- Heterozygosity.

Unit-IV 4.1 Genetics of Mitochondria and Chloroplast: Semi autonomous, Genome character, size and regulation, cytoplasmic male sterility.
4.2 Mutations: Origin, Physical and Chemical mutagenic agents, Molecular basis and mutational breeding.
4.3 Transposable elements in Prokaryotes: IS elements, Composite transposons, transposition mechanisms and their effect on phenotype and genotype
4.4 Physiology of Cancer; Genetics of Cancer: C-Oncogenes, V-Oncogenes, Tumor Suppressor genes.

Unit-V 5.1 Genetic Code: Triplet nature of code, Breaking of code, Wobble Hypothesis, Properties, Evolution and Central dogma - transcription, types of RNAs, Initiation and termination signals, differences between eukaryotic and prokaryotic transcription (promoters, caps and tails, Introns, RNA editing).
5.2 Regulation of gene expression in Prokaryotes: Gene structure, Lac - operon, Trp- operon, Phage operon, transcriptional-control systems, translational control and post translational control.
5.3 Genetics of Nitrogen fixation: Organization, function and regulation of nitrogen fixing genes in klebsiella, hup genes.

Suggested Readings:


Laboratory Exercises:
1. Squash and smear preparation; materials: Tradescantia, Colix, Allium cepa, Allium sativum; Barley, Vicia faba, Wheat, Rhoeo discolor, Aloe vera or any other ideal material
2. Isolation of chloroplast.
3. Demonstration of SEM and TEM.
4. Linear Differentiation of chromosomes through banding techniques, such as C-banding, O-banding and Q-banding.
5. Orcein and Feulgen staining of the salivary gland chromosomes of Chironomous and Drosophila.
6. Characteristics and behaviour of B-chromosomes using maize or any other appropriate material.
7. Working out the effect of monosomy and trisomy on plant phenotype, fertility and meiotic behaviour.
8. Induction of polyploidy using colchicine; different methods of the application of colchicine.
9. Effect of induced and spontaneous polyploidy on plant phenotype, meiosis, pollen and seed fertility and fruit set.
10. Meiosis of complex translocation heterozygotes.
11. Isolation of chlorophyll mutants following irradiation and treatment with chemical mutagens.
12. Estimation of nuclear DNA content through microdensitometry and flow cytometry.
13. Isolation of mitochondria.
15. Determination of chiasma frequency in any plant species
16. Incompatibility studies in ideal plant material.
17. Problems on interaction of genes; linkage and crossing over.
18. Determination of mitotic index in any plant species.

PAPER-II: RESOURCE UTILIZATION AND CONSERVATION

UNIT I: 1.1 Concept of Biodiversity; Species diversity; Genetic diversity; Ecosystem diversity.
1.2 Origin of Biodiversity; values of Biodiversity; loss of Biodiversity.
1.3 Biodiversity and agriculture; Biodiversity and food diversity; Bioprospecting; commercial values of Biodiversity.
1.4 Conservation of Biodiversity; Implementation process in India CBD.

UNIT II: 2.1 World centers of primary diversity of domesticated plants; Indo Burmese centers.
2.2 Plant introduction and secondary centers.
2.3 Origin, evolution, botany, cultivation and uses of:
   i. Food, Forage and Fodder crops.
   ii. Fibre crops.
   iii. Medicinal and Aromatic plants.
   iv. Vegetable and Oil yielding plants.

UNIT III: 3.1 Important fire wood and timber yielding plants and non wood forest products (NWFPS) such as Bamboo, Rattam raw materials for paper making, gums, resins, tannins, dyes, fruits
3.2 Green revolution; Benefits and adverse consequences, sustainable agriculture, agroecosystem approach.
3.3 Innovative approaches for meeting world food demands; modern agrucultural approach.
3.4 Plants used as Avenue trees for shade, pollution control and aesthetics.

UNIT IV: 4.1 Strategies for conservation of Biodiversity, global scenario, decline of bioresources.
4.2 Protected areas concept: Sanctuaries, National parks, Biosphere reserves (Tiger reserves with reference to Melghat Tiger Project) Wildlife Management and Sacred groves.
4.3 Conservation of wild germplasm with reference to threatened species.

UNIT V: 5.1 Principles and practices for Ex-situ conservation, Botanical gardens, Field Gene Banks, Seed Banks.
5.2 In-vitro repositories, Cryobanks, Legal aspects of conservation of Biodiversity in India.
5.3 General accounts and activities of national institutes like Botanical Survey of India (BSI), National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural
SUGGESTED READINGS:
Suggested laboratory Exercises:

The Practical course is divided into three units: (1) Laboratory work, (2) Field survey and (3) Scientific Visits.

Laboratory Work:

1. Food crops: Wheat, Rice, Maize, Chickpea (Bengal gram), Potato, Tapioca, Sweet potato, Sugarcane. Morphology, Anatomy, Microchemical tests for stored food materials.

2. Forage/fodder crops: Study of any five important crops of the locality (for example fodder Sorghum, Bajra, Berseem, clove, guar bean, gram, fucic sp.)

3. Plant fibres:
   (a) Textile fibres: Cotton, Jute, Linen, Sunn hemp, Cannabis.
   (b) Cordage fibres: Coir.
   (c) Fibres for stuffing: Silk cotton or kapok

4. Medicinal and aromatic plants: Depending on the geographical location of college/university select five medicinal and aromatic plants each from a garden crop field (or from the wild only if they are abundantly available).

Study of live or herbarium specimens or other visual materials to become familiar with these sources. (Identification, uses and products like oils).

5. Vegetable Oils: Mustard, Groundnut, Soyabean, Coconut, Sunflower and Castor. Morphology, microscopic structure of the oil-yielding tissues, tests for oil and iodine number. (Any three)

6. Gums, resins, tannins, dyes: Perform simple tests for gums and resins. Prepare a water extract of vegetable tannins (Acacia, Terminalia, mangroves, tea, Cassia spp, myrobalans) and dyes (turmeric, Bixa orellana, Indigo, Butea monosperma, Lawsonia inermis) and perform tests to understand their chemical nature. (One from each category)

7. To prepare ombrothermic diagrams for different sites on the basis of given data and comment on climate.

8. To find out association between grassland species using chi square test.


10. To determine diversity indices for protected and unprotected cropland stands.

11. To determine IVI of grassland.

12. To prove the biological spectrum of vegetation under study using Raunkiara life forms classification.

SEMESTER – I

PRACTICAL I: CELL BIOLOGY, CYTOLOGY, GENETICS, RESOURCE UTILIZATION & CONSERVATION.

PRACTICAL SCHEDULE

<table>
<thead>
<tr>
<th>Time: 6 hrs.</th>
<th>Marks - 40</th>
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<tbody>
<tr>
<td>Q.1 Karyotype Analysis</td>
<td>06</td>
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<tr>
<td>Q.2 Isolation of any cell organelle</td>
<td>05</td>
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<tr>
<td>Q.3 Smear/Squash Technique/ Specialized Chromosome</td>
<td>04</td>
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<tr>
<td>Q.4 Problem on interaction of genes</td>
<td>04</td>
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<tr>
<td>Q.5 Identification and morphological description of given economically important plant</td>
<td>05</td>
</tr>
<tr>
<td>Q.6 Chemical Characterization of tannins, resins, dyes, fibers (any 12)</td>
<td>05</td>
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</table>
PAPER – III: BIOLOGY AND DIVERSITY OF ALGAE AND BRYOPHYTIES

Unit -I: General account and reproduction

1.1 : Range of habitat and thallus organization in Algae.
1.2 : Cell structure;
   i) Ultrastructure
   ii) Pigments in Algae
   iii) Reserve food material
   iv) Flagella.
1.3 Classification by F.E. Fritsch (1935), G.M. Smith; Chapman (1938); Round (1965)
1.4 : Cyanophyta- Ultrastructure of cell, heterocyst, reproduction and affinities.
1.5 : Reproduction in Algae and alternation of generations.

Unit -II : Diversity and Phylogenetic considerations

2.1 : Chlorophyta: Volvocales, Chlorococcales, Ulotricales, Cladophorales, Chlorophyceae, Oedogoniales, Conjugales, Siphonales, Charales.
2.2 Cryptophyta: Cryptophyceae, Xanthophyceae, Bacillariophyceae
2.3 Dinophyta: Dinophyceae
2.4 Bryophyta: General account and significance.
4.1 : Classification and distribution of Bryophytes.
4.2 : Vegetative propagation in Bryophytes.
4.3 : Fossil Bryophytes.
4.4 : Economic and ecological importance of Bryophytes.

Unit -V : Morphotaxonomy and Phylogeny of Bryophytes.

5.1 : Thallus Organization; internal structure and reproduction in
   i) Sphaerocarpales, ii)Marchantiales, iii)Anthocerotales,
Laboratory Exercises:

1. Morphological study of Algae: (Any 12 of the following)
   - Oscillatoria, Nostoc, Anabaena, Spirullina, Gleotrichia, Chlamydomonas, Eudorina, Volvox, Closterium, Hydrodictyon, Pediastrum, Cladophora, Ulva, Pithophora, Draparnaldia, Cosmarium, Chlorella, Acetabularia, Chara, Nitella, Laminaria, Sargassum, Padina, Ectocarpus, Batrachospermum, Gracillaria, Gellidium, Polysiphonia,

2. Morphological, anatomical and reproductive studies of following members: Targonia, Cyathodium Marchantia, Plagiochasma, Deumortiera, Anthoceros, Notothylus; Polytrichum, Pogonatum, Sphagnum,

   Field visits: Visits to the field to study distribution of algal flora and bryophytic forms.

PAPER – IV: PLANT DEVELOPMENT AND REPRODUCTION

UNIT I: 1.1 Unique features of plant development, differences between plant and animal development.
   1.2 Structure of seed, germination of seed and seedling growth and control.
   1.3 Metabolism of nucleic acids, proteins and mobilization of reserve food.
   1.4 Seed dormancy: types, importance and means to break the seed dormancy.

UNIT II: 2.1 Organisations of shoot apical meristem (SAM). Cytological and molecular analysis of SAM, Root apical meristem.
   2.2 Types of meristem, tissue differentiation, structures, development and importance of tissue differentiation: Vascular cambium and cork cambium, evolution of Xylem.
   2.3 Wood development in relation to environmental factors, secondary growth: stem and root.
   2.4 Leaf development and structure, differentiation of epidermis and mesophyll. Structure and function of secretary ducts and laticifers.

UNIT III: 3.1 Plant reproduction: Means of reproduction, flower development, homeotic mutants in Arabidopsis and Antirrhinum, sex determination.

UNIT IV: 3.2 Structure of anther, microsporogenesis, and pollen development, pollen viability, male sterility, pollen germination, pollen storage, pollen embryo.
   3.3 Types of ovules, ovule development and structure, megasporogenesis, embryo sac development and structure.

UNIT V: 5.1 Polyembryony, apomixis, In-vitro plant regeneration through embryo, pollen and anther culture.
   5.2 Metabolic changes associated with senescence and its regulation.
   5.3 Influence of hormones and environmental factors on senescence.

Suggested Readings:

Suggested Laboratory / Field Exercises (Any 10):

1. Effect of gravity, unilateral light and plant growth regulators on the growth of young seedlings.
2. Role of dark and red light / far-red light on the expansion of cotyledons and epicotylar hook opening in pea.
3. Study of living shoot apices by dissections using aquatic plants such as Ceratophyllum and Hydrilla.
4. Study of cytohistological zonation in the shoot apical meristem (SAM) in sectioned and double-stained permanent slides of a suitable plant such as Coleus, Kalanchoe, Tobacco. Examination of shoot apices in a monocotyledon in both T.S. and L.S. to show the origin and arrangement of leaf primordia.
5. Study of alternate and distichous, alternate and superposed, opposite and superposed; opposite and decussate leaf arrangement. Examination of rosette plants (Launaea, Mollugo, Raphanus, Hyoscyamus etc) and induction of bolting under natural conditions as well as by GA treatment.
6. Microscopic examination of vertical sections of leaves such as Cannabis, Tobacco, Nerium, Maize and Wheat to understand the internal structure of leaf tissues and trichomes, glands etc. Also study the C3 and C4 leaf anatomy of plant.
7. Study of epidermal peels of leaves such as Coccinia, Gallardia, Tradescantia, Notonea, etc. to study the development and final structure of stomata and prepare stomatal index. Demonstration of the effect of ABA on stomatal closure.
9. Study of microsporogenesis and gametogenesis in sections of anthers.
10. Examination of modes of anther dehiscence and collection of pollen grains for microscopic examination (Maize, Grasses, Cannabis sativa, Crotolaria, Tradescantia, Brassica, Petunia, Solanum melongena, etc.)
13. Role of transcription and translation inhibitors on pollen germination and pollen tube growth.
15. Study of ovules in cleared preparations; study of monosporic, bisporic and tetrasporic types of embryo sac development through examination of permanent stained serial sections.
16. Field study of several types of flower with different pollination mechanisms (wind pollination, thrips pollination, bee/butterfly pollination, bird pollination).
17. Emasculation, bagging and hand pollination to study pollen germination, seed set and fruit development using self compatible and obligate outcrossing systems. Study of cleistogamous flowers and their adaptations.
18. Study of nuclear and cellular endosperm through dissections and staining.
19. Isolation of zygotic globular, heart-shaped, torpedo stage and mature embryos from suitable seeds and polyembryony in citrus, jamun (Syzygium cumini) etc. by dissections.
20. Study of seed dormancy and methods to break dormancy.
Semester – I
PRACTICAL–II: BIOLOGY AND DIVERSITY OF ALGAE AND BRYOPHYES AND PLANT DEVELOPMENT AND REPRODUCTION

Practical schedule

Time 6 hrs.  Marks: 40
Q. 1 : Isolation and identification of any two algal forms 06
Q. 2 : Characterization and identification of given Bryophytic material. 06
Q. 3 : Setting and working of any experiment based on plant development 10
Q. 4 : Microtomy 05
Q. 5 : Spotting algal, bryophyte Plant DW; flower 08
Q. 6 : Viva-voce 05

Semester – II
PAPER–V: CYTOGENETICS AND MOLECULAR BIOLOGY

Unit I :  1.1 Cytogenetics of polyploids: Types, origin and production of polyploids; genome constitution, meiotic behaviour, analysis and evolution in major crop plants; induction and characterization of trisomics; significance in crop improvement.
1.2 Breeding of polyploids: heterosis and inbreeding depression.
1.3 Plant Breeding: Methods of breeding in self-pollinated and cross-pollinated crops, genetic variability, male sterility in plant breeding.

Unit II:  2.1 Molecular Cytogenetics: Nuclear DNA content, C-value paradox; cot curve and in-situ hybridization.
2.2 Physical mapping of genes on chromosomes and their analysis, problems on linkage and crossing over, single nucleotide polymorphism (SNP).
2.3 Multigene families evolution, types of multigene families and the proteins produced, chaperones.

Unit III:  3.1 Gene expression and its regulation in Eukaryotes: fine structure of gene, cis-trans test, introns, mRNA splicing, RNA editing, CAAT BOX, TATA BOX, Homeo box, role of transcription factors.

3.2 Genetic Recombinations: Molecular mechanism of crossing over, role of Rec- A, B, C, D enzymes site specific recombination, independent assortment and crossing over.
3.3 Genetics of Yeast: Yeast genome, yeast genome characterization, Yeast artificial chromosome.

Unit IV:  4.1 Genetic and Restriction Mapping: Restriction digestion of DNA, single and double digest, restriction map construction.
4.2 Molecular markers: Isozymes, proteins, RAPD, AFLP.
4.3 Techniques in genetic engineering: DNA finger printing, Southern blotting and Electrophoresis.

Unit V:  5.1 Methods of DNA sequencing: Maxam and Gilbert technique, Sanger's Dideoxy nucleotide method, application of sequencing.
5.2 Biostatistics: Mean, mode, central tendency, standard deviation, variance, covariance, correlation, regression; sampling, chi-square test and its significance.
5.3 Molecular Biology and Bioinformatics: Overview, scope, development, introduction to databases, computers in bioinformatics, applications.

Suggested Reading:

Laboratory Exercises:
1] Isolation of mitochondria and the activity of its marker enzyme, succinate dehydrogenase (SDH).
2] Isolation of chloroplasts and SDS-PAGE profile of proteins to demarcate the two subunits of Rubisco.
3] Isolation of nuclei and identification of histones by SDS-PAGE.
4] Isolation of Plant DNA and its quantitation by a spectrophotometric method.

Semester – II
PAPER – VI: BIOLOGY AND DIVERSITY OF MICROBES AND FUNGI

UNIT I: 1.1 Archaeabacteria and Eubacteria- General account, nutrition, reproduction and economic importance.
1.2 Ultrastructure of Eubacteria.
1.3 Important bacterial diseases of regional crops.

UNIT II: 2.1 Viruses: characteristics and ultrastructure of Virions, chemical nature, replication, transmission of viruses.
2.2 Important viral disease of regional crops.
2.3 Phytoplasma: General account and important plant disease.

UNIT III: 3.1 Classification of Fungi proposed by Ainsworth (1971)
3.2 Economic importance of Fungi.
3.3 Myxomycotina: General account.
3.4 Mastigomycotina: General account of Chytridiomycetes, Oomycetes, Plasmodiophoromycetes.
3.5 Zygomycotina: General account (studies up to order level and their respective genera.)

UNIT IV: 4.1 Ascomycotina: General, vegetative and reproductive
characters of Hemiascomycetes, Plectomycetes and Discomycetes.

4.2 Basidiomycotina: General vegetative and reproductive characters of Teliomycetes, Hymenomycetes and Gastromyces.

4.3 Deuteromycotina: General account and importance.

UNIT V:

5.1 Heterothallism and Parasexuality in Fungi.

5.2 Mycorrhiza: Ectomycorrhizae and Endomycorrhizae, general account and VAM Fungi.

5.3 Fungi as Biological Agent.

Suggested Readings:

Laboratory Exercises:

1. Morphological Studies of Fungi (any 15 of the following)
   Stemonities, Perenospora, Phytophthora, Albugo, Mucor, Rhizopus, Yeast, Aspergillus, Penicillium, Chaetomium, Taphrina, Peziza, Erisyphe, Phyllactenia, Uncinula, Melamosora, Uromyces, Drechslera, Ravenella, Ustilago, Polyporus, Morchella, Cyathus, Alternaria, Helminthosporium, Curvularia, Colletotrichum, Phoma, Plasmodiophora, Cercospora, Fusarium, Claviceps.

2. Symptomology of some diseased plants (any 10 of the following).
   White rust of Crucifers, Downy mildew, powdery mildew, Rusts, Smuts, Ergot, Groundnut leaf spot (Tikka disease), False smut of paddy, red rot of Sugarcane, Wilt disease, Citrus canker, Angular leaf spot of cotton, Leaf mosaic of bhindi/ papaya, Leaf curl of tomato/Potato/Papaya, Little leaf of brinjal.

3. Identification of Fungal cultures (Any 5)
   Rhizopus, Mucor, Aspergillus, Penicillium, Drechslera, Curvularia, Phoma, Colletotrichum, Alternaria, Helminthosporium.

Semester-II

PRACTICAL – III
(CYTOGENETICS, MOLECULAR BIOLOGY, BIOLOGY & DIVERSITY OF MICROBES AND FUNGI)

Time : 6 hrs.
Marks : 40

Q. 1. Isolation and Estimation of DNA by UV-VIS spectrophotometry. 08
Q. 2. Experiment on Plant Breeding/Polyploids. 05
Q. 3. Biostatistical analysis of given data 04
Q. 4 Identification of given Fungal culture and plant disease material with its diagnostic characters and classification 08
Q. 5. Identify the given plant disease as per its symptoms 05
Q. 6. Spotting. 05
Q. 7. Viva-voce 05
Suggested Reading:


Laboratory Exercises:
1. Extraction of chloroplast pigments from leaves and preparation of absorption spectrum of chlorophylls and carotenoids.
2. To determine chlorophyll a, chlorophyll b and total chlorophyll ratio in C3 & C4 plants.
3. Estimation of sodium and potassium in plant material by flame photometry.
4. Determination of Ca: Mg ratio by spectrophotometry in plant tissue.
5. Preparation of the standard curve of proteins (BSA) by Biurette method.
6. Determination of Isoelectric point of Legumin.
9. To demonstrate photophosphorylation in intact chloroplasts, resolve the phosphoproteins by SDS-PAGE & performs Western blotting.
10. Estimation of protein content in extracts of plant material by Lowry’s or Bradford’s method.
11. Assay of the enzyme Phosphatases.
14. Demonstration of an electron transport system.
15. Estimation of carbon dioxide liberated during respiration.
16. To demonstrate the process of antagonism.
17. To demonstrate the process of fermentation by Kunhe’s vessel.
18. To demonstrate the process of tissue tension.
20. Effect of various salts on the permeability of the plasma membrane.
21. Estimation of Ascorbic Acid in the given material.
Semester-II
PAPER – VIII: PLANT METABOLISM.

Unit-I:
1.1 Carbohydrates in Biosphere, properties, functions and importance
1.2 Carbohydrate Metabolism: - Biosynthesis of starch and sugars, catabolic pathways, interaction between Hexose Pentose Phosphate and Triose phosphate pools.

Unit-II:
2.1 Amino Acid Metabolism: Assimilation of inorganic nitrogen in amino acids, Biosynthesis of amino acids in plants, Proline metabolism, a target for metabolic engineering of stress tolerance.
2.2 Protein: Regulation of cystolic protein biosynthesis in eukaryotes, post-translational modification of proteins; storage proteins, degradation of proteins.

Unit-III:
3.1 Lipid Metabolism: Classification, structure and function of lipids, biosynthesis of fatty acids, membrane lipids, structural lipids and storage lipids.
3.2 Catabolism of storage lipids, phospholipids and derived lipids (steroids).

Unit-IV:
4.1 Nitrogen Metabolism: Overview of nitrogen fixation, ammonia uptake and reduction, nitrite reduction.
4.2 Sulphur Metabolism: Sulphur chemistry and fixation, uptake and transport, reductive sulphate assimilation pathways, synthesis and function of glutathione and its derivatives.

Unit-V:
5.1 Metabolism Biochemistry: Primary and secondary metabolites in plants as important natural products; types of alkaloids, phenols, flavonoids, glycosides, and their applications; distribution and localization.
5.2 Phosphate Metabolism.
5.3 Phytochemical Techniques: Quantitative and Qualitative analysis methods; TLC, HPLC, HPTLC principle and techniques.

Suggested Readings:

LABORATORY EXERCISES:
1. Effect of time and enzyme concentration on the rate of enzyme action (e.g. acid phosphatase, nitrate reductase).
2. Estimation of stress induced amino acid (Proline)
3. Determination of total carbohydrates by Anthrone method.
4. Extraction of seed proteins depending upon solubility.
5. Determination of succinate dehydrogenase activity, its kinetics, & sensitivity to inhibitors.
7. Estimation of total fats in fatty seeds.
8. Separation of Alkaloids/Phenols by TLC.
10. Extraction of secondary metabolites from callus tissue.
11. Qualitative analysis of secondary metabolites.
12. Detection of secondary metabolites by TLC (any one)
13. Profile study of secondary metabolites by TLC (any one)
14. Separation of Amino acids by chromatographic techniques
15 Spectrophotometer estimation of secondary metabolites.
16 Estimation of phytoalexins.

**Semester – II**

**PRACTICAL – IV: PLANT PHYSIOLOGY AND PLANT METABOLISM PRACTICAL SCHEDULE**

Time: 6 Hours. 
Marks: 40

Q. 1: Setting and working of any one major physiology experiment. 08
Q. 2: Setting and working of one major Plant Metabolism experiment. 08
Q. 3: Comment on any one minor physiology experiment. 05
Q. 4: Comment on any one minor Metabolism experiment 05
Q. 5: To perform Phytochemical tests. 04
Q. 6: Principle and working of instrument. 05
Q. 7: Viva Voce 05

Syllabus for M.Sc. Part-II Botany

**Semester – III**

**PAPER-IX: BIOLOGY AND DIVERSITY OF PTERIDOPHYTES AND GYMNOSPERMS.**

**Unit-I:** General account of Pteridophyta.
1.1 Geological Time Scale & Fossilization process.
1.2 Sterile organization and evolution.
1.3 Origin of leaf and telome concept.
1.4 Heterospory and seed habit.
1.5 Classification of Pteridophyta G.M. Smith.

**Unit-II:** Morphology, anatomy and reproduction.
2.1 Psilopsida: Psilophytales and Psilotales.
2.2 Lycopsida: Lycopodiaceae, Selaginellales, Isoetales.
2.3 Sphenopsida: Calamitales, Equisetales.
2.4 Pteropsida: Filicales.
2.5 Evolutionary trends among Pteridophytes.

**Unit-III:** General account of Gymnosperms.
3.1 Characteristic features of gymnosperms. Distribution and economic importance of gymnosperms.
3.2 Variations in structure of pollen grains, pollen germination.
3.3 Evolutionary trends in female gametophyte.
3.4 Classification of gymnosperms: D.D. Pant and S.V. Meyen

**Unit-IV:** Morphology, anatomy, reproduction and evolutionary tendencies
4.1 Pteridospermales: Lyginopteridaceae, Medullosaceae, Glossopteridales, Caytoniales.
4.2 Bennettitales: Cycadeoidaceae and Williamsoniaceae.
4.3 Cycadales: Nilssoniaeae and Cycadaceae.
4.4 Pentoxylales: Pentoxylaceae.
4.5 Cordaitales: Cordaitaceae.

**Unit-V:** Morphology, anatomy, reproduction and affinities:
5.1 Ginkgoales: Ginkgoaceae.
5.2 Coniferales: Araucariaceae, Podocarpaceae, Cupressaceae and Cephalotaxaceae.
5.3 Taxales: Taxaceae.
5.4 Ephedrales; Gnetales; Welwitschiales

Suggested Readings:
Laboratory Exercises:

A. Study of morphology, anatomy and reproductive structure of Pteridophytic forms.

B. Comparative Study of vegetative and reproductive parts of Cycas, Zamia, Cedrus, Abies, Pinus, Cupressus, Cryptomeria, Taxodium, Podocarpus, Agathis, Thuya, Gnetum, Ephedra, Juniperus, Cephalotaxus, Taxus, Permanent micropreparations to be submitted by the students.

C. Ginkgo: Morphology to be studied from Museum specimens & anatomy from permanent slides only.

Suggested Readings:

20) Trees of Vidarbha (A field guide to flowering trees) by Dr. M.M. Dhole, Sh. P.S. Lachure, Sh. P.D. Gawande.

Laboratory Exercise:

**Angiosperms**:
1) Technical description of plant species available locally and identification up to family.
2) Study of species belonging to single genus and preparation of key at genus level.
3) Preparation of herbarium specimens following standard techniques. At least 100 specimens should be presented collectively by the class of locally abundant species.

Frequent field trips should be arranged to get acquainted with local flora. One tour within state and one outside the state should be arranged to study the biodiversity of gymnosperms and angiosperms. Field tour reports should be supported by exhaustive field notes and photographic representations of plant species studied.

**SEMESTER-III**

**PRACTICAL – V: PTERIDOPHYTA, GYMNOSPERMS AND TAXONOMY OF ANGIOSPERMS.**

**PRACTICAL SCHEDULE**

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<th>Time</th>
<th>Max. Marks</th>
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<td>6 Hrs.</td>
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**Q.1.** Identify and describe the given pteridophytic material 06 Marks

**Q.2.** Identify, describe and make a double stained permanent micropreparation of gymnosperm material 07 Marks

**Q.3.** Systematic description of a given angiospermic two plant species. 14 Marks

**Q.4.** Spotting:
   i) Pteridophyte 2
   ii) Gymnosperm 2
   iii) Fossil Specimen 2
   iv) Angiosperm 2
   08 Marks

**Q.5. Viva-voce** 05 Marks

**Semester-III (Elective)**

**PAPER-XI: PLANT TISSUE CULTURE-I**

**Unit-I:** Concept and Scope

1.1 Introduction, definition and scope of plant tissue culture.
1.2 Historical Developments.
1.3 Laboratory structure, instruments, requirement and general techniques, Designing of green house, Polyhouse for hardening, maintenance and multiplication.
1.4 Cellular totipotency; role of growth hormones in differentiation.
1.5 Role of photoperiod, humidity and temperature for in-vitro cultures.

**Unit II:** Media composition and sterilization.

2.1 Media constituents (inorganic & organic); growth hormones; gelling agents, media preparation and maintenance, autoclaving of media, Different media compositions.
2.2 Sterilization: dry and wet heat sterilization, sterilization of glasswares, steel material.
2.3 Surface sterilization of explants; selection of explant, size of explant.
2.4 Differentiation: Organogenic differentiations, Cytodifferentiation.

Unit III: Cell and suspension culture
3.1 Cell culture, isolation of single cell, techniques; factors affecting single cell culture, Induction of callus.
3.2 Cell suspension culture: techniques and maintenance of suspension culture.
3.3 Preparation of cloning of single cell and its regeneration to whole plant.

Unit IV: Variability and Micropropagation:
4.1 Nuclear and genetical variation; factors affecting variation.
4.2 Role of variability in selection and improvement of plant; somaclonal and gametoclonal variations.
4.3 Practical application of variability in tissue culture.
4.4 Techniques of micropropagation; factors affecting in-vitro stages of micropropagation; technical problems in micropropagation techniques.

Unit V: In-vitro selection and Application.
5.1 Commercial exploitation of micropropagation technique in horticultural and agronomical crops.
5.2 In-vitro selection for abiotic and biotic stresses. Isolation of useful nutrients at cellular level, Single cell proteins.

Suggested Readings:
6) Dr.U.Kumar (1999) Methods in Plant Tissue Culture, Agrobios (India)

Laboratory Exercises:
1) Preparation of media.
2) Surface sterilization.
3) Isolation of explant, induction of callus, establishment and maintenance of callus.

Semester III
Plant Tissue Culture : Practical-VI (Elective)

PRACTICAL SCHEDULE

Time : 8 Hrs. Max. Marks: 40
Q.1. Setting and working of one major experiment 12 Marks.
Q.2. Two Minor experiments. 08 Marks.
Q.3 Preparation of any one specific media for tissue culture. 10 Marks.
Q. 4 Comment on spots. 05 Marks.
Q. 5 Viva voce 05 Marks.

Semester- III
PAPER-XI: BIOINFORMATICS-I (Elective)

UNIT I: 1.1 Computer system: Overview functions input devices output devices, storage devices, Softwares and Hardwares.
1.2 Main circuits: Chips, Ports, Expansion slots.
1.3 Real time, offline and online processing.
1.4 Operating systems: Concepts, windows 2003/XP, VISTA, UNIX, LINUX.
1.5 Computer Virus: Overview, Transmission and Precautions.

UNIT II:2.1 Types of computers- Latest Models.
2.2 Internet: Resources, World Wide Web, Tools associated, terminologies.
2.3 Data communication, links and Data Mining
2.4 LAN, WAN, MAN, Search Engines.
2.5 Data Models: Network and Hierarchical data model and concepts.

UNIT III:
3.1 Computer application in Bioinformatics.
3.2 Databases: Primary, Secondary; Relational and Non relational; Redundant and Non Redundant
3.3 Introduction to Oracle and Perl.
3.4 Database design and management (DBMS & RDBMS).
3.5 Bioinformatics Resources: NCBI, EBI, ExPASY, EMBL, and DDBJ.

UNIT IV:
4.1 Biological Databanks: PDB, SRS, BRENDA, TREMBL, UniProt, KEGG.
4.2 Derived Databases: PROSITE, Pfam, PRINTS, CATH, SCOP, DSSP, FSSP, DALI.
4.3 Genomic Databases.
4.4 Repositories for high throughput genomic sequences: EST, STS, GSS.
4.5 Nucleic Acid databases and Protein databases.

UNIT V:
5.1 Sequence Analysis: Overview, Concepts and tools.
5.2 Similarity Searches: BLAST, FASTA, PSI-BLAST and PHI-BLAST.
5.3 Scoring Matrices: PAM, BLOSSUM and PSSM.
5.4 Pairwise Sequence Analysis: Needleman and Wunch; Smith and Waterman.
5.5 Dynamic Programming.

Semester-III
PAPER XII: BIOINFORMATICS II (Elective)

UNIT I:
1.1 Multiple sequence alignment (MSA); Basic concepts, Progressive and Hierarchical approaches CLUSTAL-W, GENEDOC.
1.2 Sequence patterns, profiles and motifs (Profilescan) Prosite type.
1.3 Phylogenetic tree: Basic concepts, methods, types of trees, Analysis algorithm UPGMA, NJ, NR, MP and its interpretation.
1.4 Comparative Genomic: Full genome alignment concepts and applications, Algorithm MUMmer, BLAST-2

UNIT II:
2.1 Gene Prediction: Gen Scan and Neural Network, HMM concepts and Applications.
2.2 Genomic: Genome analysis coding region (CpG Island, GC content, SNPs, ESTs) non-coding regions: LINES, SINES, LTRs, Tandem repeats.
2.3 Structural Genomics and Primer designing
2.4 Functional genomics: DNA Microarray.

UNIT III:
3.1 Protein structure Prediction: ab-initio method, GOR, Fold recognition (PHD, PSI- Prediction method)
3.2 Protein structure with respect to helix, sheets and coils, Ramachandran Plot.
3.3 Protein modelling and simulations: Techniques, MD Monte Carlo, docking strategies.
3.4 Protein optimisation techniques.
3.5 To study protein characteristics by using peptools.

UNIT IV:
4.1 Protein Array: Concept tools
4.2 Protein-Protein interaction: Molecular design.
4.3 Protein Validation/Homology and Resources for virology
4.4 Virtual Lab. concept
4.5 Allergic proteins and their studies by using bioinformatic tools.

UNIT V:
5.1 Biodiversity Informatics: Overview, concept, Databases (Species 2000, tree of life, ATCC, NBTI) and Softwares (delta, Metro IS, AVIS, ICTV)
5.2 Bioinformatics in Agriculture for Crop Improvement.
5.3 Drug Design: Role of bioinformatics, target identification and Model organisms (Arabidopsis thaliana, C. elegans, Drosophila melanogaster)
5.4 Chemo informatics: Concepts and Dynamics of biomolecular drugs.
5.5 Emerging areas in bioinformatics: Genechip, Forest informatics, Ontology, Phylogenetic study, Drug target identification.

Suggested Readings:
15. James D. Tisdall, 2003, Mastering Perl for Bioinformatics, O'Reilly.
24.  
41. A.R. Leach, Molecular Modelling Principles and Applications
42. Creighton T.E. Protein Folding
43. Creighton T.E. Protein Structure Prediction.
45. John E. Antonopoulos, 2000, Genomics, Xlibris Corporation
52. T. Rabilloud, 2000, Proteome Research: Two-Dimensional Gel Electrophoresis and Detection Methods (Principles and Practice), Springer Verlag.
53. R.M. Kamp, D. Kyriakidis, the Choli-Papadopoulou, 1999, Proteome and Protein Analysis, Springer Verlag.
81. Masatoshi Nei, Sudhir Kumar, 2000, Molecular Evolution and Phylogenetics, Oxford Univ Press.
Laboratory Exercises:
1. Hands on experience and Regular Usage: Windows XP, Internet Browsers (I.E. Netscape), Search Engines, E-mail, Web, mail and ftp.
2. Downloading and installing Software/plugs in on Windows XP.
4. Creation of Computer Presentations with graphics (P.P.), Slides, Wizards, inserting graphs & charts, build and animated effect.
5. Database search, NCBI, DDBJ, EMBL, BRENDA, KEGG, UniProt.
6. Pair wise Sequence Alignment-Fasta, BLAST.
7. Websites for Bioinformatics.
8. To prepare the inventory of websites.
9. To develop a phylogeny tree of at least 5 plant species.
10. To search allergic fragments of proteins in fruits / pollen grains.
11. To study Protein characteristics by using different bioinformatic tools.
12. Protein database searching GCG package or EMBOSS.
13. 3D Motif recognition.
14. 3D structure viewing tools.
15. Method of gene Annotation.
16. Assembly of full genome from sequenced fragments.
17. Blast analysis of DNA sequence.
18. Blast analysis of Protein sequence.
19. Primer designing using computers.
20. Protein prediction using DNA as template.
21. RNA prediction using DNA as template.

Semester -III
PRACTICAL -VI
ELECTIVE PAPER BIOINFORMATICS
PRACTICAL SCHEDULE

<table>
<thead>
<tr>
<th>Time: 8 Hrs.</th>
<th>Marks: 40</th>
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<tbody>
<tr>
<td>Q. 1 Setting and Working of one major experiment</td>
<td>12 Marks</td>
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<tr>
<td>Q. 2 Perform two minor experiments</td>
<td>12 Marks</td>
</tr>
<tr>
<td>Q. 3 Problem on Matrices</td>
<td>06 Marks</td>
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<tr>
<td>Q. 4 Spotting</td>
<td>05 Marks</td>
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<tr>
<td>Q. 5 Viva voce</td>
<td>05 Marks</td>
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Semester – III

Paper-XI: Angiosperm Taxonomy, Phytochemistry and Pharmacognosy-I (Elective)

UNIT I: Basic principles of phytochemical techniques – UV-Visible and Infra Red Spectroscopy, Nuclear Magnetic Resonance (NMR); Chromatographic techniques- Paper chromatography, Thin Layer Chromatography (TLC), High Performance Liquid Chromatography (HPLC), Gas Liquid Chromatography (GLC), Gel Electrophoresis.

UNIT II: Study of following secondary plant metabolites with respect to their chemistry and biological activity- Flavonoids, Simple Phenolics, Phenolic Glycosides, Tannins, Anthroquinones, Saponins, Steroids, Alkaloids, Pigments (anthocyanin and betacyanin), Resins, Gums and Volatile oils.


UNIT IV: International code of Botanical Nomenclature Type method, valid publication, Rule of priority, Author citation, conservation of names and rejection of names, Time and place of origin of Angiosperms. Probable ancestors of angiosperms (different theories of origin of angiosperms).

UNIT V: Pharmacognostic studies of following drug plants: (Nomenclature, Morphology, Anatomy, Chemistry, Uses and Adultrants) Datura metel, Solanum surattense, Zingiber officinale, Ocimum sanctum, Swertia chirata, Asparagus racemosus Commiphora weightii, Citrulus colocynthis, Digitalis purpurea; Gloriosa superba, Withania somnifera.

Ethnobotany: Dynamism in ethnobotany.

Semester – III

Paper-XII: Angiosperm Taxonomy, Phytochemistry and Pharmacognosy-II (Elective)


UNIT II: Taxonomic evidence: Vegetative and floral anatomy, palynology; embryology, cytology, Phytochemical systematics and molecular systematics. Numerical taxonomy, Biosystematics

UNIT III: Living fossils of Angiosperms: Winteraceae, Degeneriaceae, Astrobaileyaceae, Ambrorellaceae, Tetracentraceae, Trochodendraceae, Eupomatiaceae. Comparative account of vegetative and floral morphology, inter-relationships; phylogeny and distribution of plant families belonging to following subclasses as per Cronquist system (As illustrated by following orders and families).

a) Magnoliidae: Ranunculaceae, Berberidaceae, Lardizabalaceae, Menispermaceae.

b) Hamamelidaceae: Urticales- Ulmaceae, Moraceae, Cannabaceae, Urticaceae.

c) Caryophyllidae: Caryophyllales- Phytolaccaceae, Nyctaginaceae, Cactaceae, Aizoaceae, Molluginaceae, Chenopodiaceae, Amaranthaceae.

d) Dillenidae- Malvales- Elaeocarpaceae, Scytopetalaceae, Sterculiaceae, Bombacaceae, Malvaceae.

e) Rosidae: Geraniales- Oxalidaceae, Geraniaceae, Tropoaeolaceae, Balsaminaceae.

f) Asteridae: Asterales- Asteraceae.

g) Alismatidae- Alismatales- Butomaceae, Alismataceae, Limnocharitaceae, Marantaceae.

h) Commelinidae- Zinziberales- Heliconiaceae, Musaceae, Zingiberaceae, Costaceae, Cannaceae, Marantaceae.


Suggested Readings:
1) Comparative Phytochemistry - Swain, T., Academic Press.
4) Trease and Evans Pharmacognosy: W.C. Evans, Saunders.
5) Plant systematics, a phylogenetic approach - Jude, Campell, Kellog & Stevans, Sionaur Association Inc. USA.
18) Phytochemistry and Angiosperm Phylogeny: Young D.J., & Siegler, Prager.
20) Flowering Plants Origin & Dispersal: Takhtajan, A., Oliver & Boyd.

Laboratory Exercises:
1) Description of locally available dicot and monocot species. Identification upto species level with the help of flora.
2) Use of cytological data in Taxonomic studies - Karyotype analysis. Preparation of Karyograms; and Idiograms (to be done with the help of permanent preparation / diagram / photoplate).
3) Comparison of different species of a family to calculate similarity coefficient and preparation of dendrograms (numerical taxonomy).
4) Study of different taxonomic features like stomatal types, pollen types, trichome types, crystals etc.
5) Detection of secondary metabolites in plant material by quick tests. Detection of flavonoids, iridoids; leucoanthogenins, anthroquinones, alkaloids, saponins, differentiating anthocyanins from bactacyanins. Chemically differentiating angiosperm wood from gymnosperms wood.
6) Pharmacognostic studies of any 3 of the locally available medicinal plants.
7) Frequent field visits to study local flora are expected. One short tour within state and one long tour to other state to study the vegetation and biodiversity of angiosperms. Students should submit at least 100 herbarium specimens (collectively) prepared according to international norms. Excursion report should be supported by field diary and photographic presentation of the flora.

Semester - III
Elective Practical VI – Angiosperm Taxonomy, Phytochemistry and Pharmacognosy.

Practical Schedule
Time: 6 Hrs
Full Marks: 40

Q.1) Systematic description of two angiospermic plants (one from dicotyledons and one from Monocotyledons) 10 Marks.
Q.2) Preparation of artificial key 04 Marks.
Q.3) Karyotype studies 04 Marks.
Q.4) Detection of secondary plant metabolites of given plant material 03 Marks.
Q.5) Morphological and analytical characterization of given drug plant material 06 Marks.
Q.6) Spotting 08 Marks.
Q.7) Viva voce 05 Marks.

Semester III
ELECTIVE PAPER XI: ADVANCED PLANT PHYSIOLOGY AND BIOCHEMISTRY-I

UNIT I: 1.1 Membrane transport i Structure and organization of membrane, Glucoconjugates and protein membrane systems; Channels, pumps and carriers of membrane.
1.2 Aquaporines i Structure and functions; Model membranes.
1.3 Mineral nutrition — Deficiency symptoms in plants, Regulation of K+ Phosphorus nutrition and transport; Micronutrient acquisition; Plant response to mineral toxicity; Nutritional status of plants.

UNIT II: 2.1 Plant movements — Overview; phototropism, phototropic signal perception, transduction of signal.
2.2 Gravitropism — signal perception and its mechanism, growth response, Role of calcium in gravitropism.
2.3 Nastic movements — Mechanism of Nyctynasty and Seismonasty.
2.4 Sensory photobiology — Phytochromes and Cryptochromes — Phytochemical and biochemical properties; Photophysiology of light induced responses; molecular mechanism of photomorphogenic receptors; signaling and gene expression.

UNIT III: 3.1 Plastids — Chemical composition, structure and transport functions of plastid membranes.
3.2 Biosynthesis of Chorophylls, Carotenoids and fatty acids.
3.3 Thylakoid membrane network; protein synthesis, nuclear proteins for photosynthesis.
3.4 Mitochondria — Chemical composition, Transport across the membrane; Proteins synthesis; nuclear proteins for respiration.

4.2 Primary and Secondary metabolites — Coordinated control of metabolism; Metabolites as important natural products.
4.3 Types, biosynthesis and applications of terpenes, alkaloids, phenolic compounds, lignins, flavonoids, glycosides, caumarines, stilbenes, styrylopyrones and amylopyrones.

UNIT V: 5.1 Spectroscopy — Principles and applications of X-ray diffraction, Fluorescence, UV-visible, IR and NMR Mass spectroscopy.
5.2 Chromatography — Principle and applications of paper, ion exchange, affinity, and thin layer chromatography.
5.3 Flame photometry — Principle and its applications.

Semester III
PAPER XII: ADVANCED PLANT PHYSIOLOGY AND BIOCHEMISTRY-II (ELECTIVE)

UNIT I: 1.1 Carbohydrates — Chemical Structure, Types and functions of carbohydrates. Biosynthesis and degradation of starch and sucrose, Modulation of gene expression by carbohydrates.
1.2 Amino acid — Chemical properties; Overview of amino acid biosynthesis in plants.
1.3 Signal transduction — Overview, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, Calcium-Calmodulin cascade, diversity in protein kinases and phosphatases, Specific signaling mechanisms — Two compartment sensor regulator system in bacteria and plants. Sucrose sensing mechanism.

UNIT II: 2.1 Plant defence systems — Overview of plant pathogens and plant diseases; Phytoalexins and their host specificity.
2.2 Molecular basis of phytoalexin elicitation; R- genes; mode of action and its role.
2.3 Post infectional compounds of some economically important plants.
2.4 Control of pathogens by Genetic Engineering.

UNIT III: 3.1 Regulation and mode of secondary metabolites — Bioseperation of compounds, Regulation of metabolite synthesis in plants, Mode of action of target sites; Synergy principle at work in plants, pathogens, insects, herbivores and humans.
3.2 Transgenic production of secondary metabolites.

UNIT IV: 4.1 Senescence and programmed cell death — Types of cell death observed in plants. Overview of senescence, pigment and protein metabolism during senescence.
4.2 Impact of senescence on Photosynthesis and oxidative metabolism.
4.3 Degradation of nucleic acid during senescence.
4.4 Endogenous plant growth regulators and senescence, Environmental influence on senescence.

UNIT V: 5.1 Stress Physiology — Plant responses to biotic and abiotic stress, Mechanism of biotic and abiotic stress tolerance, HR and SAR.
5.2 Water deficit and draught resistance; salinity stress, metal toxicity, freezing and heat stress and oxidative stress.

Suggested Readings:
2. Sequence Analysis Primer, Michael Gribskov and John Devereux (Editors), 1992, Oxford University Press.

**Laboratory Exercises**:
1) The separation of leaf pigments by adsorption chromatography.
2) The separation of amino acids by two dimensional chromatography.
3) The identification of sugar in Fruit juices by TLC.
4) Seperation of Lipids by TLC.
5) SDS - PAGE for soluble proteins extracted from given plant material.
6) Extraction of Essential oils from plant material.
7) Separation of esters and peroxidases by native PAGE.
8) Determination of Chl-a, Chl-b & total chlorophyll in C3 & C4 plants by spectrophotometry.
9) Determination of isoelectric point of legumin.
10) The quantitative estimation of amino aids by using the ninhydrin reaction.
11) Estimation of total carbohydrates by anthrone reagent.
12) The determination of acid value of fats.
13) The determination of saponification value of fats.
14) The determination of activity of enzyme a - amylase.
15) Isolation of Chloroplast from spinach leaves.
16) The evaluation of oxygen by isolated chloroplast using Hill Oxidants.
17) Preparation of absorption spectrum of chlorophylls & carotenoids.
18) Estimation of stress induced amino acids (proline)
19) Demonstration of phototropism, geotropism, hydrotropism & seismonasty.
20) Determination of water potential by tissue weight change method.
21) Estimation of Sodium, Potassium & Calcium in plant material by Flame-photometry.
22) Estimation of peroxidase activity.
23) Detection of secondary metabolites by TLC (any one)
24) Profile study of secondary metabolites by TLC (any one)
26) Estimation of phytoalexins.
27) PR- protein ( b - 1,3 glucanase, chitinase, PAL) assay.

Semester III
Elective Practical – VI
Advanced Plant Physiology and Biochemistry

PRACTICAL SCHEDULE
Time: 6 Hrs
Q. 1 Setting and working of any one Plant Physiology experiment. 08 Marks
Q. 2 Setting and working of any one biochemistry experiment. 08 Marks
Q. 3 Comment on two experiments based on plant physiology and biochemistry that are set up. 10 Marks
Q. 4 Comment on principle and working of analytical instrument. 04 Marks
Q. 5 Perform phytochemical / biochemical test. 05 Marks
Q. 6 Viva voce 05 Marks

Semester – III
PAPER- XI: MOLECULAR BIOLOGY, BIOTECHNOLOGY
AND PLANT BREEDING-I (Elective)

UNIT I: 1.1 Chemical basis of life- Covalent bonds, Non-covalent bonds, Vander Waal’s forces, Acids, Bases and Buffers.
1.2 Protein structure and function ñ Hierarchial; structure of protein (Primary, Secondary, Tertiary, Quaternary and domain structure).
1.3 Modification and degradation of proteins. Molecular chaperons.
1.4 Membrane proteins-Integral and peripheral membrane proteins and its Interaction.
1.5 Methods of separation of cell proteins ñ Detergents, Differential and Rate zonal centrifugation, SDS-Polyacrylamide gel electrophoresis and isoelectric focusing.

UNIT II: 2.1 Nuclear genome organization ñ Genome size, Kinetics of DNA denaturation and renaturation, the law of DNA constancy and C- value paradox.
2.2 Kinetic classes of DNA ñ Repetitive and Unique DNA sequences and its significance.
2.3 Transcription in prokaryotes ñ Transcription unit, optimal prokaryotic promoter, Bacterial RNA polymerase, Transcription process.
2.4 Transcription in eukaryotes ñ RNA polymerase, transcription factors, promoters, enhancer, transcription process.
2.5 Modification in RNA ñ 5’Cap formation, Transcription termination, 3’end processing and polyadynalation, Splicing, Editing, nuclear export of mRNA and mRNA stability.

UNIT III: 3.1 Plant tissue culture- Laboratory structure and requirements, Different types of culture media, Importance of organic, inorganic nutrients in cell differentiations. Role of growth regulators in cell differentiation.
3.2 Anther and pollen culture techniques.
3.3 Protoplast culture and somatic hybridization ñ Isolation of protoplasts, culture, and fusion methods.
3.4 Techniques of Bacterial culture and selection.

UNIT IV: 4.1 Cloning techniques for E.coli. ñ Mechanical shearing, Restriction endonucleases, Synthetic linkers and adapters.
4.2 Vector systems ñ Plasmid, Cosmid, and Bacteriophages.
UNIT IV: 4.1 Plant viruses as gene vectors ñ RNA viruses, DNA viruses, Gemini viruses, and caulimovirus.
4.2 Agrobacterium mediated gene transfer ñ Agroinfection, vectorless gene transfer.
4.4 Plant as a Bioreactor ñ Production of High value of protein, new or modified carbohydrates in transgenic plants. Stability of proteins and RNA produced from genes introduced into transgenic plants.

UNIT V: 5.1 Molecular plant breeding ñ Molecular marker systems. Importance of molecular marker assisted breeding. Molecular markers in genome analysis: RFLP and RAPD.
5.2 Radiation biology ñ Radioactive isotopes, half-life of isotopes, Role of radiations in plant improvement.
5.3 Mutation breeding ñ Mutagens, treatment methods and its applications in crop Improvement.
5.4 Principle and application of Biometrical genetics in plant Breeding.

Suggested Readings:


**Laboratory exercises:**

1. To extract genomic DNA from leaves and to analyse the extracted DNA by Agarose Gel Electrophoresis.

2. Estimation of protein by Bradford’s Method.

3. Western Blotting- Protein profiling.

4. SDS PAGE.

5. Estimation of amino acids by Thin Layer Chromatography.


7. Restriction Digestion.

8. Mechanical isolation of mesophyll protoplasts.
Protoplast fusion using polyethylene glycol solution.
DNA Fingerprinting.
Plasmid preparation.
Isolation of genomic DNA from Bacteria.
Establishment of callus culture from carrot cambial explant.
Effect of ionizing radiations/chemical mutagen on growth and mitotic Chromosome.
Establishment of callus from important medicinal/ ornamental/ oil yielding/ wild and endangered/ vegetatively propagated plants.
Detection of anomalies in chromosome pairing and disjunction caused by mutant genes and structural alteration of chromosomes.
Preparation of chromosome maps from Three point test cross data.
Identification of mutant genotype in Drosophila and Arabidopsis stocks maintained by the department.
Field exploration for detection of male sterile plants and estimation of their pollen fertility in locally grown plants (Tomato, Brassica, Linum).
Emasculaion and bagging of flowers of Brasicaceae, Malvaceae, and liliaceae, pollinating them manually and estimating fruit and seed set.
Lay out of field experiment: Randomised block design, Latin square design.
Statistics:- Central value: mode median, mean; Dispersion: range, mean deviation, standard deviation; Frequency distribution: frequency curve, frequency histogram.
Use of different softwares for determination of chromosome length.
To study the DNA denaturation and renaturation kinetic study by UV-VIS spectrophotometer.

Semester III
Elective Practical –VI:Molecular Biology, Biotechnology and Plant Breeding

PRACTICAL SCHEDULE

Time : 8 Hrs. Full Marks : 40
Q. 1. Setting and working of any one major Molecular Biology experiment. 08 Marks
Q. 2. Perform one major Biotechnology experiment. 08 Marks
Q. 3. Perform one Plant breeding experiment. 10 Marks
Q. 4. Comment on principle and working of analytical instrument. 04 Marks

Semester III
PAPER –XI: PALAEOBOTANY
(EVOLUTIONARY BOTANY)-I (Elective)

Unit I: Palaeobotany as Evolutionary Science.
1.1 Basic concepts and scope of palaeobotany as evolutionary science.
1.2 Emergence of palaeobotany in world and India.
1.3 Basic principles of fossilization, fossils as an evidence of past life, methods of preservation, methods for study of different preservation types of plant fossils.
1.4 Geological time scale; stratigraphic importance of plant fossils.
1.5 Origin of life, Theory of Panspermia.
1.6 Classification of fossil plants, nomenclature and reconstruction.

Unit II: Diversification of life forms:
2.1 Algal forms like Animikiea, Kakabekia, Gunflintia, Eostrion and Stromatolite. Dinoflagellate nano-fossils, Cyanobacteria in Archaeozoic era.
2.2 Fossil fungi.
2.3 Fossil Chlorophyta, Chrysophyta, and Phaeophyta.
2.4 Non-vascular cryptogams like Thallites, Marchantiolites, Naiadita, Sporogonits, fossil mosses.
2.5 Phylogenetic significance of fossil record.

Unit III: Early Vascular land plants:
3.1 Evidence of first vascular plant.
3.2 Rhytiophyta form Rhytie chart.
3.3 Aldanophyton, Cooksonia, Baragwanathia, Rhynia, Psilophyton, Asteroxyton, Horneophyton, Yarravia, Lycopods like Leclerquia, Lopidodendrons, Lepidophlois, Lepidostrobus.
3.4 Origin of Isoetales, Equisetales, Azolla, Salvinia with special reference of Indian forms.

Unit IV: Progymnosperms: Structure and Evolution.
4.1 Aneurophytales: Aneurophyton, Propteridium, Tetraxylopteris.
4.2 Archaeopteridales: Archaeopteris.
4.3 Origin of Progynmosperms and inter relationships.
Unit V: Fossil Gymnosperms:
5.1 Evolution of early seed.
5.2 Calamopityales: *Calamopitys, Stenomylon Chapelia*.
5.3 Callistophytales: *Callistophyton, Idanothekion, Callospermarion, Vesicaspora*.
5.4 Evolutionary significance of the order.
5.5 Cycadophyta and Coniferophyta: Past distribution and evolutionary significance of different orders.

Semester-III

PAPER –XII: PALAEOBOTANY
(EVOLUTIONARY BOTANY)-II (Elective)

Unit I: Pre-angiosperm fossil forms.
1.2 Early evidence of flowers, fruits and seeds with reference to Indian flora.
1.3 Diversification of angiosperms in Cretaceous periods.
1.4 Modern concept of origin of Angiosperms, concept of punctuated equilibrium, cladistics concept.

Unit II: Biodiversity in Geologic past.
2.1 Glossopteris flora; Euramerican flora, Cathyasian flora and Angara flora.
2.2 Indian florae: Glossopteris, flora, Dicroidium flora, Ptilophyllum flora, (Rajmahal flora), Deccan Intertrappean flora.
2.3 Palaeogeographic and palaeoecological significance of floras.
2.4 Modern concepts of Gondwana with reference to its limits and extension, Karewa beds.
2.5 Concept of Archeobotany, Palaeoethno and Taphonomical concepts, Mass extinction

Unit III: Microfossil Evidences:
3.1 Definition of spore, pollen, meiospores; prepollen; morphology and dispersal of important pollen types, presentation of pollen, ornamentation of pollen wall.
3.2 Study of pollen kit, ubisch bodies; Role of pollen and spore in stratigraphy; classification of isolated spores and pollen.
3.3 Dispersed megaspores; primitive seeds.
3.4 Significance of palynology is coal and oil industry, Role of pollen grains in industrial honey production with reference to Indian work.

Unit - IV: Applied Palaeobotanical aspects:
4.1 Fossil fuels; Biodiagenesis of coal, (Process of Coalification) conditions of coal formation).
4.2 Microlithotypes found in coal viz: *Vitrinites, Resinites* etc.
4.3 Coal as an indicator of palaeoclimate, Resources of coal and its present status.
4.4 Origin of oil forming beds, source material for oil reserves of India, Formation of diatomaceous earth in marine environment, Bombay High, Present status of oil reserves.

Unit - V: Applied Aspects:
5.1 Radiometric dating of rocks, half life period; K-Ar dating, Fission track dating.
5.2 Continental Drift theory, plate tectonic model.
5.3 Palaeogeographical implications, Reconstruction of past vegetation.
5.4 Aero-allergens and its significance.

List of Books and Journals:
10. Seward, A.C. (1898) Fossil Plants Vol.-I-IV 1919
12. Scott D.N. (1923) Studies in Fossil Botany
14. Wadia, D.N. Geology of India
25. Erdtman G. Introduction to Pollen analysis.
26. Erdtman G. Pollen Morphology & Plant Taxonomy
28. Harris, T.M. 1961 The Yorkshire Jurassic Flora; I, Trustees of British Museum
29. Harris, T.M. 1964 The Yorkshire Jurassic Flora; II, Trustees of British Museum
30. Harris, T.M. 1969 The Yorkshire Jurassic Flora; III & IV, Trustees of British Museum

Journals:
1. The Palaeobotanist : BSIP, Publication, Lucknow

Laboratory Exercises:
1. Study of preservation types.
2. Techniques involved in study of different preservation.
   i.) Maceration   ii) Ground sections   iii) Acetolysis etc.
3. Study of type specimens of plant fossil; with complete monograph, sketching, etc.
5. Preparation of slides and study of cuticular characters.
6. Study of palynomorphs, typical of each age.
7. Plant life through the ages. Drawing of representative forms of geological periods.
8. Study of reconstruction of vegetation, floras.
9. Study of peat, lignite and coal samples.
10. Study of marine microfossils, especially of oil and natural gas implications.
    i) Visit to fossil localities for collection.
    ii) Visit to National Laboratories.
    iii) Submission of practical record, micropreparations, collection of fossil specimens
    iv) Field notebook, geological data.
    v) Visit to palaeobotanical museums.

Semester – III

ELECTIVE PRACTICAL-VI: PALAEOBOTANY
(EVOLUTIONARY BOTANY)-I
PRACTICAL SCHEDULE

Time: 6 hrs. Max.marks 40
1. Study of fossil specimens ............................................. 08 Marks
2. Application of technique for isolation ................................ 08 Marks
3. Identification of specimens & slides ......................... 10 Marks
4. Study of Geological time-scale ................................. 04 Marks
5. Identification of pre-angiosperm fossil forms with evolutionary
   Implications .................................................... 05 Marks
6. Viva-voce ....................................................... 05 Marks

Semester – III
PAPER – XI: REPRODUCTIVE BIOLOGY OF
ANGIOSPERMS-I (Elective)

Unit-I 1.1: Means of reproduction in flowering plants, flower structure
         and development.
         1.2: Anther structure: Biochemical and Ultrastructural aspects,
             structure and function of tapetum.
         1.3: Microsporogenesis: Cytoplasmic reorganization, pollen
             tetrad development and types, pollen wall morphogenesis,
             biochemical, physiological and genetic events involved in
             pollen development.

Unit-II 2.1: Pollen morphology: pollen wall sculpturing, Ultra structure.
         2.2: Pollen apertural types, Techniques for morphological
             preparations: Acetolysis, NPC.
         2.3: Light and scanning election microscopic studies of pollen.

Unit-III 3.1: Pollen: Physiological and biochemical aspects, viability,
             assessment of pollen viability.
             3.2: Pollen germination in-vivo and in-vitro, pollen tube
                 development and nuclear migration.
             3.3: Pollen storage, pollen bank, cryopreservation.

Unit-IV 4.1: Pistil: Structure and function of stigma and style.
             4.2: Types of stigma, stigma receptivity and its importance,
                 biochemical aspects. Stylar tissue.
             4.3: Pollen adhesion and germination on stigma, molecular basis,
                 pollen reorganization, Incompatibility and its significance.

Unit-V 5.1: Male sterility: genetic and cytoplasmic male sterility, male
           sterile lines.
           5.2: Male sterility through recombinant DNA technology.
           5.3: Sperm dimorphism and hybrid seed production.

Semester – III
PAPER – XII: REPRODUCTIVE BIOLOGY OF
ANGIOSPERMS-II (Elective)

Unit-I 1.1: Historic review of pollination studies.
         1.2: Pollination: Pollination mechanism and syndromes, pre-
             pollination events: anther dehiscence and pollen release.

Unit-II 2.1: Fertilization: Pollen tube development through stylar tissue,
           biochemical events, pollen tube entry in ovule.
           2.2: Heterospermy, differential behavior of male gametes,
               discharge and movement of sperms.
           2.3: Syngamy and triple fission, significance of double
               fertilization and triple fusion.

Unit-III 3.1: Structure and a types of ovule.
            3.2: Megasprogenesis, structure and types of embryo sac.
            3.3: Ultra structure of zygote, embryo development and
                 classification, polyembryony.

Unit-IV 4.1: Structure, development and types of endosperm.
            4.2: Ruminate endosperm, chemical composition of endosperm.
                 Storage proteins.
            4.3: Food reserve of endosperm and endosperm culture.

Unit-V 5.1: Anther/pollen culture, pollen embryo genesis, androgenic
           haploids, biochemical aspects.
           5.2: Somatic embryogenesis, biochemical aspects of somatic
               embryo genesis.
           5.3: Aeropalynology: Survey of air borne pollen analysis of
               aerospore.
           5.4: Mellitopalynology: Pollen analysis of honey, role of apiary
               in crop production.

Suggested readings:
   of pollen vedamse Book (P) Ltd. New Delhi.
   Royal Botanic Garden kew.
   Springer-Verlag.
   and Concepts. Science Publishers, INC (USA)
**Laboratory Exercises:**

1. Estimation of pollen protein concentration.
2. Separation of amino acids by TLC from pollen.
4. Study the effect of mutagens on pollen germination.
5. Induction of polyploidy in pollen grain.
6. Isolation of DNA from pollen grains.
7. DNA estimation in Pollen grains.
8. Plant regeneration through anther/pollen culture.
10. Study of in- vitro pollen germination using different culture media.
11. Studies on databases pertaining to plant reproduction/Pollination/Pollen studies.
13. Studies on e-Journals access
14. Visit to Institutes with electron microscope facilities.
15. Study of pollen wall development by preparation of anther sections.
16. Examination of reproductive mode and means.

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**PRACTICAL VI: REPRODUCTIVE BIOLOGY OF ANGIOSPERMS**

**PRACTICAL SCHEDULE**

*Time: 6 hrs.*

**Max. marks: 40**

**Q.1:** Perform the major experiment on pollen preparation for morphological studies 08 Marks

**Q.2:** Perform the minor experiment on pollen physiology 08 Marks

**Q.3:** Perform the minor experiment on pollen release/Production/monitoring 05 Marks

**Q.4:** Comment on the experiment based on anther/pollen culture. 04 Marks

**Q.5:** Spotting (Pollen morphology slide, floral reward, blossom type, pollinator, ovule types) 10 Marks

**Q.6:** Viva-Voce 05 Marks

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**Semester –III**

**Pollination experiments to demonstrate self and cross-pollination.**

**Field study on different pollination mechanism.**

**Estimation of pollen load carried out by bees / pollinator.**

**Field observations on pollinator visit, diversity and behaviour.**

**Estimation of pollen production and viability and its statistical analysis.**

**Study of in- vivo and in- vitro pollen germination.**

**Pollen preparation by acetylation method and NPC examinations.**

**SEM studies and visits to Research laboratory having SEM facilities.**

**Observations on types of stigma and its structure.**

**Study of ovules from permanent preparations.**

**The study of microsporogenesis by section cutting.**

**Air monitoring by air sampler to assess pollen aerospora.**

**Chemical nature of allergenic pollen and test for allergy.**

**Regeneration of androgenic haploids.**

**Protoplast isolation**

**Histochemical analysis of pollen tube.**

**Estimation of pollen / ovule ratio in self and cross pollinated plants.**

**Study of protein profile in pollen / pollen tube by Gel - Electrophoresis.**

**Effect of Biochemical inhibitors on pollen tube growth.**

**Estimation of pollen tube length by computer loaded measurement softwares (Sigmscan by Jandel Scientific, Electronic digital pad).**
Semester III

PAPER XI: APPLIED MYCOLOGY-I (Elective)

Unit - I: Fungal Symbiosis
1.1: Mycorrhizae Ectotrophic, endotrophic and Ectendotrophic mycorrhizae.
1.2: Morphology and structure of Arbuscular mycorrhizal fungi.
1.3: Phosphorus uptake of AM fungi.
1.4: Role and importance of AM fungi in agriculture.
1.5: Rhizosphere and phyllosphere General account and importance of rhizosphere and phyllosphere mycoflora.

Unit II: Medical mycology
2.1: General account of dermatophytic fungi.
2.2: Human diseases caused by dermatophytes viz. Tinea pedis, Tinea capitis, Tinea barbae, Tinea corporis and Tinea manum.
2.3: Birds and Animal dermatophytic fungi and the diseases caused by them.

Unit - III: Industrial mycology
3.1: Antibiotics - Penicillium, Cephalosposin & Griseofulvin.
3.2: Industrial production of Penicillin.
3.3: Organic acids - Citric acid, Gluconic acid, Lactic acid.

Unit - IV: Industrial and Nonindustrial fungal metabolites
4.1: Enzymes - Amylases, Proteases, Lipases, Pectinases, Cellulases.
4.2: Phytoalexins : General account, types and importance.
4.3: Mycotoxins _ General account, types and importance.
4.4: Aflatoxins - General account, types & Importance.

Unit V: Fungi in Human Welfare
5.1: Role of microorganisms in Biodegradation of organic wastes.
5.2: Biodeterioration of noncellulosic and cellulose materials.
5.3: Fungi in medicine-Mycoproteins & Food processing- Fungus fermented foods, fungi in cheese production.
5.4: Edible mushrooms and their cultivation practices.

Semester III

PAPER XII: PLANT PATHOLOGY-II (Elective)

Unit - I: Principles and Mechanism of Plant diseases.
1.1: History, Classification and importance of plant pathology.
1.2: Host parasite relationship, interaction and mechanism of infection.
1.3: Defence mechanism in plants - Biochemical defence mechanism of phenolic compounds, enzymes and toxins.

1.4: Koch’s Postulate - Principles and method.

Unit - II: Disease management and Forecasting.
2.1: Chemical and Biological management of Plant disease control.
2.2: Integrated Pest management (IPM)
2.3: The Forms of epidemic conditions for decline of epidemics.
2.4: Methods used in disease Forecasting.
2.5: Forest Pathology and it’s impact (General account)

Unit-III: Fungal diseases of cereals and oil seed crops.
3.1: Diseases of cereals - Rust and smuts of wheat, Blast and blight of rice, smuts and leaf spot of Jowar. Ergot, Green ear and downy mildew of Bajra.
3.2: Important diseases of oil seed crops -Soyabean, Groundnut, Sunflower, Safflower and Mustard.
3.3: General knowledge and importance of seed pathology.

Unit - IV: Important fungal diseases of vegetables & Fruits.
4.1: Diseases of vegetables - Brinjal, Tomato, Potato, Chilli, Bhindi, Cabbage and cucurbits.
4.2: Diseases of Fruit crops - Citrus, Papaya, Banana, Mango and grapes.
4.3: General account of post harvest diseases of vegetables and fruits and it’s control.

Unit - V: Bacterial and Viral diseases.
5.1: Bacterial diseases, Blight of rice, Tundu disease of wheat, Angular leaf spot of cotton, soft rot of fruits and vegetables.
5.2: Viral diseases - Mosaic and leaf curl of Papaya, Yellow vein mosaic of Bhindi, Viral diseases of Tomato and Potato.
5.3: Phytoplasmal diseases - little leaf of Brinjal, Grassy shoot of sugarcane, & Sesamum Phyllody.

Suggested readings:
Laboratory Exercises:
1. Principles & working of tools, equipments and other requirements in the Mycology & Plant Pathology laboratory.
2. Micrometry and measurement of organisms.
4. Drawing of Camera Lucida diagrams and knowledge of computer-based photomicrography and image processing.
5. Preparation of different cultural media for cultivation of Fungi and Bacteria.
8. Demonstration of dermatophytic Fungi.
9. Isolation of AM Fungi from rhizosphere 500%.
10. Demonstrate antifungal activities of different antibiotics and leaf, flower and root extract.
11. Study of hydrolytic enzymes of different fungi.
12. Study of toxicity of fungi in relation to seed germination, and seedling abnormality.
13. Cultivation of Mushroom.
15. Visit to Mushroom industry, Pharmaceutical industries & Pathological study center.
16. Isolation of Soil fungi by soil plate (War cup) and serial dilution (Walkman) method.
17. Isolation and identification of Rizosphere mycoflora.
18. Isolation of external and internal seed borne mycoflora by blotter and Agar Plate method. Cereals, pulses, oil seeds, fruit seeds.
19. Monographic study of locally available plant diseases caused by fungi (atleast 10).
20. Study of locally available crop plant diseases caused by Bacteria (Five)
21. Study of locally available plant diseases caused by viruses & Phytoplasma (Five)
22. Demonstration of morphological & physiological changes in disease plants.
23. Demonstration of Koch’s Postulate.

24. Preparation and presentation of herbarium of pathological specimens available in the region (Atleast 30)
25. Preparation of Fungal spore atlas.
26. Field visit to different localities
27. Visit to Agriculture University, Plant Pathological research centers

Semester – III
ELECTIVE PRACTICAL-VI: APPLIED MYCOLOGY AND PLANT PATHOLOGY
PRACTICAL SCHEDULED

Time: 06 hrs.
Maximum Marks: 40

Q.1) Identify and describe any two fungal plant diseases.......................... 08 Marks
Q.2) Identify and give salient features of two fungi from the mix culture. 08 Marks
Q.3) Identify, classify and describe any two fungi. from given seed borne mycoflora/soil mycoflora/Rhizosphere mycoflora........................................... 05 Marks
Q.4) Demonstrate Koch’s postulate/pure culture technique.................... 04 Marks
Q.5) Spotting (Specimen/Slide)
   (01 - bacterial disease; 01-viral diseases, 01- Phytoplasmal disease; 01-Fungal disease, 01- Spore slide)..............................10 Mraks
Q.6) Viva-Voce 05 Marks

M.Sc. PART-II BOTANY
Semester – IV
PAPER - XIII: PLANT ECOLOGY

Unit I : Basic concepts and scope.
1.1 Concept, Classification and scope of ecology; Holocoenotic Environment.
1.2 Ecological factors: Climatic, Edaphic, Biotic; Law of limiting factors.
1.3 El-Nino and global warming.
1.4 Ozone layer, Ozone Depletion and its consequences.

Unit II: Population and Community Dynamics
2.1 Population characteristics; population dynamics, carrying capacity, various parameters and measurements.
2.2 Community concept; characteristic features of communities, analysis of communities (analytical and synthetic characters.)
2.3 Community coefficients; Ecotone and edge effects; ecological niche.

Unit III: Vegetation Development
3.1 Types and mechanism of ecological succession.
3.2 Plant Formation; Association, Consociation and Society.
3.3 Evolution of Ecosystem and oxygenic development.

Unit IV: Ecosystem Organization.
4.1 Structure and Functions of Ecosystem.
4.2 Abiotic and biotic components; decomposers role in ecosystem.
4.3 Primary productivity (methods of measurements, global pattern and controlling factors)
4.4 Energy Dynamics; Energy flow in Ecosystem, Trophic organization, ecological efficiencies; Ecomodelling.

Unit V: Ecosystem Functional aspects.
5.1 Biogeochemical cycles C, N, P, S; mineral cycles (Pathways, processes and budgets)
5.2 Ecosystem stability concepts, natural and anthropogenic disturbances.
5.3 Major Biomes of the world.
5.4 Terrestrial Biodiversity; Vegetation types of world and India, hot spots.

Suggested readings:
26) K.C. Agrawal; (1993); Environmental Biology, Agro-botanical publishers, Bikaner.

Laboratory exercises:
1) To measure rainfall.
2) To measure transparency of water.
3) To study the light intensity by lux meter.
4) To determine pH of water & soil.
5) To measure the total dissolved solids in water.
6) To evaluate the soil texture.
7) To determine the bulk density or apparent density (or value weight) and porosity (or pore space) of soil.
8) To determine water holding capacity of soil by rapid spot tests.
9) To analyze the chemical properties of soil by rapid spot tests.
10) To estimate exchangeable bases (Na, K, Ca) in soil.
11) To determine organic matter in soil by Walkley & Black’s rapid titration method.
12) To assess the trophic status of aquatic habitat through algal count method.
13) To study bioindicators of polluted water.
14) To study the morphological, anatomical adaptations in Hydrophytes, Xerophytes, Halophytes, Epiphytes.
15) To determine the importance value Index IVI) of grassland species.
16) To prove the Biological spectrum of vegetation under study using Raunkiar's life forms classification.
17) To study indices of similarity & dissimilarity in a community.
18) To determine P, S, K, Ca, Na in plants by chemical methods.
19) Study of freshwater plant communities.
20) Survey of key stone species.
21) Determination of minimum size of quadrat by species curve method.
22) Determination of minimum number of quadrat by curve methods.
23) Determination of quantitative characters of plant community by Random sampling method (Abundance, Density, frequency, basal cover, canopy cover etc) and determination of quantitative characters by belt transect, line transect method and study of biological spectrum.

24) Field Survey- A survey of a part of the town or city should be carried out by the entire class in batches. Individual students will select one avenue / road and locate the tree planted on a graph paper. They will identify the trees, mention their size, canopy shape, blossoming and fruiting period and their status (healthy, diseased, infected, mutilated, misused or dyeing) and report whether or not the conditions in which they are surviving are satisfactory. The individual reports will be combined to prepare a large map of the area, which can be used for subsequent monitoring either by the next batch of students / teachers / local communities / NGOs / or civic authorities.

25) The purpose is to make the students aware of the kinds of trees and value in urban ecosystem and ecological services.
26) To prepare ombrothermic diagram for different sites on the basis of given data set and to comment on climate.
27) To find out the relationship between two ecological variables using correlation and regression analysis.

Semester – IV
PAPER – XIV: ENVIRONMENTAL ECOLOGY

Unit I: Basic Concepts
1.1 Concept of Environment and its Scope; Lithosphere, Hydrosphere, Biosphere.
1.2 Energy resources; (i) Renewable and non-renewable (ii) Forest types in India and Maharashtra.
1.3 Environmental impact assessment.
1.4 Green House gases; their sources, trend and role.
1.5 Consequences of climate change.
Unit II: Environmental pollution

2.1 Definition types and sources.
2.3 Air pollution; Natural and man made sources of air pollution, primary and secondary pollutants, toxicity and its impact on environment.
2.4 Soil Pollution: courses of soil pollution, impacts of soil pollution on quality and soil biota.
2.5 Effect of solid waste disposal on soil.

Unit III: Water Pollution.

3.1 Distribution of water and water scarcity.
3.2 Major water pollutants
3.3 Sources of water pollution
3.4 Consequences of water pollution
3.5 Water pollution indicators.
3.6 Bioaccumulation and Biomagnifications of toxic elements in food chain.

Unit IV: Conservation strategies

4.1 Principles of conservation; extinction, environmental status of plants based on IUCN.
4.2 Strategies for conservation, International efforts and Indian initiation.
4.3 Wetlands, Mangrove and coral reefs with respect to conservation of biodiversity.
4.4 Disaster management.

Unit V: Sustainable Management.

5.1 Concept of sustainable development.
5.2 Impact of urbanization; Wasteland development.
5.3 General account of legislative measures for sustainable development and management
   (ii) Environmental Protection Act, 1985
   (iii) Wildlife Protection Act, 1972; WWF.

SUGGESTED READINGS:

Laboratory Exercises:
1. Study of rainguage and measurement of rainfall
2. To study hygrometer and measurement of relative humidity.
5. To study pH meter and estimation of pH of water and soil.
6. To determine soil moisture content.
7. Study of Phytoplankton from pond water.
8. Study of Zooplankton from pond/river.
9. Study of biomass from grassland ecosystem.
10. Study of species dominance by Quadrat method.
11. Study of plant biodiversity on Hill slopes by line transact method.
12. To study the pH of rainwater during pre monsoon and monsoon season.
13. To determine interaction between grassland species by chi-square test.
15. Study of mean, variance, standard deviation, standard error, coefficient of variation and t-test for ecological data.

Semester – IV
PAPER – XV : PLANT BIOTECHNOLOGY

Unit- I: Biotechnology: Basic concepts, Principle and scope.
1.1 Cellular differentiation and totipotency
1.2 Plant Cell and tissue culture, Cell Clones, Callus culture.
1.4 Organogenesis and adventitive embryogenesis: Fundamental aspects of morphogenesis, Somatic embryogenesis and its applications.
1.4 Androgenesis: Mechanism, techniques and applications.

Unit-II: Somatic Hybridization:
2.1 Protoplast isolation, Protoplast fusion and protoplast culture limitation, achievement in protoplast research.
2.2 Cybrids and Hybrids, Selection of hybrids and regeneration, Somaclones.
2.3 Clonal propagation: Techniques and significance of artificial seeds.
2.4 Secondary metabolites: Production in tissue/s, enhancing the secondary metabolites by use of elicitors, hairy root cultures and types of elicitors (biotic and abiotic elicitors)
2.5 Cryopreservation: Germplasm storage, methods, merits and demerits.

Unit-III: Plant transformation technology.
3.1 Mechanism of DNA transfers, role of virulence genes, use of Ti and Ri plasmid as binary vectors, features of Ti and Ri plasmid.
3.2 Vector-less DNA transfer - Particle Bombardment, Electroporation, and microinjection.
3.3 Genetically modified organisms in the Environment

Unit-IV: Environmental Biotechnology
4.1 Heavy metals environmental modification, Biobleaching and Microbial leaching.
4.2 Bioremediation- General idea of Xenobiotics, Biodegradation of Xenobiotics and applications.
4.3 Phytoremediation: Needs, Metal and organic phytoremediation.

Unit –V: Applications
5.1 Microbial genetic manipulation.
5.2 Importance and application of microbes in Biotechnology
5.3 Vermicomposting

Suggested Readings:

**Laboratory Exercises:**
1. Preparation of stock solution and culture media.
2. Sterilization techniques
3. Preparation of Aseptic plant

**Semester- IV**

**PAPER– XVI: GENETIC ENGINEERING**

**Unit-I:**
1.1 Structure of Microbes: E.coli, Bacteriophage, Viruses
1.2 Genetic Recombination in Bacteria: Transduction, Transformation and Conjugation.
1.3 Bacterial cultures and maintenance of Cell lines.
1.4 Genetic improvement of industrial microbes and nitrogen fixers.
1.5 Fermentation Technology.

**Unit-II:**
2.1 Methods of gene cloning; selection of markers, reporter genes, expression vectors.
2.2 Isolation of gene.
2.3 Construction of genomic/ cDNA libraries.
2.4 Factors affecting foreign gene expression.
2.5 DNA Synthesis and Automated. Sequencing; PCR

**Unit-III:**
3.1 Aims and strategies for transgenic development.
3.2 Agrobacterium mediated gene transfer.
3.3 T- transposon mediated gene tagging.
3.4 Chloroplast transformation.
3.5 Transgenic- ethical concerns and ecological risk.
Unit-IV: 4.1 Enzymes used in Recombinant Technology.
        4.2 Types of vectors, their properties, choice of vectors.
        4.3 Alien gene transfer: Whole genomic transfer eg. Wheat, 
            Arachis, Brassica
        4.4 Transfer of individual chromosome or chromosome 
            segment.

Unit-V: 5.1 High throughput sequences and assembly.
        5.2 Human Genome Project
        5.3 Tools used in genetic Engineering, Blotting techniques,
            SSR, VNTR, STR.
        5.4 Gene Knockout Technologies.
        5.5 Gene Therapy - Strategies, gene editing, silencing.

Suggested Reading:
   Singapore.
   Biotechnology and Plant Genetic Resources Conservation and Use. 
   CAB International, Oxon, UK.
   Agriculture. Jones & Bartlett Publishers, Boston, USA.
   W.H.Freeman and Company, New York, USA.
   Publishers, New York, USA.
   Chapman & Hall, London, UK.
   Production in Higher Plants, Vols. 1-5, Fundamental Aspects and 
   Genomics, Birkhauser Verlag, Basel, Switzerland.
    Science Ltd., Oxford, UK.
    Cambridge University Press, New York, USA.
15. Cloning 1: A Practical Approach; Core techniques, 2nd Edition, PAS, 
    to recombinant DNA Techniques. Basic Experiment in gene 
    manipulation. The Benjamin / Cummings Publishing Company. Inc 
    Menlo Park, California.

Laboratory Exercises:
1. Preparation of Bacterial Cultivation media
2. Bacterial cultivation and growth characteristics by streak and spread 
   plate method
3. Isolation and estimation of Bacterial genomic DNA
4. Isolation and estimation of Onion DNA.
5. Isolation of Plasmid from E. coli strain DH5-a
6. Restriction enzyme digestion and analysis on Agarose Gel.
7. Isolation and estimation of Plant DNA.
8. Preparation of competent cells for transformation.
9. DNA ligation
10. RAPD Analysis.
11. Electro elution of DNA from Agarose Gels.
12. Test for antibiotics against bacteria.
13. Total proteins detection on Blotting Membranes.
15. Alkaline Gel electrophoresis.
17. DNA fingerprinting of plant genomic DNA.
18. Transfer of Proteins from SDS PAGE to Nitrocellulose Membrane.
19. Detecting DNA with Acridine Orange or methylene Blue.
20. ELISA
21. Immunoassay
22. Antimicrobial sensitivity testing
23. PCR
24. Preparation of insert DNA
SEMESTER-IV
PRACTICAL- VII: PLANT ECOLOGY, ENVIRONMENTAL ECOLOGY, BIOTECHNOLOGY AND GENETIC ENGINEERING.

PRACTICAL SCHEDULE

Time : 8 hrs. Marks 40

Q.1. Setting and working of any of major plant Ecology Expt. 08 Marks

Q.2. Setting and working of major Experiment on Biotechnology 08 Marks

Q.3. Working of major experiment on Environmental Ecology 07 Marks

Q.4. Major Experiment on Genetic Engineering 07 Marks

Q.5. Comment on one minor Experiment on genetic Engineering/Biotechnology. 05 Marks

Q.6. Viva-Voce 05 Marks

Important note: - One long and two short Botanical Excursions and visits to Scientific Laboratories/Institutions/Universities/Botanical Gardens/Forests within and out of state are compulsory for students of M.Sc. Botany.

PRACTICAL-VIII:

Project to the students will be distributed at the beginning of third Semester with the consent of HOD and shall be examined during the period of practical examination in IV Semester

Project 40 marks
Int. Assessment 10 Marks

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