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

Dated: 03 June, 2022

To The Hon-vice chancellor
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 Biotechnology 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.

AR (Academics)
Please put it in
BC for approval
Thanking you

Yours faithfully,

B.S.Sharma
Dean

Encls. :

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

Signature Not Verified
RAJEEV KUMAR
Digitally Signed By Registrar

# DEPARTMENT OF BIOTECHNOLOGY
# SCHOOL OF LIFE SCIENCES
# DR. BHIMRAO AMBEDKAR UNIVERSITY, AGRA

## *ATTENDANCE SHEET*

Date: 3rd June 2022

Time: 11:00 AM

Meeting: Academic Committee of Department of Biotechnology

**Members of the Committee:**

1. Prof. Rajendra Sharma (Retd)
   Department of Botany, Dr. Bhimrao Ambedkar university, Agra
   Attended virtually, Recommendation attached
2. Dr. Ajayvir Singh, Scientist 'E'
   NJIL&OMD, Agra
   3/6/22
3. Dr. Amita Sarkar,
   Agra College, Agra
   3.6.2022
4. Dr. Monika Asthana, Department of Bioteechnology,
   Dr. Bhimrao Ambedkar University, Agra
   Monika 3/6/22
5. Prof. Bhupendra Swarup Sharma, Dean Life sciences,
   Dr. Bhimrao Ambedkar University, Agra
   3/6/22

Total Pages (1-40)

# DEPARTMENT OF BIOTECHNOLOGY
# SCHOOL OF LIFE SCIENCES
# DR. BHIMRAO AMBEDKAR UNIVERSITY, AGRA

***MINUTES***

The minutes of the meeting of the Academic Committee of Department of Biotechnology held in the Department of Biotechnology of the Dr. Bhimrao Ambedkar University, Agra on 3rd June 2022 at 11:00 AM. The following members were present:

1. Prof. Rajendra Sharma (Redt.) Department of Botany, Dr. Bhimrao Ambedkar University, Agra
2. Dr. Ajayvir Singh, Scientist 'E' NJIL&OMD, Agra
3. Dr. Amita Sarkar, Agra College, Agra
4. Dr. Monika Asthana, Department of Biotechnology, Dr. Bhimrao Ambedkar University, Agra
5. Prof. Bhupendra Swarup Sharma, Dean Life Sciences, Dr. Bhimrao Ambedkar University, Agra

1. The Academic Committee considered and approved of Revised Ordinances of the M.Sc. Biotechnology. (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. Biotechnology (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)

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

5. The Academic Committee considered and approved the Syllabus of Post Graduate Diploma in Research (PGDR) in Biotechnology (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 – 5)

6. The Academic Committee considered and approved the fee structure of Post Graduate Diploma in Research (PGDR) in Biotechnology (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 via Virtually
Recommendations attached

Prof. Rajendra Sharma (Retd)
Dr. Bhimrao Ambedkar University,
Agra

Dr. Ajayvir Singh,
NJIL&OMD

3/6/22

Dr. Amita Sarkar
Agra College,

3.6.22

Monika 3/6/22

Dr. Monika Asthana
Dr. Bhimrao Ambedkar University, Agra

Prof. Bhupendra Swarup Sharma,
Dr. Bhimrao Ambedkar University, Agra

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 Biotechnology held on 03 June 2022 time 11:00 AM. I joined the meeting through virtual mode.

I considered and approved all the items

Prof. Rajendra Sharma

Annexure-1

# DR. BHIMRAO AMBEDKAR UNIVERSITY, AGRA
## FACULTY OF LIFE SCIENCE
## DEPARTMENT OF BIOTECHNOLOGY
## MASTER OF SCIENCE (M.Sc.) IN BIOTECHNOLOGY
## (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. Biotechnology (In Faculty of Life Science). The Course shall be conducted by the Department of Biotechnology (Dr. Bhimrao Ambedkar University), Agra.

2. The M.Sc. Biotechnology (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. Biotechnology (in Faculty of Life Science) programme and earned total 52 credits. The I and II semesters of the First year of the M.Sc. Biotechnology (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. Biotechnology (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. Biotechnology (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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**A. Program Duration and Credit Requirements:**

a. M.Sc. Biotechnology (In Faculty of Life Science) degree programme shall be of four semesters (2 years) M. Sc. Biotechnology (in Faculty of Life Science). The M.Sc. Biotechnology (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. Biotechnology (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. Biotechnology (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. Biotechnology (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. Biotechnology (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. Biotechnology (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. Biotechnology (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. Biotechnology (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. Biotechnology (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. Biotechnology (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 Biotechnology (In Faculty of Life Science) shall be:

a. Bachelor's degree (Three Year) with at least II division with Chemistry/ Zoology/ Botany/ Forestry/ Biotechnology/ Microbiology as one of the subjects.

or

(b) Bachelor's degree (Three Year) with at least II division in any one of the following:
Biotechnology, Biotechnology, Biomedical Science, Medical Lab Technology, Biochemistry, Life Science, Biophysics, Forestry, Environmental Science, and Home Science will also eligible.

or

(c) B.Sc. (Honours) (Three Year) with at least II division in any one of the following: Environmental Science, Biotechnology, Biochemistry, Biophysics, Biotechnology, Zoology, Botany, Forestry, Genetics, Home Science and Chemistry will also be eligible.

or

(d) B.E/ B. Tech. degree in any one Biotechnology and Biochemical Engineering or MBBS/B. V. Sc. with 50% marks in aggregate will also be eligible.

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%.

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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 tution, 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.
**(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.

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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.

27. **Course Structure**

The course structure and course outlines of M. Sc. Biotechnology (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.

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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. Biotechnology 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. Biotechnology (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.

**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. Biotechnology (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. Biotechnology (in Faculty of Life Science) or any other degree.

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Appendix-2

# DR. BHIMRAO AMBEDKAR UNIVERSITY, AGRA

## DEPARTMENT OF BIOTECHNOLOGY

## School of Life Sciences,

### MASTER OF SCIENCE (M.Sc.) BIOTECHNOLOGY

### (IN FACULTY OF LIFE SCIENCE)

### (Based on Choice Based Credit System)

### (AS PER NEP, 2020)

## Revised Syllabus

| Core Courses | Course Title M.Sc. BiotechnologyI semester | Marks | | Total 100 | Credit |
|---|---|---|---|---|---|
| | | CIE | End Semester Examination | | |
| BT-C101 | Cell Biology | 25 | 75 | 100 | 4 |
| BT-C102 | Biomolecules and Basic Enzymology | 25 | 75 | 100 | 4 |
| BT-C103 | Microbial Physiology and Metabolism | 25 | 75 | 100 | 4 |
| BT-C104 | Biostatistics and Computer Application | 25 | 75 | 100 | 4 |
| BT-C105 | Practical | | 100 | 100 | 4 |
| | **Industrial training/Survey/Research Project** | | | | |
| | **Total** | | | **500** | **20** |
| **Core Courses** | **Course Title M.Sc. Biotechnology II semester** | **Marks** | | **Total** | **Credit** |
| | | **CIE** | **End Semester Examination** | | |
| BT-C 201 | Molecular Biology | 25 | 75 | 100 | 4 |
| BT-C202 | Instrumentation and Techniques in Biotechnology | 25 | 75 | 100 | 4 |
| BT-C203 | Biology of the immune system | 25 | 75 | 100 | 4 |
| BT-C204 | Genetics | 25 | 75 | 100 | 4 |
| BT-C 205 | Practical | | 100 | 100 | 4 |
| BT-C206 | **Industrial training/Survey/Research Project** | | 200 | **200** | **8** |
| | **Minor** | 25 | 75 | **100** | **4** |
| | **Total** | | | **800** | **32** |
| **Core Courses** | **Course Title M.Sc. Biotechnology III semester** | **Marks** | | **Total** | **Credit** |
| | | **CIE** | **End Semester Examination** | | |
| BT-C301 | Animal Cell Science and Technology | 25 | 75 | 100 | 4 |
| BT-C302 | Genetic engineering | 25 | 75 | 100 | 4 |
| BT-C303 | Bioprocess Engineering and Technology | 25 | 75 | 100 | 4 |
| BT-E304 | Basic Bioinformatics | 25 | 75 | 100 | 4 |
| BT-E305 | Basic Genomics and Proteomics | | 100 | 100 | 4 |
| BT-C306 | Practical | | | | |
| | **Industrial training/Survey/Research Project** | | | **500** | **20** |
| | **Total** | | | | |
| **Core Courses** | **Course Title** | **Marks** | | **Total** | **Credit** |
| | | **CIE** | **End Semester Examination** | | |
| BT-C401 | Plant Biotechnology | 25 | 75 | 100 | 4 |
| BT-C402 | Environmental Biotechnology | 25 | 75 | 100 | 4 |
| BT-E403 | Molecular Diagnostics | 25 | 75 | 100 | 4 |
| BT-E404 | Stem Cell Biology | 25 | 75 | 100 | 4 |
| BT-E405 | Food Biotechnology | 25 | 75 | 100 | 4 |
| BT-E406 | Agricultural Biotechnology | | 100 | 100 | 4 |
| BT-C407 | Practical | | 200 | **200** | **8** |
| BT-C408 | **Industrial training/Survey/Research Project** | | | **700** | **28** |
| | **Total** | | | **2500** | **100** |
| | **Grand Total of 1st and 2nd year (I, II, III and IV semester)** | | | | |

**Note:** The I and II Semesters of the First Year of the M. Sc. Biotechnology (in Faculty of Life Science) Programme will be known as VII and VIII semesters of B. Sc. Research (in Faculty of Life Science).

## M. Sc. Biotechnology I semester
## Core Course :BT-C101, Title:Cell Biology

[Total Credits : 04]

| Topics | Teaching Hrs. 60 |
|---|---|
| **Unit I** | |
| 1. Plasma Membrane: Composition and structure, membrane proteins, lipid and carbohydrates, endo- and exocytosis.<br>2. Transport of small molecules across cell membrane: Types and mechanism.<br>3. Active transport by ATP powered pumps types: P type, V Type, F type and ABC transporters.<br>4. Cell motility: Structure and function of microfilaments and microtubules. | 15 |
| **Unit II** | |
| 1. Structure of Mitochondria and cellular energy transaction by oxidative phosphorylation,<br>2. Structure of chloroplast and cellular energy transaction by photophosphorylation<br>3. Nucleus : Nuclear envelope, nuclear pore, nucleolus and chromosomes.<br>4. Cell organelles and Secretions : Golgi complex, endoplasmic reticulum, lysosomes and peroxisomes. | 15 |
| **Unit III** | |
| 1. Cell Signaling :Paracrine, Endocrine, Autocrine. Signaling molecules – hormones, neurotransmitter, proteins and environmental factors.Cell surface receptors - G protein coupled receptor, receptor protein tyrosine kinase, cytokine receptor and non-receptor protein tyrosine kinase, receptor linked to other enzymatic activities.<br>2. Signaling pathways : Cyclic AMP pathway (second messenger and protein phosphorylation), cyclic GMP pathway, phospholipids and $Ca^{2+}$ pathway, Ras-Raf and MAP kinase pathway, JAK/STAT pathway,<br>3. Apoptosis – Programmed cell death, apoptotic pathways and regulation.<br>4. Biology of cancer, difference between normal and cancer cells | 15 |
| **Unit IV** | |
| 1. Molecular events of cell cycle<br>2. Components in cell cycle control – cyclin, CDKs, Check points in cell cycles, G0 to G1 transition, G1 – S transition, S – G2 Transition, G2 – M Transition, events of M phase, The spindle assembly checkpoints leading to anaphase.<br>3. DNA damage checkpoints by p53 protein, regulation of cell division.<br>4. Spatial and temporal regulation of gene expression. | 15 |

**Suggested reading**


1. Molecular Biology of the Cell (2002), Alberts et al
2. Molecular Cell Biology (2004), Lodish et al
3. Working with Molecular Cell Biology: A study Companion (2000), Storrie et al
4. Cell and Molecular Biology: Concepts and Experiments (3rd Ed., 2002), Gerald Karp
5. The Cell: A Molecular Approach (2004), G.M. Cooper
6. The Word of the Cell (1996), Becker et al
7. Cell Proliferation and Apoptosis (2003), Hughes and Mehnet
8. Essential Cell Biology (1998), Alberts et al
9. Biochemistry and Molecular Biology of Plants (2000), Buchanan et al
10. Harpers Biochemistry Murray et al

## M. Sc. Biotechnology I semester

## Core Course :BT- C102, Title: Biomolecules and Basic Enzymology

**[Total Credits : 04]**

| TOPIC | Teaching Hrs. 60 |
|---|---|
| **Unit I** | |
| 1 Biomolecules – Chemical composition and bonding, three dimensional structure, configuration and confirmation.<br>2 Chemical reactivity – five general types of chemical transformation of : oxidation reduction reactions, nucleophilic substitution, electron transfer with in molecules producting internal rearrangement, group transfer reaction, condensation reaction<br>3 Water – weak interactions in aqueous system, ionization of water, weak acid and weak base, concept of pH &pKa, Buffers (bicarbonate buffering system).<br>4 Principles of Bioenergentics – Entropy, enthalpy and free energy. | 15 |
| **Unit II** | |
| 1. Carbohydrates: Classification, Structure, chemical feature and function.<br>- Structure, properties and functions of homo and hetero-polysaccharides.<br>- Blood groups and bacterial polysaccharides. Glycoproteins, Cardioglycosides.<br>2. Lipids – Classification, Structure, chemical feature and function<br>- Structure and properties of fatty acids, acyl glycerols, phospholipids, sphingolipids, glycolipids.<br>- Structure and function of steroids, prostaglandins, thromboxanes and leukotrienes. | 15 |
| **Unit III** | |
| 1. Amino acids, peptides and proteins - Classification& physical properties.Elucidation of primary structure of proteins. Secondary structure – α-helix, β-sheet, triple helical structure. Ramachandran plot.<br>2. Structure of Insulin, Ribonuclease, Myoglobin and Chymotrypsin. Quaternary structure – Hemoglobin. Protein denaturation. Protein folding. Role of heat shock proteins.<br>3. Nucleotides and nucleic acids: structure of nitrogenous bases, nucleosides, nucleotides. | 15 |
| **Unit IV** | |
| 1. Enzymes – Classification and factors affecting enzyme activity<br>2. Allosteric Enzymes and their regulation<br>3. Enzyme kinetics – Equilibrium and steady state theory (Michalis-Menten equation) and determination of kinetic parameters.<br>4. Enzyme inhibition – reversible and irreversible inhibition, competitive, non-competitive and un-competitive inhibition | 15 |

**Suggested reading**


1. Principles of Biochemistry by Nelson, Cox and Lehninger.
2. Biochemical Calculations, Irwin H. Segel, john Wiley and sons Inc
3. Biochemistry, DVoet and GVoet , J Wiley and Sons
4. Laboratory Techniques in Biochemistry and molecular Biology, Work and Work
5. Biochemistry by L.Stryer 5 Ed. (Freeman-Toppan).
6. Harper's Biochemistry (Langeman).
7. Biochemistry by D.Voet and J.G.Voet (John weily).
8. Enzymes by Palmer (East).


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## M. Sc. Biotechnology I semester

## Core Course :BT- C103: Microbial Physiology and Metabolism

[Total Credits : 04]

| Topics | Teaching Hrs. 60 |
|---|---|
| **Unit I** | |
| 1. Development of Microbiology in twentieth century<br>2. General characteristics of prokaryotes, cynobacteria, Viruses,Viriods and Prions.<br>3. Methods of pure culture techniques, Theory and practice of sterilization, Construction of culture media, enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms.<br>4. Microbial Systematic and Taxonomy<br>New approaches of bacterial taxonomy, classification including ribotyping, ribosomal RNA sequencing. | **15** |
| **Unit II** | |
| **1.** Overview of Microbial nutrition.<br>**2.** Metabolic diversity among Microorganisms<br>- Photosynthesis in microorganisms; Role of chlorophylls, Carotenoids and phycobilins.<br>- Chemolithotrophy: Hydrogen-ion-nitrate-oxidizing bacteria; nitrate and sulfate reduction.<br>- Methanogenesis and acetogenesis: fermentation's-diversity. Homo and Heterolactic Fermentation.<br>- Role of anoxic decompositions: nitrogen metabolism, nitrogen fixation; hydrocarbon transformation.<br>**3.** Microbial Growth<br>The definition of growth; mathematical expression of growth; growth curve; measurement of growth and yields; Synchronous growth; Growth as affected by environmental factors likes temperature; acidity; alkalinity water availability and oxygen. | **15** |
| **Unit III** | |
| **1.** Carbohydrate Catabolism: Glycolysis, Citiric acid cycle, Pentose phosphate pathway, Embeden-Mayerhoff pathway.<br>**2.** Lipid Catabolism –Oxidation of fatty acids.<br>**3.** Amino acid oxidation and production of Urea.<br>**4.** Oxidative and Photophosphorylation, ATP production | **15** |
| **Unit IV** | |
| **1.** Carbohydrate Anabolism – Gluconeogensis, glyoxalate pathway and regulation.<br>**2.** Lipid Biosynthesis<br>**3.** Biosynthesis of Amino acids – tryptophan, alanine, cysteine, histidine, glutamate<br>**4.** Biosynthesis of nucleotides and poly amines | **15** |

**Suggested reading**

1. Microbiology, Pelczar, M.J., Chan E.C.S. and Kreig, N.R., Tata McGraw Hill.
2. Microbiology by Tortora, Funk & Case.
3. Microbiology by Prescott.

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## M. Sc. Biotechnology I semester

### Core Course :BT-C104: Biostatistics and Computer Application

[Total Credits : 04]

| Topics | Teaching Hrs. 60 |
|---|---|
| **Unit I** | |
| 1. Brief description, classification, tabulation of data and its graphical representation<br>2. Measures of central tendency and dispersion mean; median; mode range. Standard division, variance.<br>3. Simple linear regression and correlation.<br>4. Probability, Theorems of probability and probability distribution-Bionomial, Poission and Normal distribution. | 15 |
| **Unit II** | |
| 1. Test of significance; null hypothesis, alternative hypothesis, two types of errors, Level of significance,<br>2. T test, Comparision of means of two samples (equal and unequal) .<br>3. ANOVA : comparision of means by three and more samples<br>(a). Analysis of variance in one way classification (one factor analysis).<br>(b). Analysis of variance in two way classification (two factor analysis).<br>4. Chi Square test: Goodness of fit, independence of attributes. | 15 |
| **Unit III** | |
| 1. Classification of Computers: Notebook, Personal computers, Work station, Main frame systems, Supercomputers<br>2. Introduction of digital computers organization, Low level and high level language,<br>3. Number system: positional and non positional,<br>4. Binary, Octal and Hexadecimal number system.<br>5. Computer codes: BCD code, EBCDIC, Zoned and Packed Decimal Number | 15 |
| **Unit IV** | |
| 1. Flow chart and programing techniques<br>2. Introduction to Business Data processing : Data storage hierarchy, The standard methods of organizing data, file management system and data base management system,<br>3. Introduction to MS-office software, covering Word processing. spreadsheets and presentation<br>4. Introduction to internet and its application. | 15 |

**Suggested reading**


1. Wayne W. Daniel, Biostatistics: A foundation for Analysis in the Health Sciences, 8th Edition, Wiley.
2. Prem S. Mann, Introductory Statistics, 6th Edition, Wiley, 2006.
3. John A. Rice, Mathematical Statistics and Data Analysis, 3rd Edition, John A. Rice, Duxbury Press.
4. Campbell and Heyer, Discovering Genomics, Proteomics, & Bioinformatics, 2nd Edition, Benjamin Cummings, 2002.
5. Cynthia Gibas and Per Jambeck, Developing Bioinformatics Computer Skill, 1st Edition, O'Reilly Publication, 2001.
6. Computer fundamental by Pradeep K Sinha and Priti Sinha third edition BPB publication, 2003


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## M. Sc. Biotechnology II semester

### Core Course :BT-C201: Molecular Biology

[Total Credits : 04]

| Topics | Teaching Hrs. 60 |
|---|---|
| **Unit I** | |
| 1. Introduction of molecular biology and genetics.<br>2. Genome organization – genome, c-value, c-value paradox, genome complexity,<br>3. DNA Replication<br>4. Prokaryotic and eukaryotic DNA replication, mechanism of DNA replication, enzymes and accessory proteins involved in DNA replication. | 15 |
| **Unit II** | |
| 1. Transcription<br>Prokaryotic transcription and eukaryotic transcription, RNA polymerase, General and specific transcription factors, regulatory element and mechanisms of transcription regulation.<br>2. Transcriptional and post transcriptional gene silencing.<br>3. Modification of RNA : 5'-cap formation, transcription termination, 3' end processing and polyadenylation, splicing, Editing, Nuclear export of mRNA, mRNA stability. | 15 |
| **Unit III** | |
| 1. Translation<br>Prokaryotic and eukaryotic translation, the translation machinery, mechanisms of initiation, elongation and termination, regulation of translation.<br>2. Co- and Post- translational modifications of proteins. | 15 |
| **Unit IV** | |
| 1. Protein localization and transport<br>Synthesis of secretary and membrane, import into nucleus. Mitochondria E. R., Golgi complex, chloroplast, and peroxisomes, Receptor mediated endocytosis.<br>2. Antisense and ribozyme technology<br>3. Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation. Disruption of RNA structureand capping biochemistry of ribozyme; hammerhead, hairpin and other ribozymes, strategies for designing ribozyme, application of antisense and ribozyme technologies. | 15 |

**Suggested reading**


1. Lodish et al., Molecular cell Biology, 4th Edition, W.H. Freeman & Company, 2000.
2. Smith & Wood, Cell Biology, 2nd Edition, Chapman & Hall, London, 1996.
3. Watson et al., Molecular Biology of the gene, 5th Edition, Pearson Prentice Hall. USA, 2003.
4. B. M. Turner, Chromatin & Gene regulation, 1st Edition, Wiley-Blackwell, 2002.
5. Benjamin Lewin, Gene X, Edition, Jones and Barlett Publishers, 2007.
6. Alberts et al; Molecular Biology of the Cell, 4th edition, Garland, 2002.
7. Recombinant DNA technology by Watson et. al., (Scientific American Books).
8. Principles of Gene Manipulation by Old and Primrose.(Blackwell).
9. Molecular Biotechnology by Glick.

## M. Sc. Biotechnology II semester

### Core Course : BT-C202 : Instrumentation and Techniques in Biotechnology

[Total Credits : 04]

| Topics | Teaching Hrs. 60 |
|---|---|
| **Unit I** | |
| 1. Photometry – Basic principles, Instrumentation and applications of UV-Visible spectrophotometry<br>2. Infrared (IR) spectroscopy and its applications<br>3. Fluorescence spectroscopy – principle, instrumentation and applications.<br>4. Mass spectroscopy – Mass analyzers, principle, instrumentation and applications. | **15** |
| **Unit II** | |
| 1. Raman spectroscopy and its applications<br>2. Electron spin resonance (ESR) spectroscopy and applications<br>3. Nuclear magnetic resonance (NMR) Spectroscopy – principle, instrumentation and applications<br>4. Circular Dichroism (CD) spectroscopy – principle, instrumentation and applications<br>5. X-ray Crystallography – principle, instrumentation and applications | **15** |
| **Unit III** | |
| 1. Centrifugation – basic principle, types and applications<br>2. Chromatography: Principle, types and applications of Paper, Thin layer, High performance liquid chromatography; Column Chromatography – Gel filtration, Ion exchange chromatography, affinity chromatography, adsorption chromatography.<br>3. Electrophoresis: Principle, types and applications; Agarose gel, PAGE, SDS-PAGE, Iso-electric focusing, Two Dimensional gel electrophoresis, Immuno-electrophoresis, Capillary electrophoresis, Pulse Field gel electrophoresis.<br>4. Autoradiography – Principle and applications, radioisotopes used in biology and their application. | **15** |
| **Unit IV** | |
| 1. Microscopy – Basic principle and components of microscope, phase contrast and fluorescent and Confocal microscopes<br>2. Electron microscopy – principle and applications<br>3. Sequencing techniques for proteins and nucleic acids<br>4. Detection of molecules using flow cytometry and *in-situ* localization by hybridization techniques such as FISH and GISH | **15** |

**Suggested reading**


1. Biochemical Techniques : Theory and Practice by Robyt and White
2. Principles of Instrumental Analysis by Skoog and West
3. Analytical Biochemistry by Holme and Peck
4. Biological Spectroscopy by Campbell and Dwek
5. Organic Spectroscopy by Kemp
6. A Biologist's Guide to Pronciples and Techniques of Practical Biochemistry by Wilson and Goulding
7. Principles of Instrumental Analysis by Skoog, Hollar and Nicman
8. Physical Biochemistry: Applications to Biochemistry and Molecular Biology by Freifelder
9. Hawk's physiological chemistry Ed. by Oser (McGraw Hill).
10. Biochemical methods By Sadasivam and Manikam (Wiley Eastern limited).
11. An introduction to practical biochemistry by D.T.Plummer (McGraw Hill).
12. Laboratory manual in Biochemistry by J.Jayaraman (Wilety Eastern limited).
13. Biochemistry - a laboratory courses by J.M.Beckar (Academic Press).
14. Manual of clinical laboratory immunology by Rose NR.
15. The experimental foundations of modern immunology by Clark W.R.
16. Practical Biochemistry, by Wilson Walker


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## M. Sc. Biotechnology II semester

### Core Course :BT-C203:Biology of Immune System

[Total Credits : 04]

| Topics | Teaching Hrs. 60 |
|---|---|
| **Unit I** | |
| 1. Immune response: innate and adaptive immune system, cells and molecules of immune system, Cells of the Immune system : Hematopoiesis and differentiation , Lymphocyte trafficking, B-lymphocyte, Macrophage Dendritic cells, Natural killer and Lymphokine activated killer cells, Eosinophils , Neutrophils and Mast cells .<br>2. Clonal selection theory.<br>3. Organization and structure of lymphoid organ.<br>4. Nature and biology of antigens and super antigens.<br>5. Antibodies structure and function. | **15** |
| **Unit II** | |
| 1. Antigens antibody interactions.<br>2. Major histocompatibility complex.<br>3. BCR & TCR, generation of diversity.<br>4. Regulation of immune response:<br>- Antigen processing and presentation , generation of humoral and cell mediated immune response .<br>- Activation of B & T –lymphocytes.<br>- Cytokines and their role in immune regulation.<br>- T-cell regulation, MHC restriction.<br>- Immunological tolerance. | **15** |
| **Unit III** | |
| 1. Complement system.<br>2. Cell mediated cytotoxicity: Mechanism of T cell and NK cell mediated lysis, Antibody dependent cell mediated cytotoxicity, macrophage mediated cytotoxicity.<br>3. Hypersensitivity.<br>4. Autoimmunity | **15** |
| **Unit IV** | |
| 1. Transplantation<br>2. Immunity of infectious agents (intercellular, parasites helminthes & viruses)<br>3. Tumor Immunology.<br>4. AIDS and other Immunodeficiency.<br>5. Hybridoma Technology and monoclonal antibodies.<br>6. Catalytic antibodies | **15** |

**Suggested reading**


1. Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition, Freeman, 2002.
2. Brostoff J, Seaddin JK, Male D, Roitt IM., Clinical Immunology, 6th Edition, Gower Medical Publishing, 2002.
3. Janeway et al., Immunobiology, 4th Edition, Current Biology publications., 1999.
4. Paul, Fundamental of Immunology, 4th edition, Lippencott Raven, 1999.
5. Goding, Monoclonal antibodies, Academic Press. 1985.
6. Essentials of Immunology by Roit (ELBS).
7. Immunology by Roit et.al (Harper Row).
8. Text book of Immunology by S.T,Barrot (Mosby).
9. Principles of Microbiology and Immunology by Davis et.al., (Harper).

## M. Sc. Biotechnology II semester
## Core Course : BT-C204 : Genetics

**[Total Credits : 04]**

| TOPIC | Teaching Hrs. 60 |
|---|---|
| **UNIT –I** | |
| 1. Gene as unit of mutation and recombination.<br>2. Molecular nature of mutations; mutagens.<br>3. Type of DNA damage (deamination, oxidative damage, alkylation, pyridine dimmers).<br>4. Ame's test for mutagenesis<br>5. DNA repair- photorepair, excision or dark repair, recombinational repair, SOS repair. | **15** |
| **UNIT-II** | |
| 1. Methods of genetic analysis and genetic mapping, Pedigree analysis, LOD score for linkage testing.<br>2. Recombination - Homologous recombination - Holiday junction, site specific recombination - FLP/FRT and Cre lox recombination, Rec A and other recombinases<br>3. Quantitative genetics: Polygenic inheritance, heritability and its measurements, QTL mapping.<br>4. Molecular markers in genome analysis, RFLP, RAPD, AFLP, STS, SCAR (Sequence characterized amplified regions), microsatellite, SSCP, QTL. | **15** |
| **UNIT- III** | |
| 1. Bacterial genetic system: transformation, conjugation and transduction. Bacterial genetics map with reference to *E.coli*.<br>2. Complementation analysis, cir-trans test, deletion mapping, Benzer's concept of cistron, concept of overlapping genes. | **15** |
| **UNIT- IV** | |
| 1. Southern, Northern and florescence in situ hybridization for genome analysis<br>2. Chromosome micro-dissection and micro-cloning.<br>3. Important application of advances in microbial genetics. Production of proteins.<br>4. Conventional as well as new generation recombinant DNA vaccines, design and advantages | **15** |

**Suggested Reading**


1. Maloy SR, Cronan JE Jr., and Freifelder D, Microbial Genetics, Jones Bartlett Publishers, Sudbury, Massachusetts, 2006.
2. Principles of Genetics by Sinnet et.al,., (McGraw Hill).
3. Principles of Heridity by Robert Tumarin.
4. Genetics by M.W.Strick Berger (Mac Millan).
5. Cell and Molecular Biology by E, D. P. De Roberties (International edition).
6. Microbial Genetics, Malloy, S.R., Cronan, J.E. Jr and Freifelder, D.Jones, Bartlett Publishers


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## M. Sc. Biotechnology III semester,

### Core Course :BT-C301: Animal Cell Science and Technology

[Total Credits : 04]

| Topics | Teaching Hrs. 60 |
|---|---|
| **Unit I** | |
| 1. Structure and organization of animal cell.<br>2. Equipment and materials for animal cell culture technology.<br>3. Primary and established cell line culture.<br>4. Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium.Role of carbon-dioxide; Role of serum and supplements.<br>5. Serum and protein free defined media and their application. | **15** |
| **Unit II** | |
| 1. Measurement of viability and cytotoxicity.<br>2. Biology and characterization of culture cells. Measuring parameters of growth<br>3. Basic techniques of mammalian cell culture in vitro; disaggregation of tissue andprimaryculture; cell separation.<br>4. Scaling-up of animal cell culture. | **15** |
| **Unit III** | |
| 1. Cell synchronization.<br>2. Cell cloning and micromanipulation.<br>3. Cell transformation.<br>4. Application of animal cell culture.<br>5. Stem cell culture, embryonic stem cells and their applications.<br>6. Cell culture based vaccines. | **15** |
| **Unit IV** | |
| 1. Somatic cell genetics.<br>2. Organ and histotypic culture.<br>3. Measurement of cell death.<br>4. Three dimensional culture and tissue engineering.<br>5. Animal Cloning – methodology, its application and limitations. | **15** |

**Suggested Reading**


1. Animal cell culture – A practical approach Ed. By John R.W. Masters (IRL Press).
2. Animal cell culture techniques, Ed. Martin clyenes (Springer).
3. Comprehensive Biotechnology. Vol. 4. M. Moo-Young (Ed-in-chief), Pergamon Press, Oxford.
4. Elements of Biotechnology by PK Gupta (Rastogi& Co).
5. Biotechnology by Kashav. T (Wiley Eastern Ltd).
6.Concepts in Biotechnology by Balasubrahmanianet. al.,(University press).
7.Principles and practices of aquaculture by TVR Pillay.
8.Coastal aquaculture by Santhanam.
9.Animal cell culture by Ian Freshney.
10.Molecular Biotechnology by Glick.


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## M. Sc. Biotechnology III semester,
## Core Course :BT-C302 :Genetic Engineering

[Total Credits : 04]

| Topics | Teaching Hrs. 60 |
|---|---|
| **Unit I** | |
| 1. Scope of Genetic Engineering.<br>2. Isolation of enzymes, in-vitro synthesis of DNA and patenting of life forms.<br>3. Restriction enzymes and modification enzymes.<br>4. Nucleic acid Purification and Yield Analysis.<br>5. Nucleic Acid Amplification, PCR and Its application | **15** |
| **Unit II** | |
| 1. Gene cloning Vectors<br>Plasmids, bacteriophage, phagemides, cosmids, Artificial Chromosomes.<br>2. Restriction mapping of DNA fragments and Map construction.<br>3. cDNA Synthesis - mRNA enrichment, reverse transcription, DNA primers, linkers, Adapters and their chemical synthesis, Library construction and screening.<br>4. Alternative strategies of Gene Cloning.<br>Cloning interacting genes- Two and three hybrid systems.<br>5. Nucleic acid microarrays. | **15** |
| **Unit III** | |
| 1. Site directed Mutagenesis and Protein Engineering.<br>2. How to study the Gene Regulation?<br>DNA transfection, Northern blot, Primer extension, SI mapping, Rnase protection assay.<br>3. Expression Strategies for heterologous genes<br>Expression in bacteria, expression in Yeast, expression in insects and insect cells, expression in mammalian cells.<br>4. Processing of Recombinant proteins.<br>Purification and stabilization of proteins. | **15** |
| **Unit IV** | |
| 1. Phase Display.<br>2. T-DNA and Transposon Tagging<br>3. Transgenic and gene Knock out Technologies<br>Targeted gene replacement, chromosome engineering.<br>4. Gene Therapy.<br>Vector engineering, Strategies of delivery, gene replacement/ augmentation, gene correction, gene editing, regulation and silencing. | **15** |

**Suggested Reading**


1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.
5. Technical Literature from Stratagene, Promega, Novagen, New England Biolab etc.
6. Genetic Engineering by SandhyaMitra
7. Gene Technology by SN Jogdand.


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## M. Sc. Biotechnology III semester

### Core Course :BT-C303: Bioprocess Engineering and Technology

[Total Credits : 04]

| Topics | Teaching Hrs. 60 |
|---|---|
| **Unit I** | |
| 1. Introduction to bioprocess Engineering.<br>2. Bioreactor and fermentor<br>3. Isolation, Preservation and Maintenance of Industrial Microorganism.<br>4. Kinetic of Microbial Growth and death. | 15 |
| **Unit II** | |
| 1. Media for industrial fermentation.<br>2. Air and media sterilization.<br>3. Type of fermentation process; Analysis of batch, fed batch and continuous bioreactors, stability of microbial reactors, specialized bioreactors (pulsed fluidized photo bioreactors etc). | 15 |
| **Unit III** | |
| 1. Measurement and control of bioprocess parameters.<br>2. Downstream Processing: Introduction, Removal of microbial cell and solid matter, foam precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process Drying and crystallization effluent treatment; D.O.C. and C.O.D. treatment and disposal of effluents.<br>3. Whole cell immobilization and their industrial applications | 15 |
| **Unit IV** | |
| 1. Industrial production of chemical; Alcohol (ethanol), Acids (citric acetic,gluconic) solvents (glycerol, acetone), Antibiotics (penicillin, tetracycline) Amino acids (lysine, glutamic acid) ,Single cell protein.<br>2. Use of microbes in mineral beneficiation and oil recovery.<br>3. Introduction to food technology:<br>-Elementary idea of canning and packing.<br>-Sterilization and pasteurization of food products.<br>-Food preservation. | 15 |

**Suggested Reading**


1. Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991.
2. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, 2nd Edition, Prentice Hall, Engelwood Cliffs, 2002.
3. Stanbury RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.
4. Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York, 1986.
5. Aiba S, Humphrey AE and Millis NF, Biochemical Engineering, 2nd Edition, University of Tokyo press, Tokyo, 1973.
6. Comprehensive Biotechnology: The Principles, Applications and Regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4. Young M.M., Reed Elsevier India Private Ltd, India, 2004.
7. Mansi EMTEL, Bryle CFA. Fermentation Microbiology and Biotechnology, 2nd Edition, Taylor & Francis Ltd,UK, 2007.


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## M. Sc. Biotechnology III semester
## Elective Course :BT-E304: Basic Bioinformatics

[Total Credits : 04]

| Topics | Teaching Hrs. 60 |
|---|---|
| **Unit I** | |
| 1. Introduction to Bioinformatics - an overview, introduction and scope of bioinformatics.<br>2. Use of bioinformatics in nucleic acid sequence database, brief knowledge of sequence alignment and its significance<br>3. Introduction of Biological databases – Primary sequence database (Protein and DNA), Secondary database, composite database.<br>4. Applications of bioinformatics<br>- Clinical informatics<br>- Cheminformatic resources and pharmacoinformatics | 15 |
| **Unit II** | |
| 1. Searching database and locating genes, Alignment of gene sequences, Local and Global.<br>- Nucleic acid sequence databases: GenBank, EMBL<br>- Protein sequence databases: SWISS-PROT, TrEMBL, PIR<br>- Genome Databases at NCBI, EBI<br>- Derived Databases: basic concept of derived databases, PROSITE, Pfam,<br>- Repositories for high throughput genomic sequences: EST, STS<br>2. Gene structure prediction: CENSOR, RepeatMasker; detection of functional sites in DNA sequences-PromoterScan and GenScan.<br>3. Biodiversity and ecosystem based databases | 15 |
| **Unit III** | |
| 1. Analysis of DNA sequence: Sequence Similarity, Homology and Alignment;BLAST, FASTA, Multiple sequence alignment (ClustalW, Psi BLAST).Statistical significance of alignments score, motifs and pattern analysis.<br>2. Designing primers of specific gene.<br>3. Generation of restriction maps,Generating Phylogenetic trees based on DNA sequence and evolutionary relationship.Phylogenetic trees (PHYLIP)<br>4. Phylogenetic Inference Package, Sites and Centres | 15 |
| **Unit IV** | |
| 1. Protein sequence, structures and interacting proteins databases<br>2. Predicting ORFs, location of transcription start point and end point, getting polypeptide sequence from a nucleotide sequence.<br>3. Analysis of proteins: Protein classification, homology modeling,<br>4. Protein Structure Visualization: tools for structure prediction, validation and visualization;Pymol, Protein Data Bank (PDB) and PDB format. | 15 |

**Suggested Reading**


1. N. C. Jones, P. A. Pevzner, An Introduction to Bioinformatics Algorithms, MPI Press 2004.
2. D. W. Mont, Bioinformatics: Sequence and Genome Analysis, CSHL Press.
3. D. Gusfield, Algorithms on Strings, Trees, and Sequences: Computer Science and ComputationalBiology, Cambridge University Press, 1997.
4. Barnes & Gray: Bioinformatics for geneticists (2003, Wiley)
5. Lesk: Bioinformatics (2nd ed 2006, Oxford)
6. Westhead et al: Bioinformatics Instant Notes (Indian ed 2003, Viva Books)
7. Mount, Bioinformatics (2nd ed 2006, CBS)
8. Hunt and Livesey: Functional Genomics (2006, Oxford)
9. Campbel: Discovering Genomics, Proteomics and Bioinformatics (2006, LPE)
10. Bioinformatics: A practical guide to the analysis of genes and proteins. Baxevanis A.D and Ovellette B.F.F., Wiley-Interscience, (2002).


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## M. Sc. Biotechnology III semester

## Elective Course :BT-E305: Basic Genomics and Proteomics

[Total Credits : 04]

| Topics | Teaching Hrs.60 |
|---|---|
| **Unit I** | |
| **Genome**<br>1. Brief overview of prokaryotic and eukaryotic genome organization;<br>2. Extra-chromosomal DNA: bacterial plasmids, mitochondria and chloroplast.<br>3. Human Genome Project | **15** |
| **Unit II** | |
| **Genome Mapping :**<br>1. Genetic and physical maps;<br>2. Markers for genetic mapping;<br>3. Methods and techniques used for gene mapping, physical mapping,<br>4. Linkage analysis, cytogenetic techniques, FISH technique in gene mapping,Somatic cell hybridization, in situ hybridization, comparative gene mapping.<br>**Comparative Genomics** :<br>5. Identification and classification of organisms using molecular markers- 16S rRNA typing/sequencing, SNPs;<br>6. Use of genomes to understand evolution of eukaryotes, track emerging diseases and design new drugs;<br>7. Determining gene location in genome sequence | **20** |
| **Unit III** | |
| 1. **Proteome and Proteomics**:<br>- Aims, strategies and challenges in proteomics;<br>- Proteomics technologies: 2D-PAGE, isoelectric focusing, mass spectrometry, MALDI-TOF, yeast 2-hybrid system, proteome databases. | **10** |
| **Unit IV** | |
| **Functional Genomics and Proteomics :**<br>1. Transcriptome analysis for identification and functional annotation of gene, Contig assembly, chromosome walking and characterization of chromosomes, mining functional genes in genome,<br>2. Gene function- forward and reverse genetics, gene ethics;<br>3. Protein-protein and protein-DNA interactions;<br>4. Protein chips and functional proteomics;<br>5. Clinical and biomedical applications of proteomics;<br>6. Introduction to metabolomics, lipidomics, metagenomics and systems biology. | **15** |

**Suggested Readings**


1. Concepts and Techniques in Genomics and Proteomics by N Saraswathy, P Ramalingam Elsevier.
2. Genomics and Proteomics: Principles, Technologies, and Applications. byDevarajanThangadurai (Editor), JeyabalanSangeetha (Editor). Apple Academic Press; 1st edition (2015)
3. Principles of Gene Manipulation and Genomics by Sandy Primrose and Richard Twyman Blackwell Publishers Edition 7 (2006)
4. Recombinant DNA : Genes and Genomics : Short Course, By JD Watson, Publisher W.H. Edition 3 (2007)
5. Chapter 8 Basics of proteomics by Saurabh Bhatia In : Introduction to Pharmaceutical Biotechnology, Volume 2 Enzymes, proteins and bioinformatics IOP Publishing Ltd (2018)
6. S. Sahai - Genomics and Proteomics, Functional and Computational Aspects, Plenum Publication, 1999.
7. Pennington & Dunn - Proteomics from Protein Sequence to Function, 1 st edition, Academic Press, San Diego, 1996.
8. Introduction to proteomics: Tools for new biology by Daniel C. Liebler, Humana Press.


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## M. Sc. Biotechnology IV semester

### Core Course :BT-C401:Plant Biotechnology

[Total Credits : 04]

| Topics | Teaching Hrs. 60 |
|---|---|
| **Unit I** | |
| 1. Introduction to cell and tissue culture, tissue culture as a technique to produce novel plants and hybrids.<br>2. Tissue culture media (composition and preparation).<br>3. Initiation and maintenance of callus and suspension culture, single cell clones.<br>4. Organogenesis, somatic embryogenesis; transfer and establishment of whole plant in soil. | 15 |
| **Unit II** | |
| 1. Shoot tip culture, rapid clonal propagation and production of virus free plants.<br>2. Embryo culture and embryo rescue.<br>3. Protoplast isolation, culture and fusion, selection of hybrid cells and regeneration of hybrid plants; symmetric or asymmetric hybrids cybrids.<br>4. Anther, pollen and ovary culture for production of haploid plants and homozygous lines .<br>5. Cryopreservation, slow growth and DNA banking for germplasm conservation. | 15 |
| **Unit III** | |
| 1. Plant Transformation technology – basis of tumor formation, hairy root, feature of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence genes.<br>2. Use of Ti and Ri as vectors - binary vectors and co integrate vector.<br>3. Genetic markers – reporter gene, selectable marker genes.<br>4. Transgenic stability – use of 30S promoter, reporter gene with introns, use of scaffold attachment regions.<br>5. Methods of nuclear transformation - viral vectors and their applications, vector less or direct DNA transfer.<br>6. Chloroplast transformation. | 15 |
| **Unit IV** | |
| 1. Application of plant transformation for productivity and performance<br>Herbicide resistance -phosphoinothricin, glyphosate, sulfonyl urea, atrazine.<br>Insect resistance - bt genes Non bt like protease inhibitors. Alpha amylase inhibitor.<br>Virus resistance - coat protein mediated, nucleocapsid gene.<br>Disease resistance - chitinase, 1-3 beta glucanase, RIP, antifungal proteins thionins, PR proteins.<br>Nematode resistance.<br>Abiotic stress post-harvest losses - long a shelf life of fruits and flowers, uses of ACC synthase, polygalacturonase, ACCoxidase.<br>Male-sterile lines - bar and barnase system.<br>Carbohydrate composition and storage - ADP glucose pyrophosphorylase.<br>2. Plant secondary metabolites - control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway, alkaloids, industrial enzymes, biodegradable plastic – polyhyroxybutyrate, Therapeutic proteins, lysosomal enzyme antibodies, edible vaccines,<br>3. Green House. | 15 |

**Suggested Reading**


1. Introduction to Plant Biotechnology, H S Chawala 2009, 3rd Edition, Science Publishers
2. Agricultural Biotechnology, 1st edition, (2008) Rawat H, Oxford Book Co, India.
3. Agrobiotechnology and plant tissue culture, Bhojwani SS, Soh WY, Oxford & IBH Publ, India
4. Agricultural Biotechnology, (2005), Kumar HD, DayaPubl House, India
5. Plant tissue culture and molecular markers: Their role in improving crop productivity Ashwani Kumar, Shekhawat NS (2009) (IK International)
6. Plant Biotechnology by A. Slater, N.W. Scott and M.R. Fowler (Oxford University press).
7. Biotechnology in Agriculture by Swaminathan, M.S (Mc. Milllan India Ltd).
8. Biotechnology and its applications to Agriculture, by Copping LG and P.Rodgers (British Crop Projection).
9. Plant Biotechnology, by Kung, S.andC.J.Arntzen (Butterworths).
10. Biotechnology By U Satyanarayana.

## M. Sc. Biotechnology IV semester
## Core Course :BT-C402:Environmental Biotechnology

[Total Credits : 04]

| Topics | Teaching Hrs. |
|---|---|
| **Unit I** | |
| 1. Environment: basic concepts and issues.<br>2. Environmental pollution: types of pollution, Methods for the measurement of pollution, Methodology of environment management the problem solving approach, its limitation.<br>3. Air pollution and its control through biotechnology. | 15 |
| **Unit II** | |
| 1. Need for water managements, Measurement and water pollution, sources of water pollution, Waste water collection<br>2. Waste water treatment – physical and chemical processes.<br>3. Microbiology of Waste water Treatment, Aerobic Process: Activated sludge, Oxidation ditches, trickling, towers, rotation dises, rotating drums, oxidation ponds.<br>4. Anaerobic Processes: Anaerobic digestion, anaerobic filters, Upflow anaerobic blanket reactors. | 15 |
| **Unit III** | |
| 1. Treatment schemes of wastewater of dairy, distillery, tannery, sugar, antibiotic industries.<br>2. Solid wastes: Sources and managements (composting, worm culture and methane production)<br>3. Microbiology of degradation of Xenobiotic in Environment- degradative plasmids; hydrocarbons. Substituted hydrocarbons, oil pollution and pesticides. | 15 |
| **Unit IV** | |
| 1. Bioremediation of contaminated soil and wasteland.<br>2. Bio pesticides and integrated pest management.<br>3. Global Environment Problems: Ozone depletion, UV-B, greenhouse effect and acid rain, their impact and biotechnological approaches for management.<br>4. Environmental Monitoring – environmental impacts and their assessments using bio-indicators, biomarkers and biosensors. | 15 |

**Suggested Reading**


1. Biotechnology by B.D.Singh (Kalyani).
2. Ecology and Environment by PD Sharma.
3. Fundamentals of Ecology, by Odum, EP (McGraw Hill)
4. Environmental Biotechnology by Forster, C.F. and Wase D.A.J. (Ellis Horwood).
5. Biotechnological innovations in environmental management by Leach, CK and Van DamMieras, MCE (Butterworth-Herinemann, Oxford (Biotol Series).
6. Molecular Biology and Biotechnology by Meyers, RA, A comprehensive Desk reference (VCH Publishers).
7. Biotechnology by U. Satyanarayana (Books & Allied (P) Ltd).
8. Environmental Biotechnology by JN Jogdand.
9. Principles and Applications of Environmental Biotechnology for a Sustainable Future,by Ram Lakhan Singh. Springer Singapore.


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## M. Sc. Biotechnology IV semester
## Elective Course :BT-E403: Molecular Diagnostics

[Total Credits : 04]

| Topics | Teaching Hrs. |
|---|---|
| **Unit I** | |
| 1. **Genome biology in health and disease:** An overview;<br>- Chromosomal structure & mutations;<br>- DNA polymorphism: human identity;<br>- Clinical variability and genetically determined adverse reactions to drugs.<br>2. **Genome: resolution, detection & analysis:**<br>- PCR: Real-time; ARMS; Multiplex; ISH; FISH; RFLP; SSCP;<br>- Nucleic acid sequencing: new generations of automated sequencers;<br>- Microarray chips; Microarray data normalization & analysis;<br>- Molecular markers: 16S rRNA typing;<br>3. **Diagnostic proteomics:** SELDI-TOF-MS; Bioinformatics data acquisition& analysis. | 15 |
| **Unit II** | |
| 1. **Diagnostic metabolomics:** Metabolite profile for biomarker detection the body fluids/tissues in various metabolic disorders by making using LCMS & NMR technological platforms.<br>2. **Detection and identity of microbial diseases:**Direct detection and identification of pathogenic-organisms that are slow growing or currently lacking a system of in vitro cultivation as well as genotypic markers of microbial resistance to specific antibiotics. | 15 |
| **Unit III** | |
| 1. **Detection of inherited diseases:** Exemplified by two inherited diseases for which molecular diagnosis has provided a dramatic improvement of quality of medical care:<br>- Fragile X Syndrome: Paradigm of new mutational mechanism of unstable triplet repeats,<br>- von-HippelLindau disease: recent acquisition in growing number of familial cancer syndromes. | 15 |
| **Unit IV** | |
| 1. **Molecular oncology:**<br>- Detection of recognized genetic aberrations in clinical samples from cancer patients;<br>- Types of cancer-causing alterations revealed by next-generation sequencing of clinical isolates;<br>- Predictive biomarkers for personalized onco-therapy of human diseases such as chronic myeloid leukemia, colon, breast, lung cancer and melanoma as well as matching targeted therapies with patients and preventing toxicity of standard systemic therapies.<br>2. **Quality assurance and control:** Quality oversight; regulations and approved testing. | 15 |

**Suggested Reading:**


1. Campbell, A. M., &Heyer, L. J. (2006). Discovering Genomics, Proteomics,and Bioinformatics. San Francisco: Benjamin Cummings.
2. Brooker, R. J. (2009). Genetics: Analysis & Principles. New York, NY: McGraw-Hill.
3. Glick, B. R., Pasternak, J. J., & Patten, C. L. (2010). *Molecular Biotechnology: Principles and Applications of Recombinant DNA*. Washington, DC: ASM Press.
4. Coleman, W. B., &Tsongalis, G. J. (2010). *Molecular Diagnostics: for the Clinical Laboratorian*. Totowa, NJ: Humana Press.


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## M. Sc. Biotechnology IV semester
## Elective Course :BT-E404: Stem Cell Biology

[Total Credits : 04]

| Topics | Teaching Hrs.60 |
|---|---|
| **Unit I** | |
| 1. Introduction to Stem Cells,<br>2. Definition, Classification and Sources. | 15 |
| **Unit II** | |
| 1. Embryonic Stem Cells<br>2. Blastocyst and inner cell mass cells, Organogenesis,<br>3. Mammalian Nuclear Transfer Technology,<br>4. Stem celldifferentiation, stem cells cryopreservation. | 15 |
| **Unit III** | |
| 1. Application of stem Cells<br>2. Overview of embryonic and adult stem cells for therapy Neurodegenerative diseases; Parkinson's, Alzheimer,<br>3. Tissue system Failures: Diabetes, Cardiomyopathy, Kidney failure, Liver failure, Hemophilia. | 15 |
| **Unit IV** | |
| 1. Human Embryonic Stem Cells and Society<br>2.Human stem cells research: Ethical consideration; Stem cell religion consideration;<br>3. Stem cell based therapies:Pre clinical regulatory consideration and Patient advocacy. | 15 |

**Suggested Reading**


1. Ann A. Kiessling, Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential, Jones and Bartett, 2003.
2. Peter J. Quesenberry, Stem Cell Biology and Gene Therapy, 1st Edition, Willy-Less, 1998.
3. Robert Lanja, Essential of Stem Cell Biology, 2nd Edition, academic Press, 2006.
4. A.D.Ho., R.Hoffiman, Stem cell Transplantation Biology Processes Therapy, Willy-VCH, 2006.
5. C. S. Potten, Stem Cells, Elsevier, 2006.
6. Essentials of Stem Cell Biology, 2nd edition, (2009) Robert Lanza, et al. Elsevier Academic Press, USA
7. Stem cells and the future of regenerative medicine, 1st edition, (2002), National research council and Institute of medicine, National Academic press, Washington DC
8. Molecular Biotechnology: 4th edition. (2010), Glick B.R., Pasternak J.J., Patten C. L., ASM press, USA

## M. Sc. Biotechnology IV semester
## Elective Course :BT-E405: Food Biotechnology

**[Total Credits : 04]**

| Topics | Teaching Hrs. |
|---|---|
| **Unit I** | |
| 1. Introduction and history of food microbiology, General characteristics, classification and importance of microorganisms important in food microbiology,<br>2. Principles of food preservation. Asepsis–Removal of microorganisms, (anaerobic conditions, high temperatures, low temperatures, drying, canning, food irradiation).<br>3. Factors influencing microbial growth in food – Extrinsic and intrinsic factors;<br>4. Chemical preservatives. | 15 |
| **Unit II** | |
| 1. Contamination and spoilage: Cereals, sugar products, vegetables, fruits, meat and meat products, Milk and Milk products, Fish and sea foods, poultry food, spoilage of canned foods.<br>2. Detection of spoilage and characterization.<br>3. Food-borne infections and intoxications: Bacterial and nonbacterial toxins with examples of infective and toxic types – *Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia, Nematodes, protozoa, algae, fungi* and *viruses*. | 15 |
| **Unit III** | |
| 1. Food fermentations: Industrial production method for microbial starters, bread, cheese, vinegar, fermented vegetables, fermented dairy products;<br>2. Fermented beverages: beer and wine.<br>3. Microbial cells as food (single cell proteins, mushrooms),<br>4. Amino acid production: glutamic acid and lysine.<br>5. Production of probiotics and prebiotics, nutraceuticals, low calorie sweetener, food coloring and naturally occurring flavor modifiers. | 15 |
| **Unit IV** | |
| 1. Food quality standards, Monitoring and control,<br>2. Food Adulteration, R&D innovations in food microbiology,<br>3. Genetically modified foods,<br>4. Need and requirements of food packaging; Containers for packaging, Dispensing devices,<br>5. Food Regulations/Safety & Quality Standards & Food Laws | 15 |

**Suggested readings**


1. Food microbiology- Royal society of chemistry: MR Adams and MO Moss.
2. Principles of fermentation technology: PF Stanbury, A Whitekar and SJ Hall, Pergamon Press.
3. Basic Food Microbiology: GJ Banwart, CBS Publishers.


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## M. Sc. Biotechnology IV semester
## Elective Course :BT-E406: Agriculture Biotechnology

[Total Credits : 04]

| Topics | Teaching Hrs. |
|---|---|
| **Unit I** | |
| 1. Introduction to Agricultural biotechnology: Concepts and scope of Agricultural Biotechnology<br>2. Crop improvement hybridization and plant breeding techniques.<br>3. Micropropagation and plant tissue culture technique and its application in agriculture.<br>4. Somatic hybridization, haploid production and cryopreservation<br>5. Study of biopesticides used in agriculture (neem as example) | 15 |
| **Unit II** | |
| 1. Mechanism of biological nitrogen fixation process. study of NIF, NOD and HUP genes nitrogen fixation process.<br>2. Production of bio-fertilizers and applications of rhizobium, azotobacter, azolla and myconrrhiza<br>3. Use of plant growth regulators in agriculture and horticulture. | 15 |
| **Unit III** | |
| **Biotechnology for quality crop development**<br>1. Technological change in agriculture, Green Revolution: traditional and non-traditional methods of crop improvement. Molecular genetics of Photosynthesis, theory and techiques for the development of transgenic plants-conferting resistance to herbicide (Glyphosate und BASTA)<br>2. Pesticide (Bt-Gene) Technological change in agriculture- for biotic, abiotic stress: Improvement of crop yield and quality fruit ripening | 15 |
| **Unit IV** | |
| **Agro-industrial biotechnology**<br>1. Techniques of some plant tissue culture techniques for bio-resource production:<br>2. Micropropagation; Somaclonal variation, Artificial seed production; Androgenesis and its applications in genetics and plant breeding: Cell cultures for secondary metabolite production: (Gemplasm conservation and cryopreservation.<br>3. Agro-industry: Microbes in agriculture, Bio-fertilizer, Microbial enzymes and their applications in agro-chemical industries, Biocatalyst; Agro-waste utilization; Mycorrhiza in agriculture and forestry | 15 |

**Suggested Reading**

1. Plant Biotechnology and Genetics: Principles, Techniques and Applications C. NealStewart, J. Editor) Wiley, 2008
2. Agricultural biotechnology by. S. Prot - Second Enlarged ation, Agrobios, 2007
3 Agricultural Biotechnology, HD. Kumar Daya Publishing House, 2005,
4. Agricultural Biotechnology Challenges and Prospects Elite by Mahesh K. Bhalga,William P- Ridley, Allan. Felst, and James N, Seiber.

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Appendix - 3

# MINOR FOR OTHER FACULTY
# M.Sc. BIOTECHNOLOGY
# DEPARTMENT OF BIOTECHNOLOGY
# FACULTY OF LIFE SCIENCE
# DR. BHIMRAO AMBEDKAR UNIVERSITY

## Genetic Engineering

[Total Credits : 04]

| Topics | Teaching Hrs. 60 |
|---|---|
| **Unit I** | |
| 1. Scope of Genetic Engineering.<br>2. Isolation of enzymes, in-vitro synthesis of DNA and patenting of life forms.<br>3. Restriction enzymes and modification enzymes.<br>4. Nucleic acid Purification and Yield Analysis.<br>5. Nucleic Acid Amplification, PCR and Its application | 15 |
| **Unit II** | |
| 1. Gene cloning Vectors<br>Plasmids, bacteriophage, phagemides, cosmids, Artificial Chromosomes.<br>2. Restriction mapping of DNA fragments and Map construction.<br>3. cDNA Synthesis - mRNA enrichment, reverse transcription, DNA primers, linkers, Adapters and their chemical synthesis, Library construction and screening.<br>4. Alternative strategies of Gene Cloning.<br>Cloning interacting genes- Two and three hybrid systems.<br>5. Nucleic acid microarrays. | 15 |
| **Unit III** | |
| 1. Site directed Mutagenesis and Protein Engineering.<br>2. How to study the Gene Regulation?<br>DNA transfection, Northern blot, Primer extension, SI mapping, Rnase protection assay.<br>3. Expression Strategies for heterologous genes<br>Expression in bacteria, expression in Yeast, expression in insects and insect cells, expression in mammalian cells.<br>4. Processing of Recombinant proteins.<br>Purification and stabilization of proteins. | 15 |
| **Unit IV** | |
| 1. Phase Display.<br>2. T-DNA and Transposon Tagging<br>3. Transgenic and gene Knock out Technologies<br>Targeted gene replacement, chromosome engineering.<br>4. Gene Therapy.<br>Vector engineering, Strategies of delivery, gene replacement/ augmentation, gene correction, gene editing, regulation and silencing. | 15 |

**Suggested Reading**


1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.
5. Technical Literature from Stratagene, Promega, Novagen, New England Biolab etc.
6. Genetic Engineering by SandhyaMitra
7. Gene Technology by SN Jogdand


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