

Total 1 page

DR. BHIMRAO AMBEDKAR UNIVERSITY
DEPARTMENT OF BOTANY
School Of Life Sciences, Khandari Campus, Agra.

Dated: 03 June, 2022

To, The PVC /
The Assistant Registrar (Academic)
Dr. Bhimrao Ambedkar University,
Agra.

Sir,

Please find enclosed herewith the minutes of the meeting of Academic Committee of the Department of Botany held on June 03, 2022. It is requested that it may please be placed before the Academic Council / Executive Council for approval at the earliest.

Thanking you

Yours faithfully,


R.K. Agnihotri
Head

AR (Academic)
Phase put it in A.C.
for approval & discussion
Jub 3/6/22

Encls. :

1. Minutes of the Academic Committee
2. Revised Ordinances of the M.Sc. Botany (in Faculty of Life Science) Appendix- 1
3. Revised Syllabus for M.Sc. Botany (In Faculty of Life Science) Appendix- 2
4. Syllabus for Minor Subject, Appendix -3
5. Ordinances of the Post Graduate Diploma in Research (PGDR) in Botany (in Faculty of Life Science) Subject Botany Appendix- 4
6. Syllabus for Post Graduate Diploma in Research (PGDR) in Botany (in Faculty of Life Science) Subject Botany Appendix- 5

**DEPARTMENT OF BOTANY
SCHOOL OF LIFE SCIENCES
DR. BHIMRAO AMBEDKAR UNIVERSITY, AGRA**

ATTENDANCE SHEET

Date: 3rd June 2022

Time: 12:30 PM

Meeting: Academic Committee of Department of Botany

Members of the Committee:

1. Prof. Shamsul Hayat, Department of Botany,
AMU Aligarh

Attended virtually

2. Dr. Deepa Bisht, Scientist 'E',
NJIL & OMD, Agra

*DBisht
03/06/2022*

3. Prof. Rajendra Sharma (Retd),
Department of Botany,
Dr. Bhimrao Ambedkar University, Agra

Attended virtually

4. Dr. Rajneesh Kumar Agnihotri,
Head, Department of Botany,
Dr. Bhimrao Ambedkar University, Agra

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5. Dean, School of Life Sciences,
Dr. Bhimrao Ambedkar University, Agra

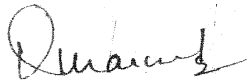
3/6/22

Prof. Rajendra Sharma (Retd.)
G 5, Panchvati Enclave,
Civil Line, Agra
Pincode- 282002

Date: 03-06-2022

With reference to your mail regarding the Academic Committee of Botany held on 03 June 2022 time 12:00 Noon . I joined the meeting through virtual mode.

I considered and approved all the items



Prof. Rajendra Sharma



ALIGARH MUSLIM UNIVERSITY
PROF. SHAMSUL HAYAT

PLANT PHYSIOLOGY SECTION
DEPARTMENT OF BOTANY
ALIGARH MUSLIM UNIVERSITY
ALIGARH-202002, INDIA

Date: 03-06-2022

With reference to your mail regarding the Academic Committee of Botany held on 03 June 2022 time 12:00 noon. I joined the meeting through virtual mode.

I considered and approved all the items

(Shamsul Hayat)

DR. BHIMRAO AMBEDKAR UNIVERSITY, AGRA
FACULTY OF LIFE SCIENCE
DEPARTMENT OF BOTANY
MASTER OF SCIENCE (M.Sc.) IN BOTANY
(IN FACULTY OF LIFE SCIENCE)
(Based on Choice Based Credit System)
(AS PER NEP, 2020)

REVISED ORDINANCES

1. The title of the M.Sc. course shall be M.Sc. Botany (In Faculty of Life Science). The Course shall be conducted by the Department of Botany (Dr. Bhimrao Ambedkar University), Agra.
2. The M.Sc. Botany (In Faculty of Life Science) course shall be of two years (divided into four Semesters) programme and based on Choice Based Credit System (CBCS). The first year of M.Sc. shall be known as M.Sc. 1st year having I and II semesters. Similarly, second year of this course shall be called M. Sc. 2nd year having III and IV semesters. Each semester shall consist of minimum 90 working days.
3. B.Sc. Research (in Faculty of Life Science) will be awarded if student exit the programme after completing M.Sc. first year (I and II semester) of M.Sc. Botany (in Faculty of Life Science) programme and earned total 52 credits. The I and II semesters of the First year of the M.Sc. Botany (in Faculty of Life Science) Programme will be known as VII and VIII semesters of the B.Sc. Research (in Faculty of Life Science).
4. The M.Sc. Botany (in Faculty of Life Science) programme is spread over four semesters. The total marks assigned for this programme shall be 2500 marks and the credits earn will be of 100 credit points and comprises of three different components viz: I) Teaching - Theory II) Lab Work and (III) Industrial/Summer Training/ Survey/ Research Project

Distribution of credits for M. Sc. Botany (In Faculty of Life Science)

Programme is:

Total Credits for M. Sc. Degree Programme	= 100 credits
i) Teaching - Theory	= 68 credits
II) Lab work	= 16 credits
III) Industrial/Summer Training/ Survey/ Research Project	= 16 credits

Distribution of credits for teaching (Total 68 credits)

i) Major/Core courses (16x4)	= 64 credits
ii) Minor courses	= 04 credits

Distribution of credits for Lab work and Project (Total 32 credits)

i) Lab work	= 16 credits
ii) Industrial/Summer Training/ Survey/ Research Project	= 16 credits

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5. A. Program Duration and Credit Requirements:

- a. M.Sc. Botany (In Faculty of Life Science) degree programme shall be of four semesters (2 years) M. Sc. Botany (in Faculty of Life Science). The M.Sc. Botany (in Faculty of Life Science) programme will be based on Choice Based Credit System (CBCS). Each semester shall consist of minimum 90 working days.
- b. These will be consecutive academic years.

B. Distribution and Requirements of Credits for M. Sc. Botany (in Faculty of Life Science) Programme is:

- a. **M. Sc. 1st year (I and II semester) / B. Sc. Research (VII and VIII Semester) will be of 52 credits.**
 - I. Teaching of 01 Major Course (4 Theory in course) in each semester (I&II Semester) = 16 + 16 credits = 32 credits
 - II. Teaching of 01 Minor Course Theory (II semester) = 4 credits
 - III. Practical work of 01 Major Course in each semester (I & II Semester) = 4 + 4 credits = 08 credits
 - IV. Industrial/Summer Training/ Survey/ Research Project in a year (I & II semester) = 8 credits

B. Sc. Research (in Faculty of Life Science) will be awarded if student exit M. Sc. first year but after completing all 2 semesters (1st year) of M. Sc. Botany (in Faculty of Life Science) programme and earned total 52 credit.

b. M. Sc. 2nd year (III and IV Semester) will be of 48 credits.

- I. Teaching of 01 Major Course (4 Theory in course) in each semester (III&IV Semester) = 16 + 16 credits = 32 credits
- II. Practical work of 01 Major Course in each semester (III&IV Semester) = 4 + 4 credits = 08 credits
- III. Industrial/Summer Training/ Survey/ Research Project in a year (III and IV semester) = 8 credits

M. Sc. Botany (in Faculty of Life Science) will be awarded after completing all 4 semesters (2 years) comprising total 100 credits.

6. A. Teaching (68 Credits)

Teaching is a major component of the M.Sc. Botany (In Faculty of Life Science) programme. It shares 68 credits out of total 100. The remaining two components i.e. Lab work and Industrial/Summer Training/ Survey/ Research Project share remaining 32 credits. Various courses offered under M.Sc. Botany (In Faculty of Life Science) programme are categorized as: A) Core courses B) Elective course. Altogether there are 13 Core courses and 03 Elective courses. All core courses are offered in I, II, III and IV semesters and all Elective Courses will be offered in III and IV semester of the M.Sc. Botany (In Faculty of Life Science) programme.

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All Core Courses and Elective courses are of 4 credits each and compulsory for all the students and cover all specialized papers.

In III semester there is 02 Elective Courses, out of which students will have to choose any 01 Elective courses to obtain 4 credits

In IV semester there is a running list of 04 Elective Courses, out of which students will have to choose any 02 Elective courses to obtain 8 credits.

One compulsory Minor course is of 4 credits will be chosen by student from other faculty in 1st year (II semester) of M.Sc. Botany (In Faculty of Life Science) Programme.

B. Lab work and Industrial/ Summer Training/ Survey/ Research Project (32 credits)

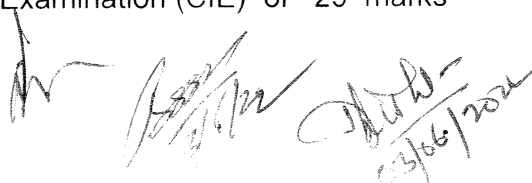
a) Lab work (16 credits)

The lab work component is spread over all four semesters and is called as practical to be completed in I,II,III and IV semesters respectively. Under Lab Work sets of experiments specially designed for M.Sc. Botany (In Faculty of Life Science) students by faculty members of the department are carried out in M. Sc. laboratory.

b) Industrial/Summer Training/ Survey/ Research Project (16 credits)

The Industrial/Summer Training/ Survey/ Research Project component is spread over all four semesters and is called as Research Project to be completed upto the end of II semester and IV semester respectively. Each student will work for M. Sc. Industrial/Summer Training/ Survey/ Research Project under the supervision of formally assigned supervisor in the Department. Assigning of supervisor will be based on academic interest shown by the student in area of research specialization of the concerned faculty member followed by the consent given by the faculty member to supervise the project work of that particular student. Student shall complete the process of academic interaction to obtain teachers consent to supervise his/her project work by the beginning of I and III semester. The work on research project will start in First/third semester under the supervision of concerned faculty member in his /her lab or from other institution govt./ private sector (industries/ consultancies/ laboratory/ NGO) in the form summer training(4-6 weeks) and will be completed by second/fourth semester with writing and submission of dissertation. Students will have to present their work and defend it in an open viva- voce in the presence of internal and external examiner in the end of the 1st year and 2nd year respectively.

7. There shall be four theory papers, One Lab Work/ Practical examination and Industrial/Summer Training/ Survey/ Research Project in each semester.
8. Each Semester shall have Four Theory Papers (Examination) of 75 marks each and Four Periodical Tests/ Continuous Internal Examination (CIE) of 25 marks


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each (one class test of 10 marks, One seminar of 10 marks and Viva- voce of 5 marks) in each course (Total marks of each theory paper 100 (4 credits) including Periodical Tests/CIE). One Practical examination of 100 marks (4 credits) in each semester and Industrial/Summer Training/ Survey/ Research Project of 200 marks (8 credits) in together in I & II semester and III & IV semester respectively.

Continuous Internal Evaluation (CIE) shall be based on one class test of 10 marks, One seminar of 10 marks and Viva- voce of 5 marks as decided by the concerned teacher/HOD).

One minor course of other faculty shall have one theory paper of 75 marks and periodical test/CIE of 25 marks only in II semester.

M. Sc. 1st year (I and II semester) / B. Sc. Research (VII and VIII Semester) will be of 1300 Marks.

a. Teaching of 01 Major Course (4 Theory in course) in each semester (I & II Semester)
= 400 + 400 = 800 Marks

I. Teaching of 01 Minor Course Theory (II semester) = 100 Marks

II. Practical work of 01 Major Course in each semester (I & II Semester)
= 100 + 100 = 200 Marks

III. Industrial/Summer Training/ Survey/ Research Project in each semester
(I & II Semester) = 200 Marks

Total Marks of M.Sc. 1st year (I & II semester) / B.Sc. Research 4th year (VII & VIII Semester)
= 1300 marks

M. Sc. 2nd year (III and IV Semester) will be of 1200 Marks.

I. Teaching of 01 Major Course (4 Theory in course) in each semester (III & IV Semester)
= 400 + 400 = 800 Marks

II. Practical work of 01 Major Courses in each semester (III & IV Semester)
= 100 + 100 = 200 Marks

III. 01 Industrial/Summer Training/ Survey/ Research Project III & IV Semester)
= 200 Marks

Total Marks of M.Sc. 2nd year (III and IV Semester) = 1200 marks

M. Sc. Botany (in Faculty of Life Science) will be awarded after completing all 4 semesters (2 years) comprising total 2500 Marks.

9. At the end of each Semester there shall be End Semester/Term Examination of three hours duration for each course and practical examination of six hours, based on prescribed courses taught during the Semester.

10. Prior to the commencement of each End Semester/ Term Examination there shall be preparation leave for not less than 7 days and not more than 10 days.

11. The theory examiners of the End Semester/Term Examination shall be 50% internal and 50% external.


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12. The practical and Research Project examination at the end of each Semester/year shall be conducted by a Board of two examiners (one external, and one internal examiner).
13. The paper setters/examiners- external as well as internal shall be appointed by the Vice- Chancellor on the recommendation of the Head of the Department.
14. To start with not more than 20 students shall be admitted in the First Semester. No admission in any other Semester will be allowed.
15. The minimum qualification for admission to the Master's course (M.Sc.) in Botany (In Faculty of Life Science) shall be:
 - a. Bachelor's degree (Three Year) with 50% Marks in aggregate with Botany, Zoology, Chemistry and allied subjects.
 - b. Either an average 55% marks in two examinations prior to the Bachelor's degree i.e. High School and Intermediate and Bachelor's Degree Examination counted together or 50% marks in each of the above examinations separately.
16. The admission of the candidate shall be on the basis of academic record, admission test and interview.
17. The admission test shall be based on objective type questions of B.Sc. standard. The test may be 2-3 hours depending upon the number of questions.
 - a. The test shall be followed by the interview to be conducted by the Department faculty members.
 - b. All the above examination shall be given equal weightage. The admission test shall be of 40 marks and the interview of 10 marks. The marks obtained from High School to B.Sc. taken in equal percentage shall be normalized to 50%.
18. Admission in the course will be finalized by the Dean/Head of the Department/Admission Committee of the Faculty of Life Science.
19. In case of misbehavior, indiscipline, the student may be expelled from the Department or given some other punishment recommended by the faculty members of the Department / Proctor of the University and the decision of the unfair means committee of the university is final in the case of cheating and using unfair means by the student in any examination. All cases of expulsion shall be referred to the Vice-Chancellor for final approval.
20. Each student shall pay tuition, examination and other fees as per semester/annual and as per University Orders.
21. (a). Each theory paper of the Course shall contain not more than 8 questions spread uniformly over the entire syllabus. The students shall have to answer only four questions in three hours, which shall be the duration of the question paper. If the 4 Units are there in the syllabus one question will be compulsory form each unit.

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(b). A student must get at least 35% marks in each theory paper (Minimum 26 Marks out of 75 Marks) and periodical tests/CIE (Minimum 9 Marks out of 25 Marks) separately in each Semester for being eligible for promotion to the next Semester. Further, he/she must get at least 35% marks in the practical examination (Minimum 35 Marks out of 100 Marks) and Research Project (70 Marks out of 200 Marks), separately. To pass the course the candidate should secure at least 35% marks in the aggregate.

22. A student who fails or want to improve in theory paper/(s) or Periodical tests/CIE shall be given only one chance to reappear in that paper along with the next following batch. The chance to reappear shall be given only in not more than two courses in one Semester. The candidate shall, however be promoted to the next Semester. No separate examination will be conducted for such candidate.

23. If a candidate fails to appear in practical examination, a special practical examination can be conducted for the candidate on the deposition of fees as prescribed by the university as a special practical examination fees.

24. A student may appear as an Ex-student in the term/semester examination provided that :-

(a) He /She has completed all the semester examination, test and seminars but failed in aggregate of all the semester examination.

(b) He /She has attended 50% of lectures, practical, appeared in tests and seminars and he/she has submitted the Medical Certificate an application on the first day of the term/semester examination or prior to this.

25. If a candidate has secured 60% or more marks in the aggregate in all the four semester he/she will be placed in I division. If he/she secured 50% or more but less than 60% will be placed in II division. If he/she secured less than 50% marks will be placed in III division. If a candidate has secured 75% or more marks in the aggregate of all the four Semester examination it counted together, it shall be mentioned in his Degree that he has passed M.Sc. Examination with Distinction.

26. Every candidate will be required to have 75% attendance of the prescribed number of periods in each paper. Teaching/ Library Reading shall be of one-hour duration and will be counted as one attendance. Practical of 2-3 hours will also be counted as one attendance.

Exemption in the prescribed number of attendance may be granted by the Vice-Chancellor on the recommendation of the Head of the Department in case of following circumstances:

The student should be a sportsman or sportswoman who have participated in games up to the level of National/ Inter-University/ Camps/ Tournaments and Youth Welfare Activities.

In spite of exemptions clarified above it will be compulsory for a candidate that he/she has attended at least 60% Prescribed number of periods.

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27. Course Structure

The course structure and course outlines of M. Sc. Botany (in Faculty of Life Science) programme shall be as per the respective regulations recommended by the respective Academic Committee/ Board of Studies of the Department and ratified by the competent authority.

28. Minor Course:

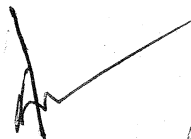
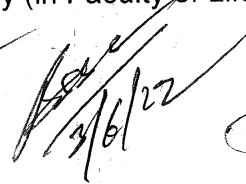
- a. The student will have to study one minor course of other faculty in II semester
- b. Minor course (other faculty) shall be allotted by Department based on availability of seats at the beginning of the semester and fill in the Examination form.
- c. Student will have to opt for a minor course of other faculty offered by Department, from the subjects available at the Institutes/departments of the Khandari Campus, Dr. Bhimrao Ambedkar University Agra. Classes and examinations for minor course shall be run simultaneously with their major courses/subjects.
- d. The student will have the freedom to choose a similar course of equal credits from MOOCs, SWAYAM portal of UGC/Ministry of education in place of a Minor Course offered in the semester as specified by the Department. The total credits required for that course could be earned in Minor Course from this mode and those credits have to be added by the University in their SGPA/ CGPA on the submission of certificate.
- e. Student may complete minor course from SWAYAM, MOOCs etc. by recognized Central or state government body, or UGC, or University during the period of II semester of M.Sc. Botany Programme it will be considered as one Minor paper of four credits. His marks/grades will be awarded according to the decision of Equivalence committee of Faculty of Life Science on the submission of the certificate.


29. Exit option and award of B.Sc. Research (in Faculty of Life Science)

- a. In case the student wishes to leave after completion of one year of M. Sc. Botany (in Faculty of Life Science) programme, He/she shall be eligible for award of B.Sc. Research in Faculty, provided the student fulfils the following conditions:
 - i. Has pursued the prescribed courses of study and has earned 52 credits as prescribed under the relevant regulations within an academic year.
 - ii. Obtained a minimum CGPA of 4.0
 - iii. Paid all the dues of the University.
 - iv. No disciplinary proceedings are pending against him/her.
 - v. Any other condition, as notified by the competent authority of the University.

  
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30. Students holding a B.Sc. Research (In Faculty of Life Science) can apply for lateral entry (with same subject) into the second year of M. Sc. Botany (in Faculty of Life Science) Programme against the vacant seats through the laid down admission process for the purpose as notified by the University.
31. Those Students who reappear in any course/s in any semester or re-register for a semester shall have to pay the prescribed fee (Tution, Examination and Other fees).
32. Challenge evaluation shall be permitted as per rules/orders of the University.
33. The Conversion of SGPA/CGPA to equivalent marks shall be as per University Norms.
- 34. Interpretation clause**
In case of any issue of interpretation arising during the course of implementation of these Ordinances or in case of any unforeseen circumstance, decision of the Vice Chancellor shall be final.
35. Anything, not covered under the Ordinance (*vide supra*) shall be decided by the Academic Committee of the Department without prejudice to the powers of The Academic Council, Executive Council, The Admission Committee, and The Examination Committee of The University. The Academic Committee shall be responsible for courses, syllabus of M. Sc. Botany (in Faculty of Life Science) or any other degree.



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03/06/2022

**DEPARTMENT OF BOTANY
SCHOOL OF LIFE SCIENCES
DR. BHIMRAO AMBEDKAR UNIVERSITY, AGRA**

MINUTES

The minutes of the meeting of the Academic Committee of Department of Botany held in the Department of Botany of the Dr. Bhimrao Ambedkar University, Agra on 3rd June 2022 at 12:30 PM. The following members were present:

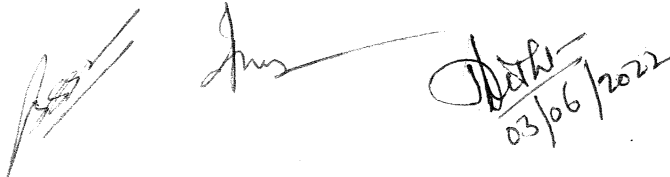
1. Prof. Shamsul Hayat, Department of Botany, AMU Aligarh
2. Dr. Deepa Bisht, Scientist 'E', NJIL & OMD, Agra
3. Prof. Rajendra Sharma (Retd), Department of Botany, Dr. Bhimrao Ambedkar University, Agra
4. Dr. Rajneesh Kumar Agnihotri, Head, Department of Botany, Dr. Bhimrao Ambedkar University, Agra
5. Dean, School of Life Sciences, Dr. Bhimrao Ambedkar University, Agra

1. The Academic Committee considered and approved of Revised Ordinances of the M.Sc. Botany. (In Faculty of Life Science) course based on Choice Based Credit System (CBCS) as per NEP 2020. (Appendix - 1)

2. The Academic Committee considered and approved the Revised Syllabus of M.Sc. Botany (In Faculty of Life Science) based on Choice Based Credit System (CBCS) as per NEP 2020. (To be implemented from the academic session 2022-2023). (Appendix - 2)

3. The Academic Committee considered and approved the Syllabus for Minor Subject for Post Graduate (M.Sc.) Courses for other Faculty, based on Choice Based Credit System (CBCS) as per NEP 2020. (To be implemented from the academic session 2022-2023). (Appendix - 3)

4. The Academic Committee considered and approved of Ordinances of Post Graduate Diploma in Research (PGDR) in Botany (in Faculty of Life Science) course based on Choice Based Credit System (CBCS) as per NEP 2020. (Appendix - 3)


03/06/2022

5. The Academic Committee considered and approved the Syllabus of Post Graduate Diploma in Research (PGDR) in Botany (in Faculty of Life Science) based on Choice Based Credit System (CBCS) as per NEP 2020. (To be implemented from the academic session 2022-2023). (Appendix -4)

6. The Academic Committee considered and approved the fee structure of Post Graduate Diploma in Research (PGDR) in Botany (in Faculty of Life Science) based on Choice Based Credit System (CBCS) as per NEP 2020 (To be implemented from the academic session 2022-2023. Tuition fees 25000/- per semester and other fees (examination, enrollment, sports and cultural activities etc.) as per University norms.

Attended virtually.

Prof. Shamsul Hayat,
Department of Botany,
Agra AMU Aligarh

Dr. Deepa Bisht
03/06/2022

Dr. Deepa Bisht,
NJIL & OMD, Agra

Attended virtually

Dr. Rajendra Sharma
Dr. Bhimrao Ambedkar University,
Agra

Dr. Rajneesh Kumar Agnihotri
03/06/22

Dr. Rajneesh Kumar Agnihotri
Dr. Bhimrao Ambedkar University, Agra

Dr. Bhimrao Ambedkar University, Agra

Dean, School of Life Sciences,
Dr. Bhimrao Ambedkar University, Agra

Choice Based Credit System (CBCS)
Department of Botany,
School of Life Sciences,
Dr. Bhimrao Ambedkar University, Agra

Core Courses	Course Title M.Sc. Botany I semester	Marks		Total 100	Credit
		CIE	End Semester Examination		
BOT-C101	PLANT DIVERSITY I	25	75	100	4
BOT-C102	PLANT DIVERSITY -2	25	75	100	4
BOT-C103	PLANT PHYSIOLOGY AND METABOLISM	25	75	100	4
BOT-C104	PLANT MORPHOLOGY AND ANATOMY	25	75	100	4
BOT-C105	PRACTICAL	25	75	100	4
	Industrial training/Survey/Research Project				
	Total			500	20
Core Courses	Course Title M.Sc. Botany II semester	Marks		Total	Credit
		CIE	End Semester Examination		
BOT-C201	ANGIOSPERMS, SYSTEMATICS AND ECONOMIC BOTANY	25	75	100	4
BOT-C202	PLANT RESOURCES UTILIZATION AND CONSERVATION	25	75	100	4
BOT-C203	FOUNDAMENTALS OF ECOLOGY	25	75	100	4
BOT-C204	PLANT CELL, TISSUE AND ORGAN CULTURE	25	75	100	4
BOT-C205	PRACTICAL	25	75	100	4
BOT-C206	Industrial training/Survey/Research Project		200	200	8
	Minor	25	75	100	4
	Total			800	32
Core Courses	Course Title M.Sc. Botany III semester	Marks		Total	Credit
		CIE	End Semester Examination		
BOT-C301	BIOLOGY OF PLANT REPRODUCTION	25	75	100	4
BOT-C302	MYCOLOGY AND PLANT PATHOLOGY	25	75	100	4
BOT-C303	MOLECULAR BIOLOGY AND GENETIC ENGINEERING	25	75	100	4
BOT-E304	CYTOGENETICS	25	75	100	4
BOT-E305	PLANT BREEDING				
BOT-E306	PRACTICAL	25	75	100	4
	Industrial training/Survey/Research Project				
	Total			500	20
Core Courses	Course Title M.Sc. Botany IV semester	Marks		Total	Credit
		CIE	End Semester		

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			Examination		
BOT -C401	BIOSTATISTICS AND COMPUTER APPLICATION	25	75	100	4
BOT -C402	CELL BIOLOGY AND PLANT BIOCHEMISTRY	25	75	100	4
BOT-E403	<i>IN VITRO</i> PLANT PROPAGATION	25	75	100	4
BOT-E404	STRESS PHYSIOLOGY OF PLANTS				
BOT-E405	ENVIRONMENTAL BIOTECHNOLOGY	25	75	100	4
BOT-E406	ETHNOBIOLOGY AND ETHNOPHARMACOLOGY				
BOT-C407	PRCTICAL	25	75	100	4
BOT-C408	Industrial training/Survey/Research Project		200	200	8
	Total			700	28

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M.Sc. Botany I semester
Core Course
BOT-C101 Plant Diversity- I

UNIT I

Phycology: Algae in diversified habitats: thallus-organization; cell ultrastructure; reproduction (vegetative, asexual and sexual); classification of algae; pigments, reserve food, flagella; algal blooms, Economic importance of algae(as fertilizers, food feed and industry).

Classification, salient features of Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta.

UNIT II

Bryophytes: Morphology, structure, reproduction and life history; distribution; Sporophyte evolution of bryophytes; classification; general account of Marchantiales, Jungermaniales, Anthocerotales, Funariales, economic and ecological importance.

UNIT III

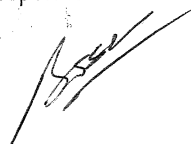
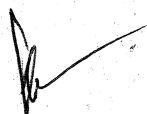
Pteridophyta: Morphology, anatomy and reproduction; classification, life cycle, evolution of stele; heterospory and origin of seed habit.

General account of fossil pteridophyta, Brief introduction of Psilopsida, Lycopsida, Sphenopsida and Pteropsida

UNIT IV

GYMNOSPERMS

Classification of Gymnosperms. Comparative study vegetative, anatomical and reproductive structures of Cycadophyta, Coniferophyta and Gnetophyta. Evolutionary trends and phylogenetic relationship among various groups of Gymnosperms. Economic importance of Gymnosperms.



03/06/2022

M.Sc. Botany I semester
Core Course
BOT-C102 Plant Diversity- II

UNIT I

Archaeobacteria and eubacteria: General account; ultrastructure, nutrition and reproduction biology and economic importance: cyanobacteria-salient feature and biological importance.

UNIT II

Viruses: Characteristics and ultrastructure of virions; isolation and purification of viruses; chemical nature, replication, transmission viruses; economic importance.

Phytoplasma: General characteristics and role in causing plant diseases.

UNIT III

Mycology and Plant Pathology:

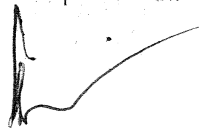
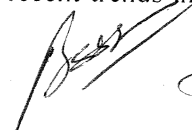
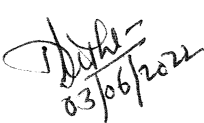
Fungi: General characters of fungi: substrate relationship in fungi; cell ultrastructure, unicellular and multicellular organization;

Plant Pathology: Concept of disease in plants; Definition of plant disease; Historical development of Plant Pathology. Methods of studying plant diseases: Collection, preservation, isolation of pathogens and proving Koch postulates. Symptoms caused by Plant Pathogenic fungi, bacteria and viruses. Brief Classification of Plant diseases.

UNIT IV

General account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina; fungi in industry, medicine and as food; fungal diseases in plants and humans; Mycorrhizae, fungi as biocontrol agents.

Cell wall composition; nutrition-saprobic, biotrophic, symbiotic; reproduction-vegetative, asexual and sexual; heterothallism; heterokaryosis; parasexuality; recent trends in classification, phylogeny of fungi.




03/06/2022

M.Sc. Botany I semester

Core Course

BOT-C103 PLANT PHYSIOLOGY AND METABOLISM

UNIT I

Energy flow : Principles of thermodynamics, free energy and chemical potential redox reaction structure and function of ATP.

Fundamentals of enzymology : General account, isozymes, kinetics of enzymatic catalysis, Michel's Menten equation and its significance.

Membrane transport and translocation of water and solutes: Plant water relations, mechanism of water transport through xylem, phloem; passive and active solute transport, membrane transport problems.

Signal transduction: Overview, receptors and G-proteins, phospholipid signaling, role of cyclic nucleotides, calcium-O clamodulin cascade, diversity in protein kinases and phosphatases, specific signaling mechanism, e.g. two component sensor regulating system in bacteria and plants, sucrose sensing mechanism.

UNIT II

Phytochemistry and photosynthesis: Evolution of photosynthetic apparatus, photosynthetic pigment and light harvesting complexes, photooxidation of water, mechanism of electron and proton transport, carbon assimilation-the calvin cycle, photorespiration, C4 cycle, CAM pathway.

Respiration and Lipid metabolism: Glycolysis, TCA cycle, electron transport and ATP synthesis, pentose phosphate pathway, glyoxylate cycle, alternative oxidases system structure and function of lipids, fatty acid biosynthesis and their catabolism.

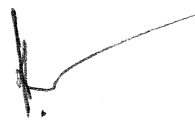
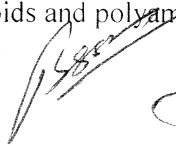
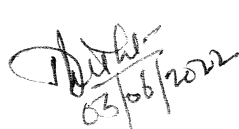
UNIT III

Nitrogen fixation, Nitrogen and sulphur metabolism: Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonia assimilation

Sensory photobiology: Phytochromes and their photochemical and biochemical properties, photoperiodism and its significance, vernalization

UNIT IV

Plant growth regulators and elicitors: Physiological effect and mechanism of action of auxin, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids and polyamines




03/06/2022

M.Sc. Botany I semester

Core Course

BOT-C104 PLANT MORPHOLOGY AND ANATOMY

UNIT I

Introduction : Unique features of plant development. Differentiates specialization and morphogenesis.

UNIT II

Seed Germination and seedling growth: Metabolism of nucleic acids, proteins and mobilization of food reserves; tropisms hormonal control of seedling growth; gene expression


UNIT III

Shoot development: Organization of the shoot apical meristem (SAM); Cytological and molecular analysis of SAM; control of cell division and cell to cell communication; anomalous secondary growth; tissue differentiation- xylem and phloem; secretary ducts and laticifers; wood development in relation to environmental factors; nodal anatomy.

UNIT IV

Leaf growth and differentiation: Determination; phyllotaxy; control of leaf form; differentiation of epidermis (with special reference to stomata and trichomes) and mesophyll.

Root Development: Organization of root apical meristem (RAM); cell fates and lineages; vascular tissue differentiation; lateral roots, root hairs; root-microbe interactions, Root nodules.

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M.Sc. Botany II semester

Core Course

BOT-C201 ANGISOPERMS, SYSTEMATICS AND ECONOMIC BOTANY

UNIT I

Origin of intrapopulation variation, and the environment : ecades and ecotype : Exxxx hotspots plant diversity.

The species concept: Taxonomic hierarchy, species, genus, family and other categories; Modern trends in plant taxonomy: Anatomy in relation to taxonomy, embryology in relation to taxonomy; salient features of the ICBN

UNIT II

Taxonomic tools: Herbarium, numerical taxonomy, cytotaxonomy, chaemotaxonomy, serological and molecular taxonomy

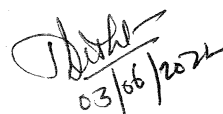
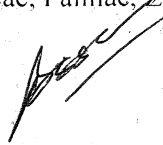

UNIT III

Systems of angiospermic classification: Phenetic verses phylogenetic system: Benthom & Hooker, Engler and Prantell & Hutchinson's system; relative merits and demerits of major systems

UNIT IV

Description of the families:

- (a) **Dicotyledons:** Ranunculaceac, Rutacoe, Meliaceae, Euphorbiaceae. Malvaceae, Apiaceae, Apocynaceae, Ascimadacoae, Cnvolvuiaceae, Lamiaceae, Solanaceac, Rubiaceae, Cucurbitaceae, Asteraceae, Verbinaceae
- (b) **Monocotyledons:** Poaceae, Cyperaceae, Palmae, Zingiberaceae, Orchidaceae



03/06/2021

M.Sc. Botany II semester

Core Course

BOT-C202 PLANT RESOURCES UTILIZATION AND CONSERVATION

UNIT I

Strategies for conservation- *In situ* conservation: International efforts and Indian initiatives; protected areas in India-Sanctuaries, National Parks, biosphere reserves, wetlands, mangroves and coral reefs for conservation of wild biodiversity.

Strategies for conservation: *ex situ* conservation : Principles and practices; botanical gardens, field gene banks, *in vitro*. repositories, cryobanks.

UNIT II

Origin, evolution, botany, cultivation and uses of food, forage and fodder, fibre, medicinal and aromatic plants, and vegetable oil yielding crops.

UNIT III

Important fire wood and timber yielding plants and non-wood forest products (NWFPs) such as bamboos, rattans, raw materials for paper making, tannins, dyes, resins and fruits.

UNIT IV

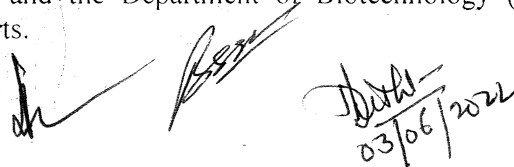
Green revolution: Benefits and adverse consequences.

Innovations for meeting world food demand.

Plants used as avenue trees for shade, pollution control and aesthetics.

Principles of conservation; extinction's environmental status of plant based on International union for conservation of Nature.

General account of the activities of Botanical Survey of India (BSI); National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific & Industrial Research (CSIR), and the Department of Biotechnology (DBT) for conservation, non-formal conservation efforts.

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M.Sc. Botany II semester

Core Course

BOT-C203 FUNDAMENTALS OF ECOLOGY

UNIT I

Climate, soil and vegetation patterns of Life zones : major biomes and major vegetation, Soil types, pedogenesis; physical and chemical characters.

Vegetation Organization: Concepts of community and continuum; analysis of communities (analytical and synthetic characters); inter-and intra specific associations; concept of ecological niche.

UNIT II

Vegetation development: Temporal changes (Cyclic and non-cyclic); mechanism of ecological succession; Ecological life-cycle of plants; autoecology, genecology- gene study in India, synecology.

UNIT III

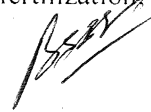
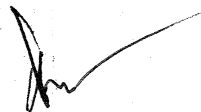
Ecosystem Organization: Structure and functions; primary production (methods of measurement), energy dynamics (trophic organization, energy flow pathways, ecological efficiencies; global biogeochemical cycles of C, N, P and S.

Biological Diversity: Concepts of levels; role of diversity in ecosystem functions and stability; speciation and extinction; IUCN categories of threat; distribution and global warming, sea level rise, UV radiation.

UNIT IV

Air, water and soil pollution: Kinds; source; quality parameters; effects on plants and ecosystems.

Climate change: Greenhouse gases (CO₂, CH₄, N₂O, CFCs: source, trends and role); ozone layer and ozone hole; consequences of climate change (CO₂ fertilization, global warming, sea level rise, UV radiation).




03/06/2022

M.Sc. Botany II semester

Core Course

BOT-C204 PLANT CELL, TISSUE AND ORGAN CULTURE

UNIT I

General introduction, history scope, concept of cellular differentiation and totipotency; Tissue culture media; preparation and sterilization procedures; Anther culture production of androgenic haploids, bullbosum method.

UNIT II

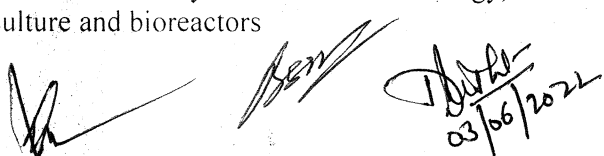
Meristem culture and production of disease free plants; Cell culture and production of secondary metabolites / natural products; Embryo culture.

UNIT III

Callus culture, somatic embryogenesis and production of synthetic seeds; Endosperm culture; Somatic hybridization: Protoplast isolation fusion and culture, hybrid selection and regeneration possibilities.

UNIT IV

Somaclonal and gametoclonal variation; Clonal propagation; Cryopreservation, germplasm storage and gene banks. Germplasm conservation and synthetic seed technology, Industrial application. Suspension culture, hairy root culture and bioreactors

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M.Sc. Botany III semester

Core Course

BOT-C301 BIOLOGY OF PLANT REPRODUCTION

UNIT I

Methods of reproduction in flowering plants: Vegetative, asexual, sexual and parasexual mode reproduction. Sexual system in flowering plants. Structure and development of male gametophyte and female gametophyte.

Pollination: Self and cross pollination, flower structure in relationship to the mode of pollination, contrivances promoting cross pollination, methods of cross pollination, insect pollination, the pollinators and causal factors, attractants and reward of pollination.

UNIT II

Pollen-Pistil interaction: Significance of pollen pistil interaction, structure of stigma and style, post-pollination events, fertilization.

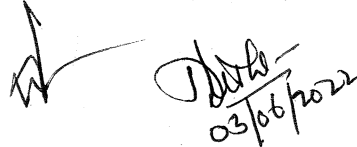
Pollen Physiology: Viability, FCR, Alexander's stain, TLC

UNIT III

Carpel Morphology: Form of carpel, closure of carpel, complex carpel, solid carpel, placentation.

UNIT IV

Seed Biology: Seed and fruit physiology of growth and development, interaction of seed and fruit, involvement of extraovarian parts in fruit development. Physiology of seed germination, seed dormancy and seedling establishment. **Morphological sterility:** Mechanical and physiological factors. **Incompatibility:** Sexual incompatibility, general concepts, mechanism of intraspecific incompatibility. Methods employed for overcoming incompatibility.



03/06/2022

M.Sc. Botany III semester

Core Course

BOT-C302 MYCOLOGY AND PLANT PATHOLOGY

Unit I

Introduction. General characteristics; Ecology and Distribution; Thallus organization; EM of haustorium and septum; Wall composition; Nutrition; Growth; Reproduction and spore); Heterokaryosis and parasexuality; Sexual compatibility; Life cycle patterns of Myxomycota. Oomycota, Zygomycota, Ascomycota, Basidiomycota, Deuteromycota.

Unit II

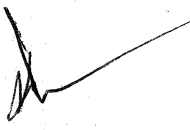
Applied Mycology Role of fungi in biotechnology Application of fungi in food industry of flavour & texture. Fermentation. Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological Control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.

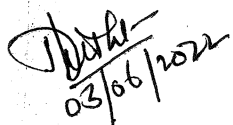
Unit III

Plant Pathology Introduction: Definition: Importance; Terms and Concepts, Classification; Causes, Symptoms Host Pathogen relationships

Unit IV

Geographical distribution of diseases; etiology, symptomology, disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine




03/06/2022

M.Sc. Botany III semester

Core Course

BOT-C303 MOLECULAR BIOLOGY AND GENETIC ENGINEERING

UNIT I

Basic concepts, principle and scope of molecular biology and genetic engineering.

Recombinant DNA technology: Gene cloning principles and techniques, construction of genomic/c DNA libraries, choice of vectors, DNA synthesis and sequencing, polymerase chain reaction, DNA fingerprinting.

UNIT II

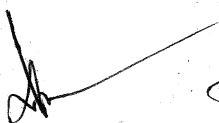
Genetic Engineering of plants: Aims, strategies for development of transgenics (with suitable examples), Agrobacterium- the natural genetic engineer, T-DNA and transposon mediated gene tagging, chloroplast transformation and its utility, intellectual property rights.

UNIT III

Microbial Genetic Manipulation: Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology.

UNIT IV

Genomics and Proteomics: Genetic and physical mapping of genes, molecular markers for introgression of useful traits, artificial chromosome, high throughput sequencing, genome projects, bioinformatics, microarrays.




03/06/2022

M.Sc. Botany III semester
Elective
BOT-E304 CYTOGENETICS

UNIT I

Chromatin Organization : Chromosome structure and packaging of DNA, molecular organization of centromere and telomere; nucleolus and ribosomal RNA genes; euchromatin and heterochromatin; chromosomes-polytene, ampbrush, B-chromosome and sex chromosome, molecular basis of chromosome pairing.

UNIT II

Structural and numerical alterations in chromosomes: Origin, meiosis and breeding behavior of duplication, deficiency, inversion and translocation heterozygotes; origin, occurrence, production and meiosis of haploids, aneuploids and euploids; origin and production of autopolyploids; chromosomes and chromatid segregation; allopolyploids, types, genome constitution and analysis; evolution of wheat and paddy crop induction and characterization of trisomics and monosomics.

UNIT III

Genetics of Prokaryotes and eukaryotic organelles: Mapping the bacteriophage genome; phage phenotypes; genetics recombination phage; genetics transformation, conjugation and transduction in bacteria; cytoplasmic male sterility.

Gene Structure and Expression: Genetics fine structure; cis-trans test; fine structure analysis of eukaryotes; introns and their significance; regulation of gene expression in prokaryotes and eukaryotes.

UNIT IV

Mutations: Spontaneous induced mutations; physical and chemical mutagens; molecular basis of gene mutations; transposable elements in prokaryotes and eukaryotes; mutations induced by transposons; site-directed mutagenesis; DNA damage and repair mechanisms.



03/06/2022

M.Sc. Botany III semester

Elective

BOT-E305 Plant Breeding

UNIT I

Cytogenetics of anuploids and structure heterozygote : Effect of an on phen.... transmission of monosomics and trisomics; breeding behaviour and genetics of structure heterozygotes; translocation tester sets; Robertsonian translocation; B-B translocation.

UNIT II

Alien gene transfer, chromosome manipulation: transfer of whole genome, example from wheat. Arachis and Brassica; transfer of individual chromosomes and chromosome segments; method of detecting alien chromatin; production characterization and utility of alien addition and substitution lines; genetic basis of inbreeding and heterosis; exploitation of hybrid vigour.

UNIT III

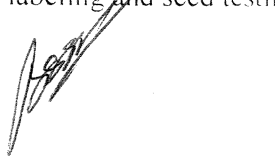

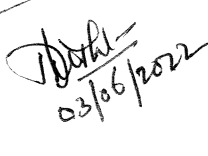
Perspectives of plant breeding, methods of reproduction in crop plants and breeding methods in crops:

- a. Aims and achievements of plant breeding
- b. Breeding methods for self pollinated crops, pure line breeding and mass selection, pedigree method
- c. Selection in cross pollinated crops, Recurrent selection, Clonal selection
- d. Hybrid and synthetic varieties
- e. Heterosis and in breeding depression

UNIT IV

Polyploidy mutation and biotechnology in crop improvement, seed production practices:

- a. Autopolyploidy, Allopolyploidy and aneuploidy, seed production practices
- b. Mutation breeding: procedure, achievements and pitfalls of mutation breeding
- c. Haploid production Embryo culture, somatic cell hybridization, genetic engineering
- d. Seed production practices: Improved varieties, role of seed certification, National seed corporation, seed labeling and seed testing

M.Sc. Botany IV semester

Core Course

BOT-C401 Biostatistics and Computer Application

UNIT I

1. Concepts of statistics and biometry
2. Continuous and discontinuous variables
3. Brief description and tabulation of data in its graphical representation.

UNIT II

1. Measures of central tendency and dispersion, mean, median mode, range, standard deviation, variance
2. Elementary probability: addition and multiplication laws.

UNIT III

1. Simple linear regression and correlation
2. Idea of two types of errors and level of significances, test of significance (F & t test); chi-square tests.

UNIT IV

1. Introduction of digital computers: organization; low level and high level language; binary number system.
2. Flow charts and programming techniques.
3. Introduction to programming techniques.
4. Introduction to programming techniques.
5. Introduction to data structure and database concepts, introduction to internet and its application.
6. Introduction to MS-Office software. covering Word Processing, Spreadsheets and Presentation software- introduction to Corel Draw.

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03/06/2022

M.Sc. Botany IV semester

Core Course

BOT-C402 CELL BIOLOGY AND PLANT BIOCHEMISTRY

Unit-I

Cell components:

Structural and functional aspects of cytoskeleton system, role in cell organization and movement, organization of microtubules, microfilaments and plasmodesmata. Ultrastructure and function of microbodies, golgi apparatus, lysosomes, peroxisomes, endoplasmic reticulum, vacuole, ribosomes, nucleus and nucleolus. Structural organization and functions of: Cell wall and Plasma membrane Membrane transport: Structure and functions of ion carriers, channel proteins.

Unit-II

Classification, structure and functions of: Carbohydrates- Monosaccharides, oligosaccharides, polysaccharides (storage and structural) Amino acids- protein, non- protein, essential and non-essential. Proteins- simple and conjugated Lipids- Fatty acids, simple and compound lipids. Nitrogen and sulfur metabolism: Biological nitrogen fixation, nitrogenase enzyme complex, nodule formation and nod factors. Mechanism of nitrate reduction-nitrate and nitrite reductase. Ammonia assimilation. Assimilation of sulfur.

Unit-III

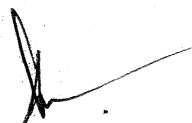
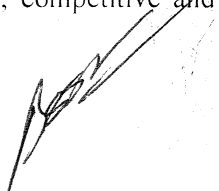
Plant growth hormones:

Biosynthesis, function and mechanisms of action of Auxins. Gibberellins. Cytokinins. Abscisic acid, Ethylene. Brassinosteroids, Polyamines, Jasmonic acid and Salicylic acid.

Unit-IV

Enzymes:

General aspects, characteristics and classification. Factors affecting enzyme activity Active sites and mode of action. Regulation of enzyme activity and allosteric mechanism Enzyme inhibition - reversible and irreversible, competitive and non-competitive. Enzyme kinetics and Michaelis-Menton equation.



03/06/2022

M.Sc. Botany IV semester

Elective

BOT-E403 *In Vitro* Plant Propagation

Unit I

Basic concepts, principles and scope of Plant cell and tissue culture: General introduction, history, concept of cellular differentiation, totipotency.

Unit II

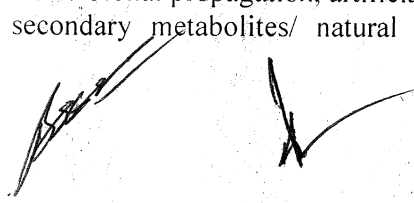
Organogenesis and adventives embryogenesis: Fundamental aspects of morphogenesis somatic embryogenesis and androgenesis. Mechanism techniques and utility. Somatic hybridization: Protoplast isolation, fusion and culture, hybrid selection and regeneration. Possibilities, achievements and limitation of protoplast research.

Unit III

Micropropagation- Factors affecting morphogenesis and proliferation rate; technical problems in micropropagation. Organogenesis- formation of shoots and roots, production of virus free plants by meristem and shoot-tip culture

Unit-IV

Application of plant tissue culture: Clonal propagation, artificial seed, production of hybrids and somaclones. Production of secondary metabolites/ natural products. Cryopreservation and germplasm storage.


03/06/2022

M.Sc. Botany IV semester

Elective

BOT-E404 Stress Physiology of Plants

Unit-I

Biological stress vs. Physical Stress, Types of stresses and general methods of measurement of stress response (Strain), Stress physiology in crop improvement, Response to UV stress: Injury and resistance mechanism

Unit- II

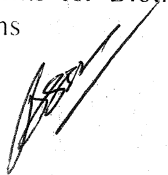
Response to low temperature stress: Chilling, freezing, frost injury and mechanism of resistance, Adaptations, Response to high temperature stress: Injury and mechanism of resistance, Heat shock proteins, Adaptations

Unit -III

Response to nutrient deficiency stress, Heavy metal stress, injury and mechanism of resistance, adaptations. Salinity stress. Ionic and salt stress injury, mechanism of resistance

Unit-IV

Response to water deficit: Desiccation, Dehydration injury; Mechanism of resistance, Adaptations. Response to water excess: Flooding, hypoxia. Mechanism of resistance, Adaptations. Causative agents for Biotic Stresses. Mechanism of Resistance against Fungal, Bacterial and viral pathogens



Dr. H. S.
03/06/2022

M.Sc. Botany IV semester

Elective

BOT- E405 ENVIRONMENTAL BIOTECHNOLOGY

Unit – I

1. Pollution and Pollutants: Cost of pollution, Kinds of Pollution and Pollutants- Air, Water, and Soil Pollution, Their effects on Plants and Ecosystems;
2. Role of Plants in Pollution Management.

Unit – II

3. Climate Change: Greenhouse Gases (CO₂, CH₄, N₂O, CFCs: sources and roles), Ozone layer and Ozone hole, Consequences of Climate change (acid rain, global warming, sea level rise, UV radiation).


Unit – III

Ecosystem Stability: Concept (resistance and resilience), Ecological Perturbations (natural and anthropogenic) and Their Impacts on Plants and Ecosystems, Ecology of Plant Invasion, Environmental Impact Assessment (EIA), Ecosystem Restoration. Environment and energy, Energy resources – Renewable and Non-renewable. Natural resources, Loss of Diversity, causes and consequences, Environmental Auditing, Conservation of Biodiversity.

Unit – IV

Ecological Management: Concepts, Sustainable Development, Remote sensing and GIS as Tools for Resources Management.

Phytoremediation: Prevention and Control, Methods of reducing Environmental impacts of Chemicals, Weedicides, Pesticides and Fertilizers. Biotechnological advances in pollution control through GEMs.

03/06/2022

M.Sc. Botany IV semester

Elective

BOT- E406 ETHNOBIOLOGY AND ETHNOPHARMACOLOGY

UNIT- I ETHNOBOTANY

Ethnobotany: concept, history, evolution and scope; Indigenous knowledge and traditional practices of some Himalayan communities; Taxonomic, epidermal characters and pharmacognostical studies to check adulteration. Problems and prospects of value addition applicable to plant resources. Scope for development of plant resources.

UNIT II: ETHNOBIOLOGY

Major ethnic group in North East India, their social institutions, livelihood, cultural and religious practices Shamanism and other belief systems, sacred grove and methods of biological resource conservation. Current status of Ethnobiology; Ethnobiology, biodiversity and traditional knowledge;

UNIT- III ETHNOPHARMACOLOGY

Role of Ethnobotany in drug discovery. Ayurvedic drug preparation and drug adulteration. Chemical composition of few medicinal and aromatic plants; extraction and uses pertaining to typical Indian formulation of drugs. Ethnopharmacological validation of traditional medicine; approaches to drug discovery from ethnobotanical leads.

UNIT- IV NATURAL PRODUCTS FROM PLANTS

Definition, importance and systematics and characterization of Natural products. Phenolic acids, alkaloids, glycosides, terpenoids, flavonoids, steroids, tannins in plants kingdom. Function of secondary metabolite for plant defense and protection.


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