KANNUR UNIVERSITY

(Abstract)

MSc Botany Programme- Scheme , Syllabus and Model Question papers (Ist and IInd semester only) under Choice Based Credit and Semester System (Outcome Based Education system- OBE) in Affiliated Colleges -Implemented with effect from 2023 admissions - Implemented- Orders issued.

ACADEMIC C SECTION

ACAD C/ACAD C4/17159/2023 Dated: 22.08.2023

Read:-1. U.O No. Acad C2/429/2017 Dated 08.09.2020
2. U. O No. Acad C1/21246/2019 Dated 07.12.2020
3 . U.O. No. Acad/C1/21246/2019 dated 16.02.2023 ,
4. U.O. No. Acad/C1/21246/2019 dated 20.04.2023
5. Minutes of the meeting of the CSMC & Conveners of Adhoc committee held on 15.06.2023
6. U.O. No. Acad/C1/21246/2019 dated 09.08.2023
7. Minutes of the Meeting of the Adhoc committee for MSc Botany programme held on 10.08.2023
8. Syllabus submitted by the Convenor, Adhoc committee for MSc Botany Programme dated 16.08.2023

ORDER

1. Curriculum Syllabus Monitoring Committee comprising the members of Syndicate was constituted for the Syllabus revision of UG & PG Programmes in Affiliated Colleges, vide paper read (1) above and as per the recommendation of this Committee in its meeting held on 20.11.2020, constitute a sub Committee to prepare the Regulation for PG programmes in Affiliated Colleges vide paper read (2) above.

2. As the reconstitution of Board of Studies of the University is under consideration of the Hon'ble Chancellor, considering the exigency of the matter, Ad hoc Committees were constituted vide paper read (3) above, & it has been modified vide paper read (4) above to revise the Curriculum and Syllabus of PG Programmes in Affiliated Colleges w.e.f 2023-24 academic year.

3. The combined meeting of the Curriculum Syllabus Monitoring Committee & Conveners of Adhoc committee held on 15.06.2023 at syndicate room discussed in detail the draft Regulation, prepared by the Curriculum Syllabus Monitoring Committee, for the PG programmes under Choice Based Credit and Semester System to be implemented in Affiliated Colleges w.e.f 2023 admission and proposed the different phases of Syllabus revision process such as subject wise workshop , vide paper read (5) above.

4. Revised Regulation for PG programmes under Choice Based Credit and Semester System (in OBE- Outcome Based Education System) was approved by the Vice Chancellor on 05.08.2023 and implemented w.e.f 2023 admission vide paper read (6) above.

5. Subsequently, as per the paper read (7) above, the Ad hoc committee for M.Sc Botany programme finalized the Scheme, Syllabus and Model question papers of Ist & IInd semester M.Sc Botany programme to be implemented w.e.f 2023 admission

6. As per the paper read (8) above, the Convener, Ad hoc committee for M.Sc Botany submitted the finalized copy of the Scheme, Syllabus and Model question papers of Ist & IInd semester M.Sc Botany programme for implementation w.e.f 2023 admission

7. The Vice Chancellor after considering the matter in detail and in exercise of the powers of the Academic Council conferred under section 11(1) Chapter III of Kannur University Act, 1996 and all other enabling provisions read together with, **accorded sanction to implement the Scheme, Syllabus and Model Question Papers of Ist & IInd semester M.Sc Botany programme under Choice Based Credit and Semester System (in OBE- Outcome Based Education System) in Affiliated Colleges under the University w.e.f 2023 admission** ***, subject to report to the Academic Council.***

8. The Scheme, Syllabus and Model question papers of Ist and IInd semester M.Sc Botany

programme under Choice Based Credit and Semester System (in OBE- Outcome Based Education System) in Affiliated Colleges under the University w.e.f 2023 admission is uploaded in the University website.

9. Orders are issued accordingly.

Sd/-
Sajesh Kottambrath
Assistant Registrar1
For REGISTRAR

To:
1. Principals of Affiliated Colleges offering MSc Botany Programme
2. Convener, Curriculum Syllabus Monitoring Committee.
3. Convener, Ad hoc Committee for M.Sc Botany Programme

Copy To:
1. The Examination Branch (Through PA to CE)
2. PS to VC / PA to PVC / PA to R/PA to FO
3. DR / AR 1 (Acad) /All sections of Academic Branch/Computer Programmer
4. SF / DF /FC
5. IT Centre (for uploading on the website)

Forwarded / By Order

SECTION OFFICER

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Re-accredited by NAAC with 'B++' Grade

CURRICULUM & SYLLABUS

For Choice Based Credit And Semester System

With Outcome Based Education System

M.Sc. Botany Programme

(KUCBCSS - PG - 2023)

PART – A

I & II Semester

In Affiliated Colleges

With effect from 2023 Admission Onwards

www.kannuruniversity.com

INDEX

PREFACE

Outcome Based Education is a student centered approach that emphasizes defining clear and measurable learning outcomes and aligning teaching and assessment methods to achieve those outcomes. The purpose of an OBE syllabus is to provide a structured frame work for designing and delivering instructions that focuses on desired learning outcomes. By clearly articulating the expected knowledge, skills, and competencies that students should acquire, the syllabus guides educators in developing meaningful learning experiences that lead to measurable results. It ensures that education is purposeful, relevant, and learner centric.

OBE incorporates clear and measurable criteria for assessing student learning outcomes. This allows for more accurate and reliable evaluation of students' achievements. By focusing on the outcomes, educators can better identify areas of strengths and weaknesses, provide targeted feedback, and implement necessary interventions to improve learning outcomes. Outcome-based education ensures that the knowledge and skills acquired by students align with the demands and expectations of the job market or specific industries.

This syllabus encompasses a wide range of topics that will expand students' knowledge and appreciation for the plant kingdom. Throughout the study of botany, you will have the opportunity to engage in hands-on laboratory work, field observations, and research projects. These practical experiences will enhance the understanding of theoretical concepts and develop essential scientific skills. Botany offers a unique perspective on the living world and provides a foundation for various careers, including plant research, environmental conservation, agriculture, education, and pharmaceuticals, among others. By studying botany, you will not only develop a deeper understanding of plants but also gain insights into the intricate mechanisms that sustain life on our planet.

As per the regulations of Kannur University Credit Based Semester System the committee has revised the MSc BOTANY curriculum for affiliated colleges focusing on the outcome based education approach. We acknowledge that the collective efforts and expertise of professionals were instrumental in shaping the syllabus and making it comprehensive, relevant, and impactful. We are sincerely grateful for their valuable inputs, which will undoubtedly enrich the educational experience for our students.

Members:

Dr. Sreeja P
Dr. Harikrishnan E
Ms. Suvarnika V
Dr. Josekutty EJ
Dr. Tomson Mani
Dr. Resmi MS
Dr. Prasanth KP

Dr. Tajo Abraham
Convener (Adhoc Committee)

KANNUR UNIVERSITY

Curriculum for Choice Based Credit and Semester System for Postgraduate Programme in Affiliated Colleges -2023

(OBE – Outcome Based Education – system)

Kannur University introduced Outcome Based Education (OBE) in the curriculum for under graduate students in 2019. Expanding OBE to the Postgraduate curriculum and syllabus from the academic year 2023 onwards demonstrates the university's commitment to further improving the learning experience for its students across different academic levels. This move is to enhance the academic rigour and relevance of the Postgraduate programmes, better preparing the students for their future careers and challenges.

Outcome based education is an educational methodology where each aspect of education is organized around a set of goals (outcomes). Students should achieve their goal by the end of the educational process. Throughout the educational experience, all students should be able to achieve their goals. It focuses on measuring student performance through outcomes. The OBE model aims to maximize student learning outcomes by developing their knowledge & skills.

The key to success in outcome-based education is clarity, for both teachers and students to understand what's expected of them. Outcome-based education aims to create a clear expectation of results that students must achieve. Here, the outcome includes skills, knowledge and attitude. In addition to understanding what's expected, outcome-based education also encourages transparency. The basic principle of outcome-based education is that students must meet a specific standard to graduate. Hence, no curve grading is used in outcome-based education, and instead, teachers are free to experiment with any methodology they feel is best.

Mission statements

- To produce and disseminate new knowledge and to find novel avenues for application of such knowledge.
- To adopt critical pedagogic practices which uphold scientific temper, the uncompromised spirit of enquiry and the right to dissent.
- To uphold democratic, multicultural, secular, environmental and gender sensitive values as the foundational principles of higher education and to cater to the modern notions of equity, social justice and merit in all educational endeavours.
- To affiliate colleges and other institutions of higher learning and to monitor academic, ethical, administrative and infrastructural standards in such institutions.

- To build stronger community networks based on the values and principles of higher education and to ensure the region's intellectual integration with national vision and international standards.
- To associate with the local self-governing bodies and other statutory as well as non-governmental organizations for continuing education and also for building public awareness on important social, cultural and other policy issues.

Establishing the Programme Outcomes (POs)

Programme Outcomes (POs): Programme outcomes can be defined as the objectives achieved at the end of any specialization or discipline. These attributes are mapped while a student is doing graduation and determined when they get a degree.

PO 1. Advanced Knowledge and Skills: Postgraduate courses aim to provide students with in-depth knowledge and advanced skills related to their chosen field. The best outcome would be to acquire a comprehensive understanding of the subject matter and develop specialized expertise.

PO 2. Research and Analytical Abilities: Postgraduate programmes often emphasize research and analytical thinking. The ability to conduct independent research, analyze complex problems, and propose innovative solutions is highly valued.

PO 3. Critical Thinking and Problem-Solving Skills: Developing critical thinking skills is crucial for postgraduate students. Being able to evaluate information critically, identify patterns, and solve problems creatively are important outcomes of these programs.

PO 4. Effective Communication Skills: Strong communication skills, both written and verbal, are essential in various professional settings. Postgraduate programs should focus on enhancing communication abilities to effectively convey ideas, present research findings, and engage in academic discussions.

PO 5. Ethical and Professional Standards: Graduates should uphold ethical and professional standards relevant to their field. Understanding and adhering to professional ethics and practices are important outcomes of postgraduate education.

PO 6. Career Readiness: Postgraduate programs should equip students with the necessary skills and knowledge to succeed in their chosen careers. This includes practical skills, industry-specific knowledge, and an understanding of the job market and its requirements.

PO 7. Networking and Collaboration: Building a professional network and collaborating with peers and experts in the field are valuable outcomes. These connections can lead to opportunities for research collaborations, internships, and employment prospects.

PO 8. Lifelong Learning: Postgraduate education should instill a passion for lifelong learning. The ability to adapt to new developments in the field, pursue further education, and stay updated with emerging trends is a desirable outcome.

Establishing the Course Outcomes

Course Outcomes (COs) are the objectives that are achieved at the end of any semester/year. For instance, if a student is studying a particular course, then, the outcomes would be concluded on the basis of the marks or grades achieved in theory and practical lessons.

Each programme shall define the COs according to the outcome set at the beginning of the study of the course.

Automated Question Bank System

The evaluation process shall be based on the revised Bloom's Taxonomy. Hence the syllabus shall be defined and designed in view of the scheme of the said taxonomy.

Modules

The syllabus shall be prepared in four Modules to reflect the spirit of revised Blooms Taxonomy and the evaluation system based on the six cognitive levels.

Evaluation process using Revised Bloom's Taxonomy

There are six levels of cognitive learning according to the revised version of Bloom's Taxonomy. Each level is conceptually different. The six levels are remembering, understanding, applying, analysing, evaluating, and creating. These levels can be helpful in developing learning outcomes.

Remember: Definition: retrieve, recall, or recognize relevant knowledge from long-term memory. Appropriate learning outcome verbs for this level include: *cite, define, describe, identify, label, list, match, name, outline, quote, recall, report, reproduce, retrieve, show, state, tabulate, and tell.*

Understand: Definition: demonstrate comprehension through one or more forms of explanation. Appropriate learning outcome verbs for this level include: abstract, arrange, articulate, associate, categorize, clarify, classify, compare, compute, conclude, contrast, defend, diagram, differentiate, discuss, distinguish, estimate, exemplify, explain, extend, extrapolate, generalize, give examples of, illustrate, infer, interpolate, interpret, match, outline, paraphrase, predict, rearrange, reorder, rephrase, represent, restate, summarize, transform, and translate.

Apply: Definition: Use information or a skill in a new situation Appropriate learning outcome verb for this level include: apply, calculate, carry out, classify, complete, compute, demonstrate, dramatize, employ, examine, execute, experiment, generalize, illustrate, implement, infer, interpret, manipulate, modify, operate, organize, outline, predict, solve, transfer, translate, and use.

Analyze: Definition: break material into its constituent parts and determine how the parts relate to one another and/or to an overall structure or purpose Appropriate learning outcome verbs for this level include: analyse, arrange, break down, categorize, classify, compare, connect, contrast, deconstruct, detect, diagram, differentiate, discriminate, distinguish, divide, explain, identify, integrate, inventory, order, organize, relate, separate, and structure.

Evaluate: Definition: make judgments based on criteria and standards Appropriate learning outcome verbs for this level include: appraise, apprise, argue, assess, compare, conclude, consider, contrast,

convince, criticize, critique, decide, determine, discriminate, evaluate, grade, judge, justify, measure, rank, rate, recommend, review, score, select, standardize, support, test, and validate.

Create: Definition: put elements together to form a new coherent or functional whole; reorganize elements into a new pattern or structure. Appropriate learning outcome verbs for this level include: arrange, assemble, build, collect, combine, compile, compose, constitute, construct, create, design, develop, devise, formulate, generate, hypothesize, integrate, invent, make, manage, modify, organize, perform, plan, prepare, produce, propose, rearrange, reconstruct, reorganize, revise, rewrite, specify, synthesize, and write.

KANNUR UNIVERSITY

Regulations for Choice Based Credit and Semester System for Postgraduate Programme in Affiliated Colleges -2023 (in OBE – Outcome Based Education – system)

1. TITLE, APPLICATION AND COMMENCEMENT

1.1 These regulations may be called "Kannur University Regulations for Choice Based Credit and Semester System for Postgraduate Programme 2023" (in OBE – Outcome Based Education – system) (KUCBCSSPG 2023)

1.2 The regulations provided herein shall apply to all regular Post-graduate programmes conducted in colleges and institutions affiliated to the Kannur University, coming under the Faculties of Science, Technology, Humanities, Social Sciences, Language & Literature, Commerce and Management Studies, Fine Arts, Communication, and such other faculties as decided by the University from time to time .

1.3 These regulations shall come into force with effect from 2023 admission onwards.

1.4 The provisions herein shall supersede all the existing regulations for the regular Postgraduate programmes of affiliated colleges and institutions to the extent herein prescribed.

2. DEFINITIONS: In these regulations, unless the context otherwise requires:

2.1 '**Programme**' means a programme of study comprising of Core Course, Elective Course, Open Course and MOOC course as applicable.

2.2 '**Duration of Programme**' means the time period required for the conduct of the programme. The duration of a Post Graduate degree programme shall be four semesters with 18 weeks in a semester distributed over a period of two academic years in compliance with hours of instruction stipulated by UGC.

2.3 '**Semester**' means a term consisting of 90 working days including examination days.

2.4 **'Academic Week'** is a unit of five working days in which the distribution of work is organised from day one to day five (normally, Monday to Friday), with five contact hours of one-hour duration on each day. A sequence of 18 such academic weeks constitutes a semester.

2.5 '**Course**' means a segment of a programme limited to one semester in a subject.

2.6 **'Core Course'** means a compulsory course in a subject related to a particular postgraduate programme.

2.7 **'Elective Course'** means an optional course to be selected by a student out of such courses offered in the same Department.

2.8 **'Open Elective Course (Multidisciplinary)'** means an elective course which is available for students of all departments including students of the same department. Students of other

departments may opt for these courses subject to fulfilling eligibility criteria as laid down by the department offering the course.

2.9 **'MOOC Course'** means Massive Open Online Course.

2.10 **'Improvement Course'** is a course registered by a student for improving her/his performance in that particular course.

2.11 **'Credit'** means the value assigned to a course which indicates the level of instruction. It is the measure of total number of hours of training received in a course during a week.

2.12 **'Credit Point' (CP) of a Course** is the value obtained by multiplying the grade point (GP) by the credit (C) of the course: **CP = GP x C**.

2.13 **'Credit Point' (CP) of a Semester is** the sum of credit points obtained by a student in various courses taken in a semester.

2.14 **'Semester Grade Point Average'** (SGPA) is the value obtained by dividing the sum of credit points obtained by a student in various courses taken in a semester by the total number of credits in that semester. SGPA shall be rounded off to three decimal places. SGPA determines the overall performance of a student at the end of a semester.

2.15 **'Cumulative Grade Point Average'** (CGPA) is the value obtained by dividing the sum of credit points in all the courses taken by the student for the completed semesters by the total number of credits acquired so far and shall be rounded off to three decimal places.

CGPA = Sum of the Credit Points secured in completed semesters/ Total Credit for the completed semesters

2.16 **'Overall Grade Point Average'** (OGPA) is the value obtained by dividing the sum of credit points in all the semesters taken by the student for the entire programme by the total number of credits in the entire programme and shall be rounded off to three decimal places. OGPA is the final grade point average after completing four semesters.

2.17 **'Grade Card'** means the official record of a student's performance, awarded to her/him. Each letter grade is assigned a **'Grade Point'** (GP) which indicates the numerical equivalent of the broad level of performance of a student in a course. **"Grade Point"** means a point given to a grade on the scale as provided under clause 7.2.

2.18 **'Letter Grade'** or simply 'Grade' in a course is a letter symbol (A^+, A, B, C, D, E, and F). Grade means the prescribed alphabetical grade awarded to a student based on her/his performance in various examinations.

2.19 **'Repeat course'** is a course that is repeated by a student in a semester for want of sufficient attendance. She/ He can repeat the course whenever it is offered again. The student registered for repeat course need not attend the classes if she/he has satisfied the requirements regarding attendance.

2.20 **'Strike off the roll'**: means removing a student who is continuously absent for 14 days without sufficient reason and proper intimation to the Principal of the college from the roll after following the procedure prescribed.

2.21 **'College Council'** means the body of all Heads of the Departments and elected members among teachers as per the Kannur University Statutes.

2.22 **'College Co-ordinator'** is a teacher nominated by the college council to coordinate the effective running of CBCSS and the process of continuous evaluation undertaken by various departments within the college. She / he shall be nominated to the College level Grievance Redressal Cell.

2.23 **'Department'** means any teaching department in a college offering a programme/course of study approved by the University, as per the Statutes and Act of the University.

2.24 **'Parent Department'** means the Department that offers a particular degree programme.

2.25 **'Department Council'** means the body of all teachers of a department in a college.

2.26 **'Department Co-ordinator'** is a teacher nominated by the Department Council to co-ordinate the continuous evaluation process undertaken in that department.

2.27 **'Faculty Adviser'** means a teacher from the parent department nominated by the Department Council, who will advise the students in academic matters and in the choice of Generic Elective course.

2.28 Words and expressions used and not defined in these regulations, but defined in the Kannur University Act, Statutes and Ordinances shall have the meaning respectively assigned to them in the Act, the Statutes and the Ordinances.

3. PROGRAMME STRUCTURE

3.1 **Duration**: The duration of a Postgraduate programme shall be four semesters inclusive of days of examinations distributed over a period of two academic years. The odd semesters (1, 3,) shall be from June to October and the even semesters (2, 4,) shall be from October/November to March. Each semester shall have 90 working days inclusive of days of all examinations. The minimum duration for completion of a two year Postgraduate programme in any subject is four semesters and the maximum period for completion is eight semesters from the date of registration. No student shall register for more than 24 credits and less than 16 credits per semester subject to the provisions of the programmes concerned.

3.2 **Admission**: Eligibility for admissions and reservation of seats for various First semester (Postgraduate) programmes shall be according to the rules framed by the University from time to time. There shall be a uniform **Academic cum Examinations Calendar** approved by the University for the registration, conduct and scheduling of examinations, and publication of results. The Academic cum Examinations Calendar shall be complied with by all colleges and offices, and the Vice Chancellor shall have all powers necessary for this purpose.

3.3 **Courses**: The Post graduate programme shall include three types of courses, viz., Core Courses, Elective Courses and Open Elective Courses (including MOOC courses). Parent Department shall offer appropriate elective courses for a specific programme. Open Elective Courses are offered either by the parent department or by any other Department or via MOOC. Open Elective courses can be opted in the third semester preferably having multidisciplinary nature. A course offered may have different components associated with the teaching-learning process of the course; namely 1. Lecture (L), 2. Tutorials (T) and 3. Practicals (P). 'L' stands for lecture session and every one-hour lecture session per week of a semester amounts to 1 credit. 'T' stands for tutorial session consisting of participatory discussion /self-study/desk work/brief seminar presentation by students. 'P' stands for practical session and it consists to acquire the much-required skill of applying the theoretically learnt concepts. A minimum of two-hour session of Tutorial or Practical amounts to 1 credit per semester. Maximum hours allotted for 1 credit practical course/tutorial course/seminar course shall not exceed 4 hours.

3.4. **Project/ Project and internship/Industry visit** There shall be a project work with dissertation (credit of which shall be decided by the concerned Board of Studies/Ad hoc committee) to be undertaken by all students. Project and dissertation work is a special course involving application of knowledge in solving/analysing/exploring a real-life situation/problem. The dissertation entails field work, lab work, report, presentation and viva voce. Project with dissertation shall be done under the supervision of a faculty member of the department as per the curriculum design. A candidate may, however, in certain cases be permitted to work on the project in an industrial/ research organisation on the recommendation of the Head of the Department. In such cases, one of the teachers from the department concerned shall be the supervisor/internal guide and an expert from the industry/research organisation concerned shall act as co-supervisor/external guide. Project dissertation shall be submitted in the last week of February in the fourth semester. Belated and incomplete project reports will not be entertained. Dissertation on project shall be prepared as per the guidelines given as Annexure 1. Board of studies/Ad hoc committee of each programme shall frame guidelines for internship/industry /academy/ library visit or such items designed by the BOS/Ad hoc committee.

3.5 **Course code**: Every course offered is identified by a unique course code; where, first two letters to denote programme name (MA for Master of Arts, MS for Master of Science, MB for Master of Business Administration, MC for Master of Computer Application, CM for Master of Commerce, MW for Master of Social Work and MT for Master of Tourism and Travel Management). Next three letters denote subject. This is followed by semester number such as 01, 02, 03 and 04. After the semester numbers, single alphabet stands for Core (C) Elective (E) and Open Elective (O).The last two digits denote the serial number of the course in that category (C, E or O) in that programme.

Illustration;

MAENG01C02

MA = Master of Arts

ENG= English

01= First semester

C = Core

02= Serial number of the core course in the programme.

3.6 **Credits**: Each course shall have a specified number of credits. The total credits required for the successful completion of four-semester programme will be 80 but for MSW the total credits will be 100 and for MBA and MCA, 120 credits each. Minimum credits for core course shall be 64.The number of credits from Elective course/Open Elective course shall vary between 12 and 16. No course shall have more than 5 credits and for dissertation and General Viva Voce, the maximum credits shall be 10.

3.7 **Attendance**: A student shall be permitted to appear for the semester examination, only if the candidate secures not less than 75% attendance in all courses of a semester put together. Female students can avail 2% menstrual leave and require only 73 % of attendance. Maternity leave for 60 days shall also be granted to girls above 18 years as per U.O. No. Acad/C2/24654/2019 dated 25-03-2023.

Records of attendance shall be maintained by the concerned Department for a period of six years and the attendance register shall be made available for verification, as and when required by the University.

3.8 **Eligibility to register for examination**: Only those students who are registered for the University examination with eligible attendance (including those under condonable limit) alone are eligible to be promoted to next semester. Students who have attendance in the prescribed limit but could not register for examination are eligible to move to the next semester after availing token registration. The candidates shall apply for token registration within two weeks of the commencement of the next semester. Token registration is allowed only once during the entire programme. It shall be the duty of the principal to ensure that only eligible candidates are promoted to the next semester. The Vice Chancellor shall be competent to cancel the ineligible promotion and impose penalty on the Principal.

3.9 **Condonation**: Students are eligible for the condonation of shortage of attendance for a maximum of 14 days in a semester subject to a maximum two times during the whole period of Postgraduate Programme. Condonation of shortage of attendance may be granted by the Vice Chancellor on production of the medical certificate from a registered medical practitioner for the days absent. Students who attend, with prior concurrence from the Head of the department/ institution, the approved co-curricular activities of College/University/higher level /other agencies approved by the Principal are eligible to get their lost days treated as 'Present' on submission of an application to the Principal through the Head of the Department with a certificate of participation / attendance certificate in such

activities, provided the student concerned must receive the required course of instruction in lieu of the days/ hours lost as may be decided by the Head of the Department/ Principal.

A student who is not eligible for condonation of shortage of attendance shall repeat the semester along with the subsequent batch, in the same institution by availing re-admission.

3.10 For **re-admission** additional seats shall be allocated, if there is no vacancy in the batch concerned, with a maximum limit of 10% of the total seats, over and above the sanctioned strength.

3.11 **Absence from classes**: If a student registered in the first semester of a Postgraduate programme is continuously absent from the classes for more than 14 days at the beginning of the first semester without intimation to the Principal, the matter shall immediately be brought to the notice of the Registrar of the University, by the Principal. The names of such students shall be removed from the rolls. A student who is continuously absent for 14 days during a semester without sufficient reason and proper intimation to the Principal of the College shall be removed from the roll provided before removing the student from the roll, the Principal shall consult the College Council and shall communicate the student the decision of the College Council giving the student a reasonable time to file appeals/ complaints, if any, to the Principal before the date of strike off the roll. Such appeals/ complaints shall be considered by the College Council for further proceedings.

3.12 **Grace marks**: Grace marks shall be awarded to eligible candidates as per the University orders in this regard from time to time.

4. BOARD OF STUDIES AND COURSES

4.1 The programme/ course under these Regulations shall be designed to include the title of the programme /course, Programme Specific Outcome (PSO)/Course Outcome (CO), the number of credits, maximum marks for End Semester Evaluation and Continuous Evaluation and the distribution there of, duration of examination hours and reference materials. Maximum efforts shall be made to maintain a uniform pattern while designing the courses, project, viva, practical etc. in the scheme and syllabus of various programmes coming under same faculty. The Vision and Mission Statements of the University and Programme Outcomes, as given in Annexure (i) and (ii) shall be given in all syllabi. The concerned PG Boards of Studies/ Ad hoc committees shall design all the courses offered in the Postgraduate programmes. The Boards/Ad hoc committees shall design and introduce new courses, modify or re-design existing courses and replace any existing courses with new/modified/re-designed courses to facilitate better exposures and training for the students.

4.2 Each course shall have an alpha-numeric code and title of the course. The code gives information on the subject, the semester number and the serial number of the course.

4.3 The syllabus of each course shall be prepared module (unit)-wise. Number of instructional hours and reference materials are also to be mentioned against each module.

4.4 The scheme of examination and model question papers are to be prepared by the Board of Studies/Ad hoc committee.

4.5 Board of Studies/Ad hoc committees should analyse the question papers of previous examinations.

4.6 Board of Studies/Ad hoc committee should make the changes in the syllabi and text books in consultation with the teachers concerned.

4.7 At least two meetings of teachers may be held in every department in every College, one in the mid-year and one towards the year end to discuss the academic and general activities of the Department. The recommendations of these meetings should be sent to the Boards of Studies/Ad hoc committee.

4.8 Boards of Studies/Ad hoc committees have to be constantly in touch with other Universities. Subject experts are to be identified in all major fields of study and endeavour, and consulted frequently.

4.9 Different types of questions shall possess different marks to quantify their required analysis. Maximum marks can vary from course to course depending on their comparative importance.

5. EXAMINATION

5.1 There shall be university examinations at the end of each semester. A candidate who fails to register for the University Examination shall not be permitted to move to the next semester. However, token registration is possible as per clause 3.8.

5.2 **Practical** examinations shall be conducted by the University at the end of the semester. If necessary, it shall be conducted before the End Semester Evaluation.

5.3 **External Viva-voce**, if any, shall be conducted along with the practical examination/project evaluation.

5.4 **Project/Dissertation** evaluation shall be conducted at the end of the fourth semester. 20 % of marks are to be awarded through continuous evaluation.

5.5 **Improvement:** Improvement of courses in a particular semester can be done only once. The student shall avail the improvement chance in the succeeding year along with the subsequent batch. If the candidate fails to appear for the improvement examination after registration, or if there is no change in the results of the improvement examination, the mark/grade obtained in the first appearance will be retained. Candidates may be permitted to cancel their improvement registration/appearance if applied before the publication of results, and after that application for cancellation shall not be permitted. To avoid a situation of undergoing two courses of study during the same academic year, those candidates who intend to avail improvement chance after successful completion of the programme, shall surrender their Grade Cards and submit their Transfer Certificate to the University along with application for registration for examination. Transfer Certificate shall be returned to the students after releasing the hall tickets and fresh Grade Card shall be issued incorporating the improvement

results. There shall be no improvement chance for continuous evaluation, project/viva voce/practical. The internal marks already obtained will be carried forward to determine the new grade/mark in the improvement examination.

5.6 There shall be no supplementary examinations. For reappearance/improvement the students shall appear along with the students of subsequent admissions as and when the examinations are conducted by the University.

6. EVALUATION:

6.1 Course Evaluation:

The evaluation scheme for each course shall contain two parts

a) Continuous Evaluation (CE)

b) End Semester Evaluation (ESE)

20% Weightage shall be given to the Continuous Evaluation (CE) and 80% Weightage shall be for the End Semester Evaluation (ESE)

6.2 Continuous Evaluation (CE):

a. 20% of the total marks in each course are for continuous assessment. The continuous evaluation shall be based on a pre-determined transparent system involving two or more of the following components:

   For theory course: written test, assignments, seminars, viva, book/article review etc.

   For practical course: lab involvement, records, written test, etc.

b. Two components and their respective weightages shall be as prescribed in the scheme and syllabus by the Board of Studies/Adhoc committee concerned.

c. Attendance ***shall not be*** a component for Continuous Evaluation (CE).

d. There is no pass minimum insistence on Continuous Evaluation marks.

6.3 To ensure transparency in the evaluation process, the Continuous Evaluation marks awarded to the students in each component of each course in a semester shall be displayed on the notice board at least three days before the commencement of the End Semester Evaluation. There shall not be any chance for the improvement of Continuous Evaluation. Only the total CE marks awarded to a candidate in each course need be sent to university by the principal of colleges concerned. The College shall maintain the academic record of each student registered for the course, with the details of the marks awarded to each component of Continuous Evaluation of courses with the signatures of the students, course teacher and HoD which shall be preserved in the college for a period of six years from the last date of the End Semester Examination of the semester concerned and shall be made available to the University for inspection as and when required. Complaints, if any, with regard to the Continuous Evaluation shall be submitted by the student to the Course Teacher. If the student feels that justice is denied, she/he can submit appeal to the Head of the Department and

thereafter to the Principal of the College. The Department Council/ College Council shall consider the complaint and ensure that assessments are done by the teacher in a just and fair manner. In case the student is not satisfied with the decision at the college level, further appeal/complaints may be submitted by the student to the Controller of Examinations, Kannur University for being placed before the University Level Committee for consideration.

6.4 **End Semester Evaluation (ESE)**

End Semester Evaluation carries 80% of the total marks. The End Semester Evaluation in theory courses are to be conducted with the question papers set by external experts. The evaluation of the answer scripts shall be done by examiners appointed by the University based on a well-defined Scheme of valuation and answer keys provided by the University. After the End Semester Evaluation marks are to be entered in the answer scripts. Marks secured for End Semester Evaluation only need to be communicated to the University. All other calculations including grading are to be done by the University by the Chairperson of Board of Examiners. The End Semester Evaluation in the practical courses shall be conducted by two examiners (one internal and one external) appointed by the University. End Semester Evaluation of all semesters will be conducted in centralised valuation camps immediately after the examination. All question papers shall be set by the University.

6.5 **Project Evaluation**: Project evaluation shall be conducted at the end of the fourth semester as per the following general guidelines or by the guidelines framed by the Board of Studies/Ad hoc committee concerned:

a. Evaluation of the Project Report shall be done under Mark System.

b. The evaluation of the project will be done at two stages:

i) Continuous Evaluation (supervising teachers will assess the project and award Continuous Evaluation Marks)

ii) End Semester Evaluation (external examiner appointed by the University)

c. Marks secured for the project will be awarded to candidates, combining the Continuous Evaluation and End Semester Evaluation marks.

d. The Continuous Evaluation to End Semester Evaluation components is to be taken in the ratio 1:4. Assessment of different components may be taken as follows:-

e. Components of Continuous Evaluation and End Semester Evaluation of Project other than the following can be decided by the concerned Board of Studies/Adhoc committee.

f. For internship/industry/academy/library visit, BOS/ Adhoc committee shall frame suitable evaluation methods including records presentation etc.

Continuous Evaluation (20% of total)	
Components	**Percentage**
Punctuality	20
Use of Data	20
Scheme/Organization of Report	40
Viva voce	20

End Semester Evaluation (80% of total)	
Components	**Percentage**
Relevance of the Topic Statement of Objectives Methodology/Reference/Bibliography	5 10 15
Presentation of facts/figures/language style/diagrams etc Quality of Analysis/Use of Statistical tools	20 15
Findings and recommendations	10
Viva-Voce	25

g. External Examiners will be appointed by the University from the list of IV semester Board of Examiners in consultation with the Chairperson of the Board.

h. The chairman of the IV semester examination should form and coordinate the evaluation teams and their work.

i. Continuous Evaluation should be completed 2 weeks before the last working day of the IV semester.

j. Continuous Evaluation marks should be published in the department.

k. In the case of courses with practical examination, project evaluation shall be done along with practical examinations.

l. Chairperson Board of Examinations, may at his/her discretion, on urgent requirements, make certain exception in the guidelines for the smooth conduct of the evaluation of project.

m. Submission of the Project Report and presence of the student for Viva are compulsory for Continuous Evaluation. No marks shall be awarded to a candidate if she/he fails to submit the Project Report for End Semester Evaluation.

n. The student should get a minimum of 40 % marks of the aggregate and 40% separately for ESE and 10% CE for a pass in the project.

o. There shall be no improvement chance for the Marks obtained in the Project Report.

p. In an instance of inability of obtaining a minimum pass marks as required under clause 6.5 n, the project work shall be re- done and the report may be re-submitted along with subsequent exams through parent department.

6.6 **Viva Voce**: There shall be a comprehensive viva voce at the end of the programmes covering questions from all courses of the programme including project work. The candidate shall present one copy of the Dissertation on project before the Viva voce board. The viva voce shall be conducted by two external examiners.

7. GRADING:

7.1 Indirect Grading System based on the scale specified in clause 7.2 is used to evaluate the performance of students.

7.2 Indirect grading system shall be adopted for the assessment of a student's performance in a course (both CE and ESE) Each course is evaluated by assigning marks with a letter grade (A^+, A, B, C, D, E and F) to that course by the method of indirect grading. Mark system is followed instead of direct grading for each question. For each course in the semester, letter grade, grade point and percentage of marks are introduced in the indirect grading system with scale as per guidelines given below:

% of Marks (CE+ESE)	Grade	Interpretation	Range of Grade Points
90 and above	A+	Outstanding	9-10
80 to below 90	A	Excellent	8-8.99
70 to below 80	B	Very Good	7-7.99
60 to below 70	C	Good	6-6.99
50 to below 60	D	Satisfactory	5-5.99
40 to below 50	E	Pass	4-4.99
Below 40	F	Failure	0-3.99

7.3 Evaluation (both CE and ESE) is carried out using Mark system. The grading on the basis of a total CE and ESE marks will be indicated for each course. Each letter grade is assigned a **'Grade point'** (GP) which is a point given to a grade on the scale as envisaged under clause 7.2 and is obtained using the formula:

Grade Point = (Total marks awarded / Total Maximum marks) x 10.

7.4 **'Credit point'** (CP) of a course is the value obtained by multiplying the grade point (GP) by the credit (C) of the course

CP = GP x C

A minimum of grade point 4 is needed for the successful completion of a course.

7.5 A candidate securing not less than 40% of aggregate marks of a course [both ESE and CE put together) with not less than 40% in End Semester Examination [ESE] shall be declared to have passed in that course. A minimum of grade point 4 with letter grade E is needed for the successful completion of a course.

7.6 Appearance for Continuous Evaluation (CE) and End Semester Evaluation (ESE) are compulsory and no grade shall be awarded to a candidate if she/he is absent for CE/ESE or both.

7.7 After the successful completion of a semester, Semester Grade Point Average (SGPA) of a student in that semester is calculated using the formula given below.

SGPA = Sum of the Credit Points of all courses in a semester / Total Credits in that semester

Semester Grade Point Average' (SGPA) is the value obtained by dividing the sum of credit points obtained by a student in the various courses taken in a semester by the total number of credits in that semester. SGPA determines the overall performance of a student at the end of a semester.

For the successful completion of a semester, a student should pass all the courses in that semester. However, a student is permitted to move to the next semester irrespective of the SGPA obtained.

SGPA shall be rounded off to three decimal places.

7.8 The **Cumulative Grade Point Average** (CGPA) of the student is calculated at the end of each semester. The CGPA of a student determines the overall academic level of the student in each stage of the programme. CGPA can be calculated by the following formula:

CGPA = Sum of Credit Points of all completed semesters / Total Credits acquired

CGPA shall be rounded off to three decimal places.

7.9 At the end of the programme, the overall performance of a candidate is indicated by the Overall Grade Point Average. **Overall Grade Point Average (OGPA)** of the student is calculated at the end of the programme. The OGPA of a student determines the overall academic level the student in a programme and is the criterion for classification and ranking the students. OGPA can be calculated by the following formula.

OGPA = Sum of Credit Points obtained in all semesters of the programme / Total Credits (80)

OGPA shall be rounded off to three decimal places.

An overall letter grade for OGPA for the entire programme shall be awarded to a student after completing the entire programme successfully. Overall letter grade based on OGPA and conversion of Grades into classification shall be in the following way.

Grade range OGPA	Overall Letter Grade	Classification
9 - 10	A+	First class with Distinction
8 - 8.999	A	
7 - 7.999	B	First class
6 - 6.999	C	
5 - 5.999	D	Second class
4 - 4.999	E	Pass
Below 4	F	Fail

7.10 The Percentage of marks based on OGPA is calculated by multiplying them by 10.**Percentage in two decimal places = [OGPA in three decimal places] x 10**

7.11 Those candidates who pass all the courses prescribed for a programme shall be declared to have successfully completed the programme and eligible for the degree. Minimum OGPA required for the successful completion of the degree programme is 4. In the event a candidate fails to secure pass in any course in a semester, consolidation of SGPA and CGPA will be made only after obtaining pass in the failed course in the subsequent appearance, as envisaged in clause 7.5.

7.12 A student who fails to secure a minimum mark for a pass in a course is permitted to write the examination along with the subsequent batch.

7.13 **Moderation:** Moderation shall be decided by the concerned Board of examiners subject to the Statistics of marks made available from the Examination branch and as per the prescribed guidelines.

7.14 **Revaluation:** In the new system revaluation is permissible. The prevailing rules and regulations of revaluation are applicable to KUCBCSSPG2023.

8. GRADE CARD

8.1 The University shall issue to the students grade/marks card (by online) on completion of each semester, which shall contain the following information:

a) Name of University

b) Name of College

c) Month and year of examination

d) Title of Postgraduate Programme

e) Semester concerned

f) Name and Register Number of student.

g) Course Code, Title and Credits of each course opted in the semester

h) Continuous Evaluation marks, End Semester Evaluation marks, total marks, Grade point (G), Credit point and Letter grade in each course in the semester

i) Total credits, total credit points and SGPA in the semester (corrected to three decimal places)

j) Semester percentage = SGPA X 10 and CGPA separately.

8.2 The **final Grade/mark Card** issued at the end of the final semester shall contain the details of all courses taken during the entire programme including those taken over and above the prescribed minimum credits for obtaining the degree. The final grade card shall show OGPA (corrected to three decimal places) and the overall letter grade of a student for the entire programme. If the students are in need of separate grade card of each semester for the purpose of higher studies, the same shall be issued on attestation by the Controller of Examinations / Joint Registrar/ Deputy Registrar/ Assistant Registrar after levying the prescribed fee.

9. AWARD OF DEGREE

9.1 For the successful completion of all the courses (core, elective and open elective (multidisciplinary)) a candidate has to secure minimum E grade as provided in clause 7. Satisfying the minimum credit 80 and securing minimum OGPA 4 shall be the minimum requirement for the award of degree.

9.2 Rank certificates up to third rank shall be issued, instead of Position

Certificates, on the basis of highest OGPA secured for the programme.

10. MONITORING OF THE PROGRAMME AND GRIEVANCE REDRESSAL MECHANISM

10.1 **College level**: Every programme conducted under the Choice Based Credit and Semester System in a College shall be monitored by the College Council. The College shall form a Grievance Redressal Committee in each department comprising of course teacher and one senior teacher as members and the Head of the department as chairperson. This committee shall address all grievances relating to the continuous evaluation marks of the students. There shall be a college level Grievance Redressal Committee comprising of staff advisor of College Union as Convenor, Chairperson of College Union, General Secretary of College Union, two senior teachers and two members elected by the College Council from among the teachers of the College as members and Principal as Chairperson.

10.2 **University level**: The University shall form a Grievance Redressal Committee under the chairmanship of Pro-Vice Chancellor as the Chairperson with Convenors of Standing Committees on Examinations, and Student Welfare, Controller of Examinations as Convenor, One Senior officer in Examination branch not below the rank of Joint Registrar/Deputy Registrar , Director of Student Services ,University Union Chairperson, University Union General Secretary as members to consider the complaints/appeal from students with regard to Continuous Evaluation or any other matter coming under the purview of these regulations .

11. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Vice-Chancellor shall, for a period of three year from the date of coming into force of these regulations, have the power to make provisions by order to address any issues arising out of the implementation of these regulations for solution of which no provisions are explicitly provided in these regulations. All such decisions taken by the Vice Chancellor shall be reported to the Academic Council and the Syndicate.

12. REPEAL

The Regulations now in force in so far as they are applicable to Post Graduate programmes offered by the University and to the extent they are inconsistent with these regulations stand repealed. In the case of any inconsistency between any other existing regulations and these regulations in their application to any programme offered in a College, the latter shall prevail.

Annexure 1; Guidelines for the preparation of dissertation on project:

1. Arrangement of contents shall be as follows:

    1. Cover page and title page
    2. Bonafide certificate
    3. Declaration by the student
    4. Acknowledgements
    5. Table of contents
    6. List of tables
    7. List of figures
    8. List of symbols, Abbreviations and Nomenclature
    9. Chapters
    10. Appendices
    11. References

2. Page dimension and typing instruction:

The dimension of the dissertation on project should be in A4 size. The dissertation should be typed in bond paper and bound using flexible cover of the thick white art paper or spiral binding. The general text shall be typed in the font style 'Times New Roman' and font size 12. For major headings font size may be 16 and minor heading 14. Paragraph should be arranged in justified with margin 1.25 each on top. Portrait orientation shall be there on left and right of the page. The content of the report shall be around 40 pages.

3. Bonafide certificate shall be in the following format

CERTIFICATE

This is to certify that the project entitled .....(title) submitted to the Kannur University in partial fulfilment of the requirements of Post Graduate Degree in .....(subject), is a Bonafide record of studies and work carried out by .....(Name of the student) under my supervision and guidance.

Office seal

Signature, name, designation and official address of the Supervisor.

Date

4. Declaration by the student shall be in the following format:

DECLARATION

I.....(Name of the candidate) hereby declare that this project titled .....(title) is a bonafide record of studies and work carried out by me under the supervision of .....(Name, designation and official address of the supervisor), and that no part of this project, except the materials gathered from scholarly writings, has been presented earlier for the award of any degree or diploma or other similar title or recognition.

Date:

Signature and name of the student

SCHEME AND CREDIT DISTRIBUTION CHART OF COURSES IN THE M.Sc. BOTANY PROGRAMME

SEM	COURSE WITH CODE		MARKS			CREDIT	Hrs/wk	
			INTERNAL	EXTERNAL	TOTAL		L	P
I	MSBOT01 C01	GENERAL AND APPLIED MICROBIOLOGY	15	60	75	4	4	2
	MSBOT01 C02	PHYCOLOGY, MYCOLOGY AND PLANT PATHOLOGY	15	60	75	4	4	3
	MSBOT01 C03	BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS	15	60	75	4	4	3
	MSBOT01 C04	RESEARCH METHODOLOGY, INSTRUMENTATION AND BIOSTATISTICS	15	60	75	4	3	2
	MSBOT01 C05	PRACTICAL PAPER -1	12	48	60	4		
	RECORD+SUBMISSION		3	12 (6+6)	15			
TOTAL FOR FIRST SEMESTER			**75**	**300**	**375**	**20**	**15**	**10**
II	MSBOT02 C06	PALEOBOTANY, PALYNOLOGY AND EVOLUTION	15	60	75	4	3	2
	MSBOT02 C07	ANGIOSPERM ANATOMY, EMBRYOLOGY AND MICROTECHNIQUE	15	60	75	4	4	3
	MSBOT02 C08	GENETICS AND CROP IMPROVEMENT	15	60	75	4	4	2
	MSBOT02 C09	PLANT PHYSIOLOGY AND BIOCHEMISTRY	15	60	75	4	4	3
	MSBOT02 C10	PRACTICAL PAPER -2	12	48	60	4		
	RECORD+SLIDES		3	12 (6+6)	15			
TOTAL FOR SECOND SEMESTER			**75**	**300**	**375**	**20**	**15**	**10**
III	MSBOT03 C11	ENVIRONMENTAL SCIENCE	15	60	75	4	4	2
	MSBOT03 C12	ANGIOSPERM SYSTEMATICS	15	60	75	4	4	4
	MSBOT03 C13	CELL AND MOLECULAR BIOLOGY	15	60	75	4	4	2
	MSBOT03 O01/02/03	OPEN ELECTIVE (Multi Disciplinary)	15	60	75	4	3	2
	MSBOT03 C14	PRACTICAL PAPER -3	12	48	60	4		
	RECORD+HERBARIUM		3	12 (6+6)	15			
TOTAL FOR THIRD SEMESTER			**75**	**300**	**375**	**20**	**15**	**10**
IV	MSBOT04 C15	GENETIC ENGINEERING AND PLANT BIOTECHNOLOGY	15	60	75	4	4	3
	MSBOT04 E01/02/03	ELECTIVE	15	60	75	4	4	2
	MSBOT04 E04/05/06	ELECTIVE	15	60	75	4	4	2
	MSBOT04 C16	PROJECT, FIELD STUDY AND INSTITUTE VISIT	15	60 (40+10+10)	75	4		6
	MSBOT04 C17	PRACTICAL PAPER -4	12	48	60	4		
	RECORD+MOOC COURSE		3	12 (6+6)	15			
TOTAL FOR FOURTH SEMESTER			**75**	**300**	**375**	**20**	**12**	**13**
TOTAL			**300**	**1200**	**1500**	**80**		

Continuous Assessment (CA): This assessment shall be based on predetermined transparent system involving periodic written tests, assignments, seminars and regularity/punctuality in respect of theory courses and based on tests, lab skill, records/viva and regularity/punctuality in respect of practical courses.

The percentage of marks assigned to various components for internal evaluation is as follows;

Theory Component	**% of internal marks**
Two test papers	40
Publication/ Book review/ Debates	20
Seminar/ Presentation of case study	20
Regularity/ Punctuality	20

Practical Component	**% of internal marks**
Test Papers	40
Lab skill	20
Records/ Viva	20
Regularity/ Punctuality	20

To ensure transparency of the evaluation process, the internal assessment marks awarded to the students in each course in a semester shall be published on the notice board at least one week before the commencement of external examination. There shall not be any chance for improvement for internal marks. The course teacher shall maintain the academic record of each student registered for the course, which shall be forwarded to the University, through the college Principal, after endorsed by the HoD.

Tests: For each course there shall be at least two class tests during a semester. The probable dates of the tests shall be announced at the beginning of each semester. Marks should be displayed on the notice board. Valued answer scripts shall be made available to the students for perusal within 10 working days from the date of the tests.

Assignments: Each student shall be required to do Publication/Book review for each course. Publication /Book review after valuation must be returned to the students. The teacher shall define the expected quality of the above in terms of structure, content, presentation etc. And inform the same to the students. Punctuality in submission is to be considered.

Seminar: Every student shall deliver one seminar as an internal component for every course and must be evaluated by the respective course teacher in terms of structure, content, presentation

and interaction. The soft and hard copies of the seminar report are to be submitted to the teacher in charge.

Elective Courses: Three elective courses are to be selected from the nine elective courses, during the third and fourth semester. The model question for the elective course will be in the same pattern as that of other core theory papers. Out of the total one of the elective will be multi disciplinary open elective.

MOOC: The students should complete an online course of their choice on SWAYAM platform during the two years of study. The course completion certificate should be produced at the time of the IV semester Practical examination.

Master of Science in BOTANY

The aim of the MSc Botany course is to provide students with a comprehensive understanding of botany, develop their research and practical skills, and prepare them for professional careers in the field of botany or further academic pursuits.

Objectives:

1. **Advanced Knowledge in Botany:** To provide students with in-depth knowledge and understanding of various basic aspects of botany. This includes plant anatomy, plant physiology, plant taxonomy, plant ecology, plant genetics, plant biochemistry, plant pathology, and other specialized areas within botany.
2. **Research Skills:** To equip students with the skills required to conduct independent research in the field of botany. Students are trained in research methodologies, experimental design, data analysis, scientific instruments, and scientific writing.
3. **Specialization**: To gain expertise in their chosen area of specialization. This may include studying specific plant groups (e.g., algae, fungi, bryophytes, gymnosperms, or angiosperms), or focusing on specific fields such as plant biotechnology, plant ecology, or plant pathology.
4. **Practical Skills**: To develop practical skills in plant collection, preservation, microscopic techniques, tissue culture, molecular biology techniques, and other essential laboratory and field skills. Students are engaged in laboratory work, fieldwork, and plant identification exercises.
5. **Critical Thinking and Problem Solving:** To foster scientific mindset, critical thinking and problem-solving abilities among students. This involves analyzing and interpreting scientific data, evaluating research findings, and developing innovative solutions to botanical problems.
6. **Communication and Presentation Skills:** To develop the ability to communicate scientific information clearly and effectively to both scientific and non-scientific audiences. Students are encouraged to present their research findings through scientific presentations, seminars, and scientific writing.
7. **Professional Development:** To prepare students for careers in research, academia, industry, conservation organizations, or other related fields. This may involve workshops on scientific ethics, career guidance, and opportunities for networking with professionals in the field.

SEMESTER – I

MSBOT01 C01-GENERAL AND APPLIED MICROBIOLOGY

Objectives: Studying microbiology is aimed at advancing our understanding of microorganisms and their interactions with living and non-living systems. This knowledge has significant implications for human health, agriculture, biotechnology, industry, and environmental sustainability.

The specific objectives are: To study microbial diversity and classification, to study microbial structure and function, to study role of microbes in diseases and to study applications of microbes in industry and biotechnology.

Theory-4 Hrs/wk **Practical–2 Hrs/wk**

MODULE-I

Unit-1: The Study of Microbial Cell Structure: Bacteria-Microbial specimen preparation. Staining techniques. Structure External to cell wall-Capsule, Slime layers, Flagellae, Pili, Fimbriae. General account on Spirochetes, Rickettsia, Chlamydiae, Mycoplasma, appendaged, sheathed, gliding and fruiting bacteria, Archaeobacteria, Actinomycetes.

Unit-2: Microbial Diversity: Taxonomy and Phylogeny: Introduction to classification systems, Three domain classification, Classification according to Bergey's manual of systematic bacteriology. Recent trends in Microbial Taxonomy: a) Chemotaxonomy: cell wall components, lipid composition, isoprenoid-quinones, cytochrome composition. b) Molecular method: DNA homology, DNA-RNA homology, G + C ratio, rRNA sequencing. c) Genetic methods in taxonomy d) Serological methods e) Taxonomy based on ecology. Bacterial phylogeny, Phylogenetic trees-evolutionary models, homology, methods for tree building, organizing data on a tree, evaluating phylogenies.

MODULE-II

Unit-1: Growth and Control of Microbes: Micro and macro nutrients, growth factors. Nutritional types of bacteria. Culture media: classification of media (Simple, complex and special media with example).Growth: Growth kinetics, generation time, growth curve, factors affecting growth. Aerobic, anaerobic, batch, continuous and synchronous cultures. Media formulation, sterilization methods, effect of physiological parameters. Control of microbial growth by Physical and Chemical Agents; Maintenance and preservation of pure cultures, culture collection centres-national and international.

Unit-2: Microbial Ecology: Role of microbes in Biogeochemical Cycling; Microorganisms in Marine and Fresh water Environments, Microbial Adaptations to Marine and Freshwater Environments, Microorganisms in Terrestrial Environments. Microbial associations with Vascular Plants. Microbial Interactions-Human-Microbe Interactions, Impact on immunity, Extremophiles.

MODULE-III

Unit-1: Virology: Acellular entities-Viruses, Viriods and Prions: Brief outline on discovery of viruses, origin of viruses, Nomenclature and classification of viruses-ICTV system of classification, distinctive properties of viruses. Types of envelopes and their composition- viral genome (RNA, DNA), Viroids, Prions. Cultivation and assay of viruses: Cultivation of viruses in embryonated eggs, experimental animals and cell cultures (suspension cell cultures and monolayer cell cultures; cell lines and cell strains).Virus and cancer.

Unit-2: Applied Microbiology- Industrial Microbiology: Microbial fermentation and production of small and macro molecules-Alcohol production, Organic Compounds, Vinegar. Food Microbiology: Microbes as food source. Food Spoilage and control of spoilage. Medical Microbiology: Antimicrobial agents, Vaccines, Nutrients, Vitamins, Probiotics, Hormones. Environmental and Agricultural Microbiology: Pollution control-Bacillus sps, Pseudomonas sps, Nitrogen fixation and Biofertilizer-Azotobacter sps, Anabaena sps, Nostoc sps. Symbiotic association –Rhizobium sps, Frankia sps

Unit-3: Bacterial genetics and Microbial Biotechnology: Genetics of bacterial recombination, Extra-chromosomal genetic material-Plasmids: Classification of plasmids and significance. Plasmids as vectors for cloning and expression of recombinant protein. Insertional inactivation and selection of recombinants, Blue-white colony selection. Biosafety measures: Labsafety, handling pathogenic microbes, Hazardous microbes, genetically modified organisms.

MODULE-IV (Self studying Module)

Unit-1: History and Scope of Microbiology: A brief account. The Discovery of Microorganisms-The Scope and Relevance of Microbiology- The Future of Microbiology. Prokaryotic cell organization and ultra structure of cell wall - Bacteria. Morphological characteristics of bacteria.

Unit-2: Emerging Infectious diseases-HIV, SARS, EBOLA, NIPAH, CoVID-19. Control and preventive measures of infectious diseases, Global and national initiatives. Zoonotic and arthroponotic transmissions.

PRACTICAL

1. Preparation of microbial Specimens for microscopy: Fixation, Simple staining, differential staining, Staining Specific structure.
2. Gram's staining
3. Media preparation – Media for General purposes (Nutrient agar, LB agar etc).
4. Sterilization techniques (Demonstration only)
5. Isolation techniques of microorganisms: Isolation of pure cultures; dilution/spread plate/streak plate/pour plate.
6. Biofermentor models (Demonstration only-Visit to a nearby fermentation facility)
7. Vectors : pBR 322, and pUC 18

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MSBOT01 C02: PHYCOLOGY, MYCOLOGY AND PLANT PATHOLOGY

Objective: Studying algal diversity and fungal diversity are to understand and explore the various species and their roles in ecosystems, as well as to investigate their potential applications in various fields. The specific objectives are: Taxonomic Classification, Ecosystem Functions, Habitat and Distribution, Adaptations and Morphology, Medicinal and Industrial Applications, Pathogenicity and Disease, Conservation and Preservation and Applied Research.

Plant pathology studies contribute to the understanding, prevention, and control of plant diseases, thereby promoting global food security, environmental sustainability, and agricultural productivity.

Theory: 4hrs/wk **Practical: 3hrs/wk**

PHYCOLOGY

MODULE-I

Unit-1: Classification of Algae (Fritsch F. E. 1935; Lee R. E. 1984) General characters up to order level. Modern trends in algal classification (brief account) – Major algal groups (Cyanophyta, Glaucophyta, Chromophyta, Chlorophyta, Charophyta and Rhodophyta) and their salient features - Thallus organization, cell structure, organelles (chloroplast, pyrenoid, eyespot, flagella and Gas vacuoles), pigments and stored food materials and Life cycle patterns. Major features used for algal classification. Phylogeny and interrelationship among different algal groups. Fossil algae (brief account). Algologists and their contribution: MOP Iyengar and Krishnamurthy.

Unit-2: Applications of Algae (both beneficial and detrimental). General account on economic importance of algae. Role of algae in Primary productivity and carbon sequestration. An account on different algal genera involved in Nitrogen fixation; algal blooms and its impact- algal toxicity- NSP (Neurotoxic shellfish poisoning), DSP (Diarrhetic Shellfish Poisoning), ASP (Amnesic Shellfish Poisoning), PSP (Paralytic Shellfish Poison), Ciguatera and cyanobacterial toxins; Biofouling and algae; indicators of pollution; Algae in biotechnology and research- bioluminescence, biofuel.

PRACTICAL:

1. Collection, preparation and submission of macro algal herbarium/whole mounts.
2. Collection and study of the types mentioned below and their identification up to generic level:

   Pediastrum, Scenedesmus, Hydrodyctyon, Ulva, Pithophora, Bulbochaete, Cephaleuros, Draparnaldiopsis, Bryopsis, Codium, Caulerpa, Halimeda, Closterium, Nitella, Botrydium, Biddulphia, Coscinodiscus, Ectocarpus, Dictyota, Padina, Turbinaria. Batrachospermum,

Gracilaria and Champia.

3. Microscopic photographs of algae present in pond/estuarine/marine waters, taken by the student, can be printed and submitted in the record as separate sheets.

MYCOLOGY

MODULE-II

Unit-1: Classification of Fungi (Alexopulos et al, 1996), Major fungal groups and their salient features (Zygomycota, Ascomycota, Basidiomycota and Deuteromycota) with an emphasis to the macroscopic and microscopic features -morphology; fungal tissue and organs, cell structure and organization, Reproduction and reproductive structures and types of lifecycles. Parasexuality in fungi. Comparative account on fungal cell wall and fruiting bodies. Famous mycologists – E J Butler and Subramanian C V

Unit-2: Ecological role of fungi: Interactions with plants, animals, and other organisms, Fungal symbiosis- Mutualism, commensalism and parasitism. Fungi in nutrient cycle and decomposition. Lichens and their ecological role.

Unit 3: Applications of Fungi (both beneficial and detrimental): Agriculture and Industrial Mycology- Fungi in agriculture; Plant pathogens, Mycorrhiza and biocontrol agents. Fungi in food production and fermentation. Medical Mycology-Fungal pathogens and diseases in humans; Major fungal infections and treatments; Antifungal agents and drug resistance. Fungi in biotechnology and Industrial application. Fungal toxins: Mycotoxins-Aflatoxin, Amanitarin and ergot

PRACTICAL

1. Collection, preparation and submission of fungi.
2. Collection and study of the types mentioned below and their identification up to generic level: *Synchytrium, Pilobolus, Mucor, Claviceps, Xylaria, Geaster, Auricularia, Cyathus, Polyporus* and *Ustilago*.
3. Microscopic photographs/Photographs of fungi from various fields, taken by the student, can be printed and submitted in the record as separate sheets.

PLANT PATHOLOGY

MODULE-III

Unit-1: Host-parasite interaction: Enzymes and toxins in plant diseases- Host- specific and non-host specific toxin. Defense mechanism in plants: Pre-existing structural and biochemical defense mechanisms, lack of essential nutrients. Induced structural and biochemical defense mechanisms, inactivation of pathogen enzymes and toxins, altered biosynthetic pathways. Phytoalexins and second messengers in plant defense. Gene-for-gene concept, protein-for-protein and immunization basis, management of resistance gene.

Unit-2: Plant disease management: Insect Vectors of Plant Viruses and other Pathogens and their

characteristics (aphids, whiteflies, mealy bugs, mites and thrips and leaf hoppers); mouth parts and feeding processes of important insect vectors. Epidemiology and management of insect transmitted diseases through vector management. Biological Control-Antagonists, Mode of action of antagonists, Efficacy of bio-control agents, cross protection and induced resistance. Cultural practices-Production and use of disease- free propagating materials, adjustment of crop culture to minimize disease incidence, field and plant sanitation. Chemical control: Definition and classification of fungicides, formulation of fungicides, methods of fungicidal application, fungicidal toxicity, Use of foliar and post-harvest fungicides, seed and soil treatments. Systemic fungicides and Antibiotics. Integrated pest and diseases management. Regulatory methods - Plant quarantine, inspection and certification, seed certification. Quarantine restrictions in the movement of agricultural produce, seeds and planting material.

MODULE-IV (Self studying module)

Unit-1: Morphological, Anatomical features and Life cycle of type specimens: *Pediastrum, Scenedesmus, Hydrodyctyon, Ulva, Pithophora, Bulbochaete, Cephaleuros, Draparnaldiopsis, Bryopsis, Codium, Caulerpa, Halimeda, Closterium, Nitella, Botrydium, Biddulphia, Coscinodiscus, Ectocarpus, Dictyota, Padina, Turbinaria. Batrachospermum, Gracilaria* and *Champia.*

Unit-2: Morphological, Anatomical features and Life cycle of type specimens: *Synchytrium, Pilobolus, Mucor, Claviceps, Xylaria, Geaster, Auricularia, Cyathus, Polyporus* and *Ustilago.* Lichen- Usnea

Unit-3: Classification of plants diseases: based on symptoms, causative organism, etiology and disease cycle. Pathogenesis- Biotic and Abiotic factors in pathogenesis, pathogen factors in diseasedevelopment. Symptoms, etiology, transmission and control of important disease of crops. Potato: Bacterial wilt, late blight; Ladie's finger- Yellow vein mosaic; Chillies – Anthracnose (Fruit rot), Papaya - Foot rot, Papaya mosaic; Banana -Bunchy top; root knot by nematodes; Rubber: Powdery mildew; Bird's eyespot; Pepper- Pollu disease (Anthracnose).

PRACTICAL

1. Make suitable micropreparations and identify the diseases (especially fungal and bacterial diseases) mentioned in the theory syllabus, with due emphasis on symptoms and causative organisms.
2. Collection and preservation of specimens from infected plants. Submit herbarium sheets/live specimens along with a report.
3. Photographs of diseased plants, taken by the student, can be printed and submitted in the record as separate sheets.

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MSBOT01 C03-BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS

Objective: Studying bryophytes, pteridophytes, and gymnosperms helps us appreciate the diversity of plant life, understand their ecological roles, contribute to conservation efforts, and expand our knowledge of plant biology and evolution.

Taxonomy and Classification: Helps in understanding their morphological, anatomical, and reproductive characteristics, leading to their accurate classification and taxonomy.

Evolutionary Significance: By studying these groups, students can gain insights into the evolutionary transitions from aquatic to terrestrial habitats and the development of key adaptations such as vascular tissues and seeds.

Conservation and Biodiversity: Understanding the biodiversity, ecological and economical roles of these groups is crucial for preserving ecosystems and ensuring long-term sustainability. Students can contribute to overall understanding of plant biology and advance knowledge in diverse scientific research.

Theory: 4 hrs/wk **Practical: 3 hrs/wk**

BRYOPHYTES

MODULE -I

Unit-1: General features of Bryophytes, Modern trends in classification of bryophytes- Fossil bryophytes- Contributions of Indian bryologists: S R Kashyap, S K Pande, Ram Udar, and Gangulee, Affinities of bryophytes- Ecological importance of bryophytes - Habitat of bryophytes, role as ecological indicators- origin and evolution of bryophyte- thallus diversity in bryophytes.

Unit-2: Anatomical and morphological studies of gametophytes and sporophytes with reference to hepaticopsida, anthocerotopsida and bryopsida- special reference to marchantiales, jungermaniales, anthocerotales and bryales- Dehiscence of capsule and dispersal of spores.

PRACTICAL

1. Morphological and reproductive study of following using cleared whole mount preparations, dissections and sections: *Pallavicinia*, *Cyathodium*, *Lejeunea*, *Targionia*, *Lunularia*, *Notothylus*, *Bryum*, *Fissidens*.
2. Collection and preservation of specimens. Submit herbarium sheets/live specimens along with a report.

PTERIDOPHYTES

MODULE-II

Unit-1: Classification and Phylogeny of Pteridophytes, General characters of Pteridophytes; classification -Trends and concepts -Molecular systematics- Pteridophyte Phylogeny group-PPG (2016). Classification of Extant Pteridophytes-Balakrishna et al (2019). Distribution of Pteridophytes in India with special reference to Western Ghats- Rare, endangered and endemic species-Conservation of Pteridophytes-Strategies and methods – In-vitro propagation of Pteridophytes Ecology and evolution of Pteridophytes- sporophytes and gametophyte.

Unit-2: Diversity of Pteridophytes- Vegetative, reproductive features and affinities of the following groups; Lycopodiales, Isoetales, Calamitales, Ophioglossales, Osmundales, Gleicheniales, Salviniales.

PRACTICAL

1. Identification of fossil Pteridophytes- Calamites, Sphenophyllum
2. Comparative study of vegetative and reproductive structures of the living genera mentioned below- *Lycopodium*, *Gleichenia*, *Blechnum*, *Angiopteris*, *Salvinia*, *Ceratopteris*, *Achrostichum*.
3. Collection and preservation of specimens. Submit herbarium sheets/live specimens along with a report.

GYMNOSPERMS

MODULE-III

Unit-1: General characters of the gymnosperms and comparison with other groups. Distribution of living and fossil gymnosperms in India. Phylogenomics of gymnosperms and updated classification - Christenhuzs et al. (2011). Contributions of - Birbal Sahni and Bharadwaj in gymnosperm studies. Gymnosperms in India- Ethnic and economic uses.

Unit-2: Morphology,anatomy and reproductive biology of the following orders: Pteridospermales (Medullosaceae, Caytoniaceae), Pentoxylales (Pentoxylacaeae) ,Bennettitales (Williamsoniaceae), Cycadales (Cycadaceae), Coniferales (Podocarpaceae, Arucariaceae, Cuppressaceae), Ginkgoales, Taxales, Gnetales (Welwitschiaceae, Ephedraceae).

PRACTICAL

1. Identification of fossil gymnosperms- Heterangium and Medullosa
2. Comparative study of vegetative and reproductive structures of the living genera; *Zamia, Cryptomeria, Cupressus, Agathis, Podocarpus, Taxus, Ephedra.*
3. Collection and preservation of specimens. Submit herbarium sheets/live specimens along with a report.
4. Field visit to various habitats, botanical gardens, various ecosystems etc.

MODULE-IV (Self studying Module)

Unit-1: Morphological and Anatomical features and life cycles of type specimens mentioned in the syllabus. **Bryophytes**: *Pallavicinia, Cyathodium, Lejeunea, Targionia, Lunularia, Notothylus, Bryum, Fissidens.* **Pteridophytes**: *Lycopodium, Gleichenia, Blechnum, Angiopteris, Salvinia, Ceratopteris, Achrostichum*. **Gymnosperms**: *Zamia, Cryptomeria, Cupressus, Agathis, Podocarpus, Taxus, Ephedra.*

Unit-2: Ecological and economic importance of Bryophytes, Pteridophytes and Gymnosperms. Conservation, diversity and threats of groups. Major research centers and activities in India related to the topic.

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MSBOT01 C04-RESEARCH METHODOLOGY, INSTRUMENTATION AND BIOSTATISTICS

Objectives: Equips researchers with a solid foundation and set of skills to undertake rigorous and meaningful research. It promotes a scientific and systematic approach to knowledge generation and contributes to advancements in various fields of study.

Involves gaining knowledge and skills related to the systematic and scientific investigation of various phenomena. The objectives are; 1. Understanding the research process, 2. Developing critical thinking skills, 3. Enhancing research design and planning, 4. Conducting ethical research, 5. Analyzing and interpreting data, and 6. Enhancing research communication.

Theory: 3 hrs/wk **Practical: 2 hrs/wk**

RESEARCH METHODOLOGY

MODULE-I

Unit-1: Introduction of research: meaning, aims, objectives, utility, and importance. Types of research-descriptive vs analytical, applied vs fundamental, qualitative vs quantitative, conceptual vs empirical. Research plan and its components: Identification and criteria of selecting a research problem, literature collection, and review, development of a working hypothesis,-methodology (experimental design, sampling methods) Data collection, data analysis– interpretation - presentation, and drawing conclusions.

Unit-2: Scientific paper writing-layout of a research paper, manuscript preparation. Research journals- journals in botanical science, Impact factor, and paper citation index. Oral presentation – Use of visual aids. Importance of effective communication. Ethical issues related to publishing. Plagiarism and self-plagiarism. IPR and patenting. Ethical and legal issues of research-Authentication of specimens, legal permissions for collection of biological materials from local biodiversity committees, forest Department, State Biodiversity Board and National Biodiversity Authority.

PRACTICAL

1. Selection of a research problem, Preparation of methodology to solve the issue and Presentation.

BIOSTATISTICS

MODULE-II

Unit-1: Introduction to Biometrics -Collection of data-Primary and Secondary, Summarization of data, classification and tabulation of data, diagrammatic and graphical representations, utility and limitations of graphical representation, Characteristics of an ideal measure- merit and demerit of

different measures. Measure of Dispersion- range, quartile deviation, mean deviation- variance and standard deviation. Coefficient of variability, Skewness and kurtosis.

Unit-2: Introduction to probability - Probability distribution, discrete probability distribution-binomial, Poisson–continuous probability distribution - normal distribution. Theorem of addition of probability, theorem of multiplication of probability.

Unit-3: Experimental designs-Principles-replication, randomization, local control; Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) and Factorial Design (FD). Test of hypothesis: Null hypothesis, Alternate hypothesis, Type of error, Level of significance, Degree of freedom, Decision Making, Parametric test-z test, t-test: test of independence, paired t-test, equality of variance F-test. Non parametric test: Chi square test; Test of independence, goodness of fit, Kruskal wallis test, Mann whitney u-test. Practical application of simple test of significance viz,"t" and "F"test.

Unit-4: Correlation and Regression- Types of correlation - measurement of correlation - correlation coefficients, rank correlation- lines of regression, regression coefficients. Principles of Analysis of Variance (ANOVA) – Assumptions, Principles, Types-one way ANOVA and two way ANOVA. Expected variance components. Comparison of means and variances for significance. Statistical Softwares- SPSS, SPAR, MINITAB & R-program.

PRACTICAL

1. Diagrammatic and graphic representation of data using MS Excel.
2. Work out problems – Standard deviation, mean deviation, t-test, ANOVA, Correlation coefficient
3. Data analysis using SPSS software.

INSTRUMENTATION

MODULE-III

Unit-1: Different types of microscopes-Principles and applications; Light microscopes-various types (Dark field Microscope, Phase contrast Microscope, Deferential Interference Contrast Microscopy, Confocal microscopes, Fluorescent Microscopes), Electron microscope (SEM and TEM), Cryo-Electron Microscopy.

Unit-2: Spectrophotometer- UV/visible, fluorescence, circular dichroism, NMR, and ESR spectroscopy. Molecular analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods, Use in proteomics, metabolomics and lipidomics. Molecular structure determination using X-ray diffraction and NMR. Flow cytometer: Cell population study and identification of sub populations.

Unit-3: Separation techniques: Chromatography-Principle and Types-Ion exchange and affinity chromatography, TLC, HPTLC, HPLC, GC. Centrifuge- Principle and Types- Differential centrifugation and Density gradient centrifugation. Electrophoresis- Principle and Types-Agarose

Gel Electrophoresis, Polyacrylamide gel electrophoresis (Native PAGE, SDS-PAGE), Two-Dimensional Gel Electrophoresis (2D-GE), Capillary electrophoresis, Isoelectric focusing, Pulse field gel electrophoresis (PFGE).

Unit: 4: Thermal Cycler, Real-Time PCR -Principle and applications; DNA Sequencer- Principles and Types. Incubators: Principle and applications. Types-Microbiological Incubators, CO_2 Incubators, Anaerobic incubators, Plant growth chambers. Bioreactors.

PRACTICAL

1. Determine the concentration of biomolecules like DNA, RNA, protein or pigments using spectrophotometer.
2. Separation of DNA/protein using electrophoresis.
3. Separation of Pigments using Paper/Thin layer/Column Chromatography
4. Demonstration of thermal cycler, Incubators etc.
5. Visit to major research institutes to introduce major equipments.

MODULE-IV (Self studying module)

Unit-1: Major research institutes related to Plant Sciences in India. A brief idea about Government research and funding agencies: National - DST, DBT, ICAR, ICMR, CSIR, UGC, KSCSTE (Kerala state); International-CGIAR and FAO. Ethical issues related with biological research.

Unit-2: Measures, Probability, Correlation and regression-Characteristics of an ideal measure-Measures of central tendencies- mean, median and mode. Skewness and kurtosis. Measures of variations- range, quartile deviation, mean deviation- variance and standard deviation. Standard error and Coefficient of variation. Probability distribution- normal binomial and Poisson distribution- Correlation and regression analysis.

Unit-3: Next generation sequencing techniques (Brief account only)- Solexa, Ion proton, Nanopore etc.

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SEMESTER – II

MSBOT02 C06- PALEOBOTANY, PALYNOLOGY AND EVOLUTION

Objectives: Paleobotany: Its primary objective is to understand the history of plant life on Earth, including their evolution, diversification, distribution, and ecological interactions. This knowledge contributes to understanding of Earth's history and its biodiversity, and also has implications for modern-day conservation and environmental management.

Palynology: To demonstrate the broad range of applications and contributions that palynological studies offer in various scientific disciplines, from understanding Earth's history and environmental changes to aiding in archaeological investigations and forensic analysis.

Evolution: To provide a comprehensive understanding of how life on Earth has changed and diversified over time, and how these processes continue to shape the biological world we observe today

Theory: 3hrs/wk **Practical: 2hrs/wk**

PALEOBOTANY

MODULE-I

Unit-1: Preservation of plants as fossils: Definition; Taphonomy; environment for fossilization; modes of preservation; types; major rock types, rock cycle and rocks containing Fossils; systematics, reconstruction and nomenclature. Fossils and Geological Time Scale - Mega and microfossils - Geological time scale – Fossil angiosperms – Morphological diversity of early pollen, flower, stamen, gynoecium - A detailed study of external, internal morphology and reproduction in the following fossils – Lepidocarpon lomaxi, Cordaites . Contributions of Indian Paleobotanist- Birbal Sahni.

PALYNOLOGY

MODULE-II

Unit-1: Branches of palynology & application - Branches of palynology; palynology in taxonomic & phylogenetic deductions; palynology in academic & applied aspects including aero palinology, melissopalynology, medical palynology, forensic palynology, entomopalynology & copropalynology. Pollen allergy, symptoms and diagnosis in human being. Spore-pollen morphology: units, polarity, symmetry, shape, size, aperture; NPC system for numerical expression of apertural details; evolution of aperture types. Pollen wall and extra exinous wall materials: Sporoderm stratification and sculptures; LO-analysis; sporopollenin; pollen wall development; Ubisch body; pollen connecting threads, perine, pollen-kit. . Natural spore/pollen traps: Types, their implications in floristic & environment reconstruction.

EVOLUTION

MODULE-III

Unit-1: Evolution of Life- Molecular evolution-Origin of basic molecules and formation of polymers-primitive cell and organic evolution- concept of Oparin and Haldane-evolution of prokaryotes and eukaryotes- neutral theory of molecular evolution. Mechanism of evolution. Concept of species- Expression of relationships- Monophyly, Polyphyly, Homology. Analogy, Parallelism, Divergence, convergence and cladistics. Mutation and evolution, Polyploidy in evolution-Cataclysmic evolution. Origin of species-Adaptive radiation- isolation mechanisms-Natural selection- kin's selection and Hamilton's rule - migration-genetic drift- Co evolution. Origin and Evolution of Flowers-nectaries-evolution of stamens and Carpels-Concept of Foliar origin-evolution of ovary and placentation-evolution of pollination mechanisms.

MOLECULAR PHYLOGENETICS

MODULE-IV

Unit-1: Molecular phylogenetics-Molecular tools in phylogeny, classification and identification-Construction of Phylogenetic trees-protein and nucleotide sequence analysis. Bioinformatics tools in phylogeny Molecular divergence and molecular clocks -Origin of new genes, gene duplication and divergence.

Unit-2: (Self studying module) – Comparative analysis of plant adaptations in different environments and explore the evolutionary mechanisms that might have lead to the development of adaptations. A brief account on applications of palynology in archaeological investigations. Applications of palynology in biodiversity studies. Archeological explorations in India in relation with paleobotany.

PRACTICAL

1. Phylogenetic tree preparation
2. Acetolysis of pollen grain to study different types of exine ornamentation
3. Environment and Phenotypic variations– inter specific variation- stomatal size and density in sun and shade leaves.
4. Biological diversity – inter/intra specific variation – in size and shape of leaves.
5. Study of fossil types – Lepidocarpon, Cordaites

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MSBOT02 C07: ANGIOSPERM ANATOMY, EMBRYOLOGY AND MICROTECHNIQUE

Objective: The objectives of plant anatomy revolve around unraveling the internal structure, organization, function, and evolutionary relationships of plants, providing essential knowledge for various fields such as botany, agriculture, horticulture, and ecology. Plant anatomy aims to achieve the following goals: Identification and description, organization and differentiation, evolutionary insights and ecological and environmental studies. Plant microtechnique involves the preparation and manipulation of plant tissues at a microscopic level, allowing for the study and observation of plant anatomy in detail.

Plant embryology studies aim to deepen our understanding of plant development, reproductive processes, genetic regulation, and ecological adaptations. Plant embryology provides insights into the diverse reproductive strategies adopted by different plant species. It examines variations in embryo development, seed formation, and dispersal mechanisms across plant taxa. This knowledge helps in understanding the evolutionary adaptations and ecological significance of different reproductive strategies.

Theory: 4hrs/wk **Practical: 3hrs/wk**

ANGIOSPERM ANATOMY

MODULE-I

Unit-1: Origin, structure and function of cambia and its derivatives. Concept and classification. Abnormal Cambium: Classification, origin and function, experimental studies. Cambium in wound healing and grafting, factors influencing cambial differentiation and activity. Cork cambium - origin, types, derivatives and function. Development of Roots, lateral roots, and other specialized roots-pneumatophores, parasitic roots.

Unit-2: Root -stem transition- features and types; Nodal anatomy-features and types; Development of leaves- Origin and development of lamina – general pattern and phyllotaxy. Controversies on phylogenetic trends in nodal anatomy and root stem transition. Plastochronic stages. Experimental studies on meristems, vegetative to reproductive apex. Reversion from reproductive to vegetative apex. Floral development in *Arabidopsis* and *Antirrhinum*. Fruit and seeds: General anatomy of fleshy and dry fruits; General anatomy of seeds.

Unit-3: Applied anatomy: Wood anatomy of economically important plants- *Tectona, Artocarpus* and *Dalbergia*. Applications of anatomy in Systematics and Pharmacognosy. Research prospects in anatomy.

PRACTICAL

1. Variations in Epidermis – Trichomes, stomatal types; estimation of stomatal index.

2. Types of Nodal anatomy and Root - stem transition

3. Maceration of Xylem in herbaceous and woody stems to separate different cell types.

4. Abnormal secondary growth – different patterns: *Aristolochia, Cyclea, Achyranthes, Amaranthus, Nyctanthes, Mirabilis, Bougainvillea* and *Strychnos*.

ANGIOSPERM EMBRYOLOGY

MODULE-II

Unit-1: Major concepts in Angiosperms Embryology: structure and development pattern in microsporangium and megasporangium. Pollen development: Role and ultra structural changes of tapetum in pollen development. Male gametophyte: Microspore/pollen mitosis, division of generative cell heterogenicity in sperms, pollen fertility and sterility, pollen storage, viability and germination.

Unit-2: Ovule and megasporogenesis: Ovular Ontogeny, types and evolution, reduction, nutrition. Sub-cellular features of archesporial and megaspore mother cells, megaspore tetrad, dyad and coeno megaspore, termination of functional megaspore. Female gametophyte - Embryo sac: Classification and types, ultra structure of components; synergids and antipodal haustoria, nutrition of embryo sac. Molecular biology of micro and megasporogenesis: interaction of mitochondrial and nuclear genes; signal transduction at the level of stigma style and ovules; physicochemical aspects of pollination; pollination energetics.

Unit-3: Pollination: Primary and secondary attractants of pollination. Ultrastructural histochemical details of style and stigma, significance of pollen-pistil interaction, role of pollen wall proteins and stigma surface proteins, intra - ovarian pollination and in vitro fertilization. Co-evolution of Pollinators and flowers with special emphasis on major pollination mechanisms.

Unit-4: Double fertilization and triple fusion; post fertilisational changes and endosperm development. Role of synergids, filiform apparatus, heterospermy, differential behaviour of male gametes, syngamy and triple fusion, post fertilization metabolic and structural change in embryo sac. Endosperm: Classification and types, ultrastructure, cellularisation in nuclear endosperm, endosperm haustoria, their extension and persistence, function, storage metabolites. Embryo: Polarity in relation to development, classification and types, Histo- and organogenesis of mono- and dicot embryos, delayed differentiation of embryo structure, cytology and function of suspensor, physiological and morphogenetic relationship of endosperm and embryo.

PRACTICAL:

1. Preparation of dissected whole mounts of micro and mega sporangium; pollinia and embryos.

2. Developmental stages of anther, ovule, embryo and endosperm.

3. Study of types of embryo sacs during apomictic development by employing ovule-clearing method.

MICROTECHNIQUE

MODULE-III

Unit-1: Dehydration, Clearing, Embedding and Sectioning.

(a) Dehydration: Principles of dehydration, properties and uses of important dehydrating and clearing agents - alcohols, acetone, xylol, glycerol, chloroform, dioxan.

(b) Dehydration Methods: (i) Tertiary-butyl alcohol method. (ii) Alcohol-xylol method.

(c) Embedding: Paraffin method.

(d) Sectioning: Free hand sections – prospects and problems; sectioning in rotary microtome, sledge microtome and cryotome.

Unit-2: Protocol for preparation of (i) Natural stains - Haematoxylin and Carmine, (ii) Coal tar dyes – Fast green, Orange G, Safranine, Crystal violet, Cotton Blue and Oil Red O. (b) Techniques of staining: (i) Single staining; Staining with Safranine or crystal violet, (ii) Double staining; Safranine-Fast green method, Safranine-Crystal violet method. (iii) Triple staining; Safranine-Crystal Violet-Orange G method. (c) Histochemical localization of starch, lipids, nucleic acid, protein and lignin.

Unit-3: Mounting techniques: (a) Mounting: Techniques, common mounting media used - DPX, Canada balsam, Glycerin jelly and Lacto phenol. (b) Whole mounts: Principles and techniques of whole mounting, TBA/Hygrobutol method, Glycerine xylol method. Staining of whole mount materials (haematoxylin, fast green or Safranine-fast green combination). Significance of whole mounts. (c) Techniques of smear, squash and maceration (d) Cleaning, labelling and storage of slides.

PRACTICAL

1. Students are expected to be thorough with the following techniques. (a) Preparation of semi-permanent slides. (b) Preparation of permanent slides. (c) Preparation of whole mounts. (d) Maceration. (e) Preparation of fixatives (FAA, Carnoy's fluid). (f) Preparation of dehydration series (Alcohol, Acetone, TBA). (g) Preparation of paraffin blocks. (h) Preparation of microtome serial sections.

2. Candidates should prepare and submit 5 permanent slides in which the following categories should be included: (a) Free hand sections (single/double stained). (b) Serial sections (single/double stained). (c) whole mounts and (d) maceration .

MODULE-IV (Self Studying module)

Unit-1: Major concepts and theories in Anatomy: Differentiation, Dedifferentiation and redifferentiation. Definition and significance of these three terms. Environmental factors influencing differentiation of the divergent tissue systems, experimental studies, and their economic importance. Recent theories on organization of root and shoot apical meristems- Buvat; Popham and Chan; Korper-Kappe theory; Gifford and Corsan (1971).

Abnormal secondary growth – different patterns: *Aristolochia, Cyclea, Achyranthes, Amaranthus, Nyctanthes, Mirabilis, Bougainvillea* and *Strychnos*.

Unit-2: Polyembryony and Apomixis: Classification and types of polyembryony and Apomixis: Factors affecting polyembryony and apomixes. Diplospory, Apospory, Adventive Embryony, Agamospermy and parthenogenesis of embryos. Fruit and seed: Fruit and seed development: morphological, anatomical and biochemical changes. Parthenocarpy — induction of seedless fruits.

Unit-3: Staining: (a) Principles of staining; classification of stains, acidic, basic and neutral. Killing and Fixing: Principles and techniques of killing and fixing; properties of reagents, fixation images; properties and composition of important fixatives - Carnoy's Fluid, FAA, FPA, Chrome acetic acid fluids, Zirkle-Erliki fluid.

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MSBOT02 C08-GENETICS AND CROP IMPROVEMENT

Objectives: Plant genetics and crop improvement studies are multifaceted and aim to enhance agricultural productivity, improve crop quality, and ensure food security. Specific objectives include; Studying crop genetic diversity, inheritance and variation of characters, qualitative and quantitative improvement of traits, sustainable practices, and conservation approaches.

Plant genetics and crop improvement studies aim to harness the potential of plant genetic resources to develop improved crop varieties that address the challenges faced by agriculture, ultimately contributing to global food security and sustainable development.

Theory: 4 hrs/wk **Practical: 2 hrs/wk**

GENETICS

MODULE –I

Unit-1: Extensions of mendelian principles- allelic and non-allelic gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, and complementation test. Application of probability in genetics (Additive rule, multiplication rule and chi-square analysis).

Unit-2: Linkage and recombination- basic concepts, early evidence for linkage (T.H. Morgan, Bateson, and Punnet), Crossing over: physical basis of recombination, construction of linkage maps, and tetrad analysis, mapping with molecular markers. Sex-linked inheritance and extra-chromosomal inheritance.

Unit-3: Quantitative and Microbial Genetics: Polygenic inheritance-skin colour in humans, ear size in maize. Heritability and its measurement. QTL mapping. Methods of gene transfer-transformation, conjugation, transduction and sex-duction. Mapping gene by interrupted mating, fine structure analysis of genes.

MODULE-II

Unit-1. Mutation: Basic concept, spontaneous and induced mutations, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants. physical and chemical mutagens insertional mutagenesis: Transposons and their use in mutagenesis and gene tagging in plant system. Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

Unit-2: Human genetics: Human pedigree Analysis- Autosomal recessive traits, Autosomal dominant traits, X-linked recessive traits, X-linked dominant traits, Y-linked traits. Lod score for linkage testing. Population genetics: Measurement Gene frequency and allelic frequency. Systems of

mating, Hardy-Weinberg equilibrium, factors effecting Hardy Weinberg, mutation, selection, migration, genetic drift, Bottle neck effect and founder effect. Inbreeding and co-ancestry.

PRACTICAL

1. Workout the problems from linkage, tetrad analysis, quantitative traits, mutation, population genetics and pedigree analysis.

CROP IMPROVEMENT

MODULE-III

Unit-1: Crop genetics-a general account of origin, genetic variability, floral biology, breeding programs, agronomic practices- and major breeding achievements in the case of cereals-Rice, Plantation Crops (Coconut, Coffee, Rubber, Arecanut and Cashew nut) and Spices- Pepper, Turmeric and Vanilla; Tuber Crops-Tapioca.

Unit-2: Genetic resources: Conservation and utilization in crop improvement. Gene banks: rural gene banks, International net work of Gene banks- FAO, role of domestication and plant introduction and acclimatization improvement. Agronomic package of practices (field preparation, nursery management, plant materials, improved planting materials, manuring, breeding, inter cropping, soil and water conservation)

Unit-3: Crop improvement methods: Hybridization; Heterosis, systems of incompatibility and sterility. Back crossing theory and practice. Inbreeding and inbreeding depression. Production of hybrid seeds. Applications of euploidy in crop improvement: significance of haploids and polyploids. Clones and clonal propagation. Somatic variation, somatic hybridization. Application of tissue culture in crop improvement. Mutation breeding: achievements and future. Resistance breeding for disease.

MODULE-IV

Unit-1: Selection as a method in crop improvement. Decentralized participatory plant breeding-concept, scientific basis, advantages and disadvantages; organic plant breeding- concept, principles and need of organic plant breeding. Release and multiplication of varieties: procedure of variety release, classes of seeds, seed certification.

Unit-2: Intellectual Property Rights-Introduction, definition and forms of Intellectual Property Right-copy right, trade mark, industrial designs, geographical indication, trade secrets, patents-objectives of patent system, conditions for patentability, Patent Act (1970) and important amendments, types of patent application, patent procedures, precaution in filing patent application, renewal of patents.

Unit-3: (Self studying unit): Introduction to genetics: Classification of genetics-classical, population and molecular genetics. Basic principles of heredity-monohybrid and dihybrid crosses, chromosome theory of inheritance. Mendelian inherited disorders in man.

History and traditional plant breeding approaches, Major national initiatives and achievements. Green revolution-A global perspective. Modern approaches in crop improvement and Sustainable agriculture practices (General account only). Conservations strategies for crop plant genetic

resources. Agencies involved in conservation of crop genetic resource activities-NBPGR and ICAR-achievements. Plant quarantine regulatory measures.

PRACTICAL

1. Stigma receptivity-Hydrogen peroxide test

2. Emasculation and Hybridization- Rice, Cashew, Colocasia, Solanum melongena, Cephalandra, Vigna etc.

3. Floral biology-Coconut, Vigna, Colocasia, Abelmoschus, Solanum melongena, Capsicum frutescens, etc.

4. Popular hybrids in Coconut, Cashew, Rice, Tuber crops, Spices, Rubber and Coffee under cultivation in Kerala

5. Germplasm characterisation of Banana/Coconut/Rice/Mango.

6. Visit to the major plant breeding stations and submission of a certified report.

7. Cytology of diploids and triploids-Colocasia or any other plant

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MSBOT02 C09-PLANT PHYSIOLOGY AND BIOCHEMISTRY

Objective: The study of plant physiology and biochemistry plays a vital role in advancing our knowledge of plant biology, addressing global challenges in agriculture and food security, and promoting sustainable and environmentally conscious practices. The key objectives are; understanding plant growth and development, investigating plant responses to environmental factors, plant stress responses and resilience and unraveling plant metabolism and biochemical pathways.

Theory: 4 hrs/wk Practical: 3 hrs/wk

PHYSIOLOGY

MODULE-I

Unit-1: Respiration: Overview of the process, site of action and mechanism. Plant mitochondrial electron transport system and ATP synthesis – organization of electron transfer complexes (complex I – IV). ATPase (Complex V) – detailed structure of F1 and Fo subunits, binding change mechanism of ATP synthesis. Chemiosmotic mechanism, Cyanide resistant pathway - alternative oxidase, its regulation and significance. Rotenone-insensitive pathway in plants.

Unit-2: Plant growth and development: Plant growth regulators: Physiology and biochemistry of phytohormones. Physiology of flowering: Florigen, ABC model of floral organ development. Sensory photobiology: Structure, function, and mechanisms of action of phytochromes, cryptochromes, and phototropin; photoperiodism and biological clocks; circadian rhythm, Light dependent stomatal opening, Role of blue-light reception. Fruit ripening. Physiology of seed: hormonal regulation of seed development. Seed dormancy- role of phytohormones, Seed germination- Mobilization of stored food reserve, Programmed cell death, senescence, and aging.

Unit-3: Stress physiology:Responses of plants to biotic (pathogen and herbivores) and abiotic (water, temperature, salinity and Heavy metal) stresses. Oxidative stress: Reactive Oxygen Species (ROS). Mechanism of stress tolerance: role of scavenging systems (enzymatic and non-enzymatic), osmolytes, phytochelatins and metallothioneins, heat shock and antifreeze proteins. Stress tolerant transgenic plants.

PRACTICAL

1. Preparation of molar, normal, and percentage solutions and their dilutions.
2. Determination of moisture content of plant materials,
3. Determination of osmotic potential by plasmolytic method.
4. Isolation of chloroplast from fresh leaves
5. Separation of plant pigments by paper chromatography/ thin layer chromatography
6. Estimation Chlorophyll content in any five plants- Quantification

7. Determination of peroxidase activity in normal and stressed plants
8. Viability test of seed by chemical method-Tetrazolium Test
9. Determine the germination percentage of few economically important plants

BIOCHEMISTRY

MODULE-II

Unit-1: Proteins- Structure and Classification – Primary structure-Peptide bond, Secondary structure alpha-sheets, beta-pleats, Disulphide bridges. Tertiary and Quaternary structures. Denaturation of Proteins. Ramachandran plot. Nucleic acids – Functions, Components of nucleic acids –Nucleotides-Structure of Polynucleotides. Types of Nucleic acids- Conformations. Vitamins and Hormones – Overview of types, structure and functions

Unit-2: Metabolism-Introduction to Metabolic pathways: Primary Metabolism, Secondary metabolism and Intermediary metabolism. Metabolism of Carbohydrates- Glycolysis, Citric acid cycle, Gluconeogenesis Glycogenesis, Glycogenolysis, Hexosemonosphospahte shunt. Metabolism of lipids – Fatty acid oxidation, biosynthesis of fatty acids and cholesterol. Nitrogen metabolism: Nitrate assimilation, Ammonium assimilation, Amino acid biosynthesis, Genetics of Nitrogen fixation, Urea cycle. Metabolism of Nucleic acid – Overview of Purine and pyrimidine biosynthesis and degradation. Secondary metabolites- overview, types and roles and significance.

MODULE-III

Unit-1: Physiological Biochemistry: Biological oxidation-High energy compounds – Pyrophosphates, Acyl phosphates, Enol phosphates, Thioesters, Phosphagens, oxidative phosphorylation –mechanism. Enzymes involved in Biological oxidation.

Unit-2: Enzymology – Enzymes – Functions. Nomenclature and classification, Chemical nature and Properties. Factors influencing enzyme activity, Active site and Catalytic residues, Enzyme inhibition. Km Value and Vmax. Michelis-Mentenequation. Specificity of enzymes. Coenzymes. Mechanism of Enzyme catalysis. Regulation of enzyme action. Isoenzymes, Non-protein enzymes.

Unit-3: Basics of Immunochemistry: Innate and Acquired immunity, Primary and secondary immune response, Humoral and cell mediated immune response, MHC, Antibody- structure, types and functions, Monoclonal and polyclonal antibodies. Vaccines. Disorders due to impaired immune system.

MODULE-IV (Self Studying Module)

Unit-1: Photosynthesis: Overview of the process, component and site of action/process and mechanism: Light harvesting complexes: PS I, PSII; Structure and composition of reaction centers. Basic principles of light absorption, excitation energy transfer, mechanism of electron transport, photooxidation of water, proton electrochemical potential – photophosphorylation:-cyclic and non-cyclic. Synthesis of starch and sucrose, Structure and function of RuBisco, CO_2 fixation – Calvin cycle. Photorespiration, role of photorespiration in plants. CO_2 concentrating mechanisms C4 cycle, CAM pathway, Photosynthetic efficiency: quantum yield and energy conversion. Transport of

photoassimilates – phloem loading and unloading, mechanism of phloem translocation – pressure flow. Photoinhibition and its tolerance mechanism.

Unit-2: Biomolecules: Structure and Function: Aminoacids and Proteins: Functions. Amino acids: Properties, Physical and Chemical, Zwitterion, Structure and classification, Standard amino acids and Non-standard amino acids. Carbohydrates- Functions; Classification of Carbohydrates; Monosaccharides: structural aspects, derivatives of monosaccharides. Oligosaccharides and glycosidic bonds, Polysaccharides- homopolysaccharides and heteropolysaccharides. Lipids – Functions; Classification of Lipids: Simple, Complex, Derived. Fatty acids, Essential fatty acids, Triacylglycerol, Phospholipids, Glycolipids, Lipoproteins, Steroids, Amphipathic lipids.

PRACTICAL

1. Qualitative test and Estimation of protein by Biuret method.
2. Generate standard graph and determination of unknown concentration of protein by Lowry method.
3. Qualitative test of carbohydrates-Molisch's, Benedict's, Seliwanoff's, Test for sucrose and iodine test for starch..
4. Qualitative test of aminoacids-Ninhydrin test and Xanthoproteic test.
5. Effect of inhibitors on enzyme activity
6. Effect of temperature on enzyme activity

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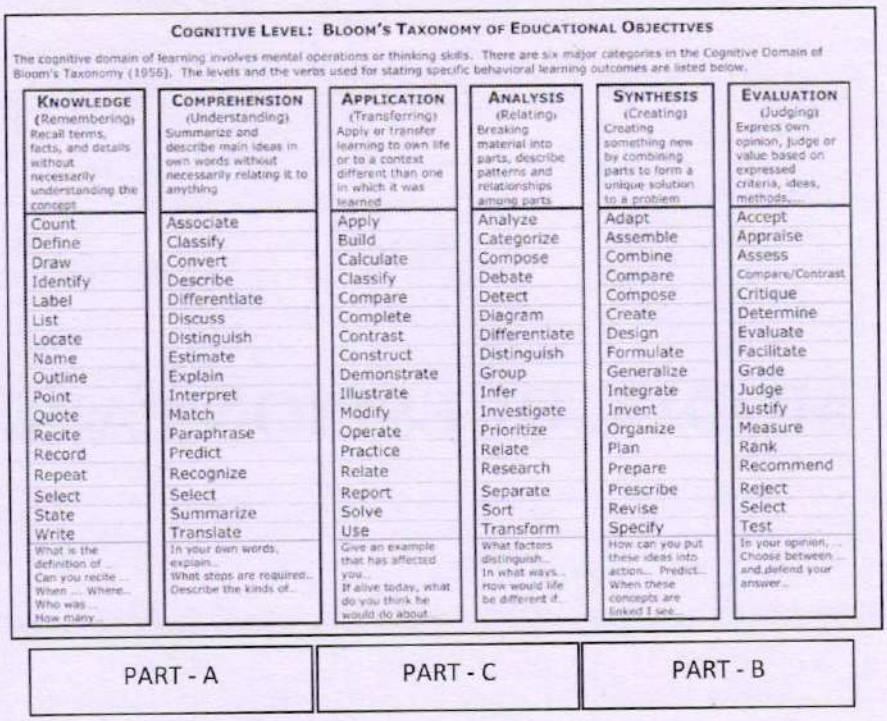
MODEL QUESTION PAPER

END SEMESTER EVALUATION

Evaluation in outcome-based education is designed to measure the attainment of specific learning outcomes. It involves aligning assessments with the outcomes, using criterion-referenced assessment methods, providing continuous feedback, and evaluating the effectiveness of the overall educational program. By focusing on clear outcomes and providing regular feedback, evaluation in outcome-based education supports student learning and helps improve the quality of education. Outcome evaluation goes beyond assessing individual knowledge and comprehension and focuses on the broader application and integration of knowledge, skills, and attitudes. In outcome evaluation, learners are expected to demonstrate their ability to critically analyze and evaluate the overall impact and effectiveness of what they have learned or the program they have participated in.

The end semester examination is based on Bloom's taxonomy criteria (1956), both in the case of theory and practical, given as follows;



COGNITIVE LEVEL: BLOOM'S TAXONOMY OF EDUCATIONAL OBJECTIVES

The cognitive domain of learning involves mental operations or thinking skills. There are six major categories in the Cognitive Domain of Bloom's Taxonomy (1956). The levels and the verbs used for stating specific behavioral learning outcomes are listed below.

KNOWLEDGE (Remembering) Recall terms, facts, and details without necessarily understanding the concept	COMPREHENSION (Understanding) Summarize and describe main ideas in own words without necessarily relating it to anything	APPLICATION (Transferring) Apply or transfer learning to own life or to a context different than one in which it was learned	ANALYSIS (Relating) Breaking material into parts, describe patterns and relationships among parts	SYNTHESIS (Creating) Creating something new by combining parts to form a unique solution to a problem	EVALUATION (Judging) Express own opinion, judge or value based on expressed criteria, ideas, methods...
Count	Associate	Apply	Analyze	Adapt	Accept
Define	Classify	Build	Categorize	Assemble	Appraise
Draw	Convert	Calculate	Compose	Combine	Assess
Identify	Describe	Classify	Debate	Compare	Compare/Contrast
Label	Differentiate	Compare	Detect	Compose	Critique
List	Discuss	Complete	Diagram	Create	Determine
Locate	Distinguish	Contrast	Differentiate	Design	Evaluate
Name	Estimate	Construct	Distinguish	Formulate	Facilitate
Outline	Explain	Demonstrate	Group	Generalize	Grade
Point	Interpret	Illustrate	Infer	Integrate	Judge
Quote	Match	Modify	Investigate	Invent	Justify
Recite	Paraphrase	Operate	Prioritize	Organize	Measure
Record	Predict	Practice	Relate	Plan	Rank
Repeat	Recognize	Relate	Research	Prepare	Recommend
Select	Select	Report	Separate	Prescribe	Reject
State	Summarize	Solve	Sort	Revise	Select
Write	Translate	Use	Transform	Specify	Test
What is the definition of... Can you recite... When ... Where... Who was... How many...	In your own words, explain... What steps are required... Describe the kinds of...	Give an example that has affected you... If alive today, what do you think he would do about...	What factors distinguish... In what ways... How would life be different if...	How can you put these ideas into action... Predict... When these concepts are linked I see...	In your opinion, ... Choose between ... and defend your answer...

PART - A	PART - C	PART - B

Question Paper Pattern

Part	No. of questions	No. of Questions to be answered	Mark for each question	Total	Cognitive level
A	6	5	3	15	Remembering Understanding
B	5	3	6	18	Creative Judging
C	5	3	9	27	Application Analysis
TOTAL MARKS				60	

MODEL QUESTION PAPER

I SEMESTER M. Sc BOTANY DEGREE EXAMINATION

(2023 Admission onwards)

MSBOT01 C01- GENERAL AND APPLIED MICROBIOLOGY

Time: 3 hrs **Maximum Marks: 60**

PART-A (*Answer any* five *questions. Each question carries* 3 *marks*)

1. Describe the structure and organization of Bacteria.
2. Write a brief account of Bergey's manual on systematic bacteriology.
3. Summarize the significance of viroids and prions.
4. What are extremophiles? Discuss its significance.
5. Discuss the role of microbes in food spoilage and food poisoning.
6. What are the lab safety measures required in a microbiology lab.

5x3=15

PART-B (*Answer any* three *questions. Each question carries* 6 *marks*)

7. A farmer reported an epidemic infection in his field. Formulate a methodology to identify the causative organism.
8. You are provided with sequences of a group of microorganism; design a strategy to find out the phylogenetic relationship among them.
9. Critically evaluate the control measures taken during CoVID 19 outbreak and compare with your recommendations.
10. "Majority of the microbes are beneficial" Justify the statement with reasons.
11. After microbial transformation experiment with *E. Coli* the culture plate showed blue and white coloured colonies. Judge the results.

3x6=18

PART-C (*Answer any* three *questions. Each question carries* 9 *marks*)

12. Classify and comment on the various applications of microbes to human kind.
13. Compare the genetic recombination methods in Bacteria.
14. Differentiate between various groups of viruses based on its structure and genetic material.
15. Compare the artificial culture methods of bacteria and viruses.
16. Investigate the impact of emerging infectious diseases to human population.

3x9=27

KANNUR UNIVERSITY

M.Sc. BOTANY- PRACTICAL EXAMINATION - PAPER I

MSBOT01 C05 - General and Applied Microbiology, Phycology, Mycology and Plant Pathology, Bryophytes, Pteridophytes and Gymnosperms and Research Methodology, Instrumentation and Biostatistics

Time: 4 Hours **Total Marks: 48**

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1. With the help of micro preparations, identify the specimens **A,** and **B** with reasons.

   (Preparation 2, Identification 1, Reason 2) 2 x 5=10

2. Prepare the microbial specimen C for staining special structure.

   (Preparation 2, Procedure, 2, Result and Identification 1) 1 x 5=5

3. Make clean mount of three algae **D, E** and **F**. Draw labeled diagrams and identify giving important reasons.

(Preparation 1, Identification with Reasons 1, Diagram 1) 3 x 3=9

4. Work out the given problem G.

(Steps and description 3, Result, 2) 1 x 5=5

5. Determine the concentration of sample H (DNA/RNA/protein/pigments) using spectrophotometer.

   (Procedure-2, Calculation and Result-3) 1 x 5=5

6. Indentify and write the principle of equipment given

   (Identification-1, Principle-1) 1 x 2=2

7. Identify the specimens with identifying reasons, J, K, and L.

(Indentification-1, Reasons-2) 3 x 3=9

8. Indentify and write note on specimen M.

(Indentification-1, Notes-2) 1 x 3=3

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PAPER I

MSBOT01 C05 - General and Applied Microbiology, Phycology, Mycology and Plant Pathology, Bryophytes, Pteridophytes and Gymnosperms and Research Methodology, Instrumentation and Biostatistics

KEY TO THE SPECIMENS

A. Algae/Fungi/Pathology

B. Bryophyte/Pteridophyte/Gymnosperm

C. Microbial specimen

D. E. F. (Mixture may include filamentous, colonial and unicellular)

G. Work out problem (Standard deviation/mean deviation/t-test/ANOVA/Correlation coefficient and Graphic representation of data using MS Excel or Data analysis using SPSS software.

H. Sample containing DNA/RNA/protein/pigments

I. Any equipment specified in the syllabus

J, K, L. Reproductive part of Fungi, Bryophyte, Pteridophyte or Gymnosperm.

M. Fossil pteridophyte/Fossil gymnosperm

KANNUR UNIVERSITY

M.Sc. BOTANY- PRACTICAL EXAMINATION-PAPER II

MSBOT02 C10 -Paleobotany, Palynology and Evolution, Angiosperm Anatomy, Embryology and Microtechnique, Genetics and Crop Improvement and Plant Physiology and Biochemistry

Time: 4 Hours **Total Marks: 48**

1. Take T. S. of the material **A**. Prepare double stained permanent slide and submit for valuation and explain the anomaly.

   (Section-2, Double staining-3, Anomaly-2) 1 x 6=7

2. Make suitable micro preparation of **B** by acetolysis. Describe the pollen morphology (two) with the aid of a diagram.

   (Preparation-3, Description with diagram-2, Procedure-1) 1 x 6=6

3. Demonstrate ovule-clearing method in **C** and identify the types of embryo sacs during apomictic development.

   (Preparation-3, Identification and description-2) 1 x 5=5

4. Work out the problems **D**

   (Tabulation and Calculation-3, Result-1) 1 x 4=4

5. Demonstrate emasculation and hybridization in the specimen **E.**

   (Demonstration-4, viva-2) 1 x 6=6

6. Construct a phylogenetic tree with given data **F** and interpret the phenetic relationship.

   (Construction-2, Interpretation-2) 1 x 4=4

7. Biochemical analysis of given sample **G**

   (Analysis-3, Result-2, Procedure-1) 1 x 6=6

8. Demonstrate the sigma receptivity test in given sample H.

   (Procedure-1, Experiment and result-3) 1x 4=4

9. Write notes on **I,J,K**

   (Indentification-1, Notes-1) 3 x 2=6

KANNUR UNIVERSITY

M.Sc. BOTANY- PRACTICAL EXAMINATION

PAPER II

MSBOT02 C10 -Paleobotany, Palynology and Evolution, Angiosperm Anatomy, Embryology and Microtechnique, Genetics and Crop Improvement and Plant Physiology and Biochemistry

KEY TO THE SPECIMENS

A. *Aristolochia, Cyclea, Achyranthes, Amaranthus, Nyctanthes, Mirabilis, Bougainvillea* and *Strychnos.*

B. Mixture of pollen sample (at least 4 types)

C. Suitable ovule samples

D. Problems from linkage, tetrad analysis, quantitative traits, population genetics and pedigree analysis.

E. Emasculation and Hybridization (Rice, Cashew, Colocasia, Solanum melongena, Cephalandra, Vigna etc.

F. Data for phylogenetic tree.

G. Determination of osmotic potential by plasmolytic method/ Isolation of chloroplast from fresh leaves/ Estimation Chlorophyll content in any five plants/ Determination of peroxidase activity in normal and stressed plants/ Generate standard graph and determination of unknown concentration of protein by Lowry method.

H. Flower buds of various developmental stage (at least three numbers)

I. Nodal anatomy or Root-stem transition

J. Popular hybrids in Coconut, Cashew, Rice, Tuber crops, Spices, Rubber and Coffee under cultivation in Kerala

K. Physiology and Biochemistry