COURSE STRUCTURE

M. Tech.

BIOTECHNOLOGY

Under

Choice Based Credit System (CBCS)

2023-24

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering & Technology

Ref: RU/FET/ PG /BT/BOS/2023 **Dated:** 03/06/2023

Department of Biotechnology

Minutes of Meeting

Boards of Studies

A meeting of Boards of Studies of M.Tech. Biotechnology, FET was held on 03/06/2023 at 10:30 PM in conference room of FET. The following members were present:

1. Dr. Ajay Kumar - Chairperson
2. Dr. Vivek Srivastava - Member
3. Dr. Samakshi Verma - Member
4. Dr. Manoj Kumar Mishra - Member
5. Dr. (Prof.) Sanjay Mishra - External Member

Agenda:

1. **Action Taken Report (ATR) on Minutes of Previous Meeting.**

   The BOS committee reviewed and confirmed the minutes of the BOS meeting held on 20/05/2022

2. To consider and approve new Evaluation Scheme and Syllabus.

S. No.	Item No.	Existing	Recommendation /Action Taken
1	**RU/FET/ PG /BT/BOS/2022** To consider and approve the CBCS based Evaluation Scheme and Syllabus for M.Tech. (Biotechnology) students to be admitted in the session 2023-24	The BOS reviewed existing Evaluation Scheme and Syllabus for M.Tech. (Biotechnology). For revised curriculum. **1. MTBT-501** Applied Biochemistry & Molecular Biology **2. MTBT-502** Advanced Microbioloy	The BOS considered suggestions for the Evaluation Scheme and Syllabus for said courses and thereafter discussion, recommended the same **1. MBT-101** Applied Biochemistry & Bioenergetics (Addition of bioenergetics helps to understand the process

		3. MTBT-011 Analytical Techniques **4. MTBT-012** Immunology & Vaccine Technology **5. MTBT-013** Medical Biotechnology **6. MTBT-021** Enzyme Technology & Industrial Application **7. MTBT-022** Pharmaceutical Technology **8. MTBT-023** Tissue Culture Techniques **9. MTBT-551** Applied Biochemistry & Molecular Biology Lab **10. MTBT-551** Advanced Microbiology Lab **11. MTBT-601** Bioinformatics **12. MTBT-602** Genetic Engineering **13. MTBT-031** Applied Food Biotechnology **14. MTBT-032** Quality Control In Biotechnology **15. MTBT-033** Agricultural Biotechnology	reaction r and relevant for this programme and exclude the molecular biology) **2. MBT-102** Microbiology And Virology (For Better understanding of microbes, merging of Virology with microbiology) **3. MBT-011** Bio-Analytical Techniques (No changes have done only the Title and code has changed as per Board Meeting Suggestion) **4. MBT-012** Molecular Immunology & Vaccine Technology (No changes have done only the Title and code has changed as per Board Meeting Suggestion) **5. MBT-013** Bio-Medical Technology (No changes have done only the Title and code has changed as per Board Meeting Suggestion) **6. MBT-021** Enzymology & Industrial Application (Some Contents have changed along with the Title and code as per Board Meeting Suggestion) **7. MBT-022**

		16. MTBT-041 Biological Treatment Of Waste Water **17. MTBT-042** Industrial Biotechnological Products **18. MTBT-043** Nano Biotechnology & Toxicology **19. MTBT-651** Bioinformatics Lab **20. MTBT-652** Genetic Engineering Lab **21. MTBT-701** Advanced Bioprocess Engineering & Technology **22. MTBT-051** Down Stream Processing **23. MTBT-052** Diagnostic Techniques In Biotechnology **24. MTBT-053** Fundamentals Of Stem Cell Technology **25. MTBT-753** Bioprocess Engineering & Technology Lab	Pharmaceutical Biotechnology (Some Contents have changed along with the Title and code as per Board Meeting Suggestion) **8. MBT-023** Animal And Plant Tissue Culture Technology (Some Contents have changed along with the Title and code as per Board Meeting Suggestion) **9. MBT-151** Applied Biochemistry & Bioenergetics Lab (Some Contents have changed along with the Title and code as per Board Meeting Suggestion) **10. MBT-152** Microbiology And Virology Lab (Some Contents have changed along with the Title and code as per Board Meeting Suggestion) **11. MBT-201** Computational Biology (Some Contents have changed along with the Title and code as per Board Meeting Suggestion) **12. MBT-202** Molecular Biology and Recombinant DNA Technology (To the advancement of this course merged the molecular biology and recombinant DNA Technology with revised

			content, title and code as per Board Meeting Suggestion) **13. MBT-031** Food Biotechnology (Some Contents have changed along with the Title and code as per Board Meeting Suggestion) **14. MBT-032** Quality Control In Biotechnology (Some Contents have changed along with the Title and code as per Board Meeting Suggestion) **15. MBT-033** Agricultural Biotechnology (To the advancement of this course revised content for crop improvement, title and code have changed as per Board Meeting Suggestion) **16. MBT-041** Biological Waste Water Treatment, Biofuels and Bioenergy (To the advancement of this course merged the Biofuels and bioenergy with revised content, title and code as per Board Meeting Suggestion) **17. MBT-042** Industrial Biotechnological Products (No changes have done only the Title and code has changed

			as per Board Meeting Suggestion) **18. MBT-043** Nanotechnology For Medical And Healthcare (To the advancement of this course update of nano-techniques have introduced with revised content, title and code as per Board Meeting Suggestion) **19. MBT-251** Computational Biology Lab (No changes have done only the Title and code has changed as per Board Meeting Suggestion) **20. MBT-252** Molecular Biology and Recombinant DNA Technology Lab (No changes have done only the Title and code has changed as per Board Meeting Suggestion) **21. MBT-301** Bioprocess Engineering & Process Biotechnology (Updated some Contents along with the Title and code as per Board Meeting Suggestion) **22. MBT-051** Advanced Fermentation Technology (Added the new advanced

			course relevant to industrial job along with the Title and code as per Board Meeting Suggestion) **23. MBT-052** Molecular Diagnostic Technology (Some Contents have changed along with the Title and code as per Board Meeting Suggestion) **24. MBT-053** Stem Cell Engineering (Some Contents have changed along with the Title and code as per Board Meeting Suggestion) **25. MBT-353** Bioprocess Engineering & Technology Lab (No changes have done only the Title and code has changed as per Board Meeting Suggestion)

Result Analysis: Final year students have 88.89 % passed their final exam with good marks. 77.78 % students of M.Tech Ist year (Including Ist and 2nd semester) was cleared pass the final exam with good marks. All students of M.Tech Ist year to M.Tech IInd Year have to promote in next semester of the session 2022-23 (Annexure -1).

4. **Feedback Analysis:** Feedback from all M.Tech. Students of session 2022-23 were good for academic and at present available infra of the department.

5. **Short term course:** In coming session 2023-24, we have proposed again short term "Plant Tissue Culture Techniques" as per last session.

The meeting concluded with a vote of thanks to the chair.

Date of the Next Meeting: to be decided and intimated thereafter

The meeting concluded with a vote of thanks to the chair.

Date of the Next Meeting: to be decided and conveyed later

(Chairperson)

Signature 03/6/2023

Name : Prof (Dr.) Ajay Kumar

Date :

Internal Members

Signature: 1..... 2.....

Name: Dr. Vivek Srivastava Dr. Samakshi Verma

3.....

Dr. Manoj Kumar Mishra

External Members

Signature: 1.....

Name: Dr. (Prof.) Sanjay Mishra

Date:

Encl.: Recommended Curricula attached for consideration and approval.

CC:

1. Dean
2. Registrar Office

ORDINANCE

FOR

THE DEGREE

OF

MASTER OF TECHNOLOGY

(M.Tech.)

RAMA UNIVERSITY UTTAR PRADESH

KANPUR, INDIA

Approved in Academic Council Meeting held on----------

APPLICABILITY:

This ordinance shall apply to all programmes leading to Master's Degrees in Technology.

1. DEFINITIONS:

1. Academic Programme/ Programmes shall mean a programme of courses and/or any other component leading to a Master's degree in Technology.

2. An Academic Year is a period of nearly 12 months devoted to completion of requirements specified in the Scheme of Teaching and the related examinations.

3. Board of Studies (BoS) shall mean the Board of Studies of the Institute concerned.

4. Course means a component of the academic programme, carrying a distinctive code number and specific credits assigned to it.

5. University shall mean **Rama University**

6. External Examiner shall mean an examiner who is not in the employment of the University.

7. Semester System – A programme wherein each academic year is apportioned into two parts known as semesters.

8. Student shall mean a person admitted and registered for a programme in the Institutes of the University.

2. ADMISSION

• The University will permit admission and award of M.Tech. degrees in only such courses which are duly approved by the Academic Council of the University

• Admission to M.Tech. First Semester will be made as per the rules prescribed by the Academic Council of the University.

• Admission on migration from any other university to the university is not permitted. However, a student of constituent Institution/College enrolled in any other university may be allowed to migrate to the University provided that he/she has failed. He/she will continue his/her study in the same Institution/College where he/she was previously studying.

3. ELIGIBILITY FOR ADMISSION

B.Tech. or an equivalent degree in the relevant branch of Engineering with a minimum of 50% marks from a recognized University.

OR

MCA or M.Sc. degree in a related branch with 55% or higher aggregate marks from a recognized University

4. CURRICULUM

M.Tech. courses shall be of any one of the following types:

(a) M.Tech. (Residential/Full-Time/Regular): It shall be a regular four-semester course in which students will be required to spend the entire study duration in the University campus or the Industry/ Institution/ R&D Organization where they shall be doing their dissertation/ project work.

(b) M.Tech. (Week-End): It shall be a regular four-semester course specially run by the University for working teachers, persons employed in Industry or Research and Development Organizations, who have a 5-day working week. The programme consists of three semesters of coursework in the University campus and one semester of dissertation/ project work in the University or in the Industry/ Institution/ R&D Organization. Number of contact hours in each subject will be the same as that of Residential M.Tech. Course. A candidate shall normally be required to submit a no objection certificate from his/her employer for this course.

(c) M.Tech. (Part Time): It shall be a six-semester part-time course meant for serving engineers/ teachers of the neighboring areas who can attend the classes during morning or evening hours only. A candidate shall normally be required to submit a no objection certificate from his/her employer for this course.

5. PROGRAMMES CONTENT & DURATION

(a) A Master's Degree programme shall comprise of a number of courses and/or other components as specified in the Teaching & Examination Scheme of the concerned programme duly approved by the Academic Council.

(b) The minimum period required for completion of a programme shall be the programme duration as specified in the Teaching & Examination Scheme for the concerned programme.

(c) The maximum permissible period for completing a programme for which the prescribed programme duration is n semesters, shall be (n+2) semesters. All the programme

requirements shall have to be completed in (n+2) semesters. Under very special circumstances the duration of the total period may further be extended by a maximum of two (2) semesters with the approval of the Vice Chancellor. This excludes the period of expulsion or suspension by the University / medical leave.

(d) (i) A student may be allowed to "audit" a course(s) not included in the Teaching & Examination Scheme, or one of the elective course(s) in the Teaching & Examination Scheme, which the student is not opting for as a credit course.

(ii) The University may ask a student to audit one or more courses as pre-requisite courses so as to make up any deficiency at the entry level.

(iii) Such audited course(s) shall be shown in the final mark-sheet under a distinct head of "Audited Course(s)" provided the attendance requirement of the course is duly certified to have been met by the concerned teacher(s).
However, a student shall neither be entitled to any credits for such course(s), nor these shall be considered for the purpose of declaration of results.

(e) Except for the first semester, registration for the next semester will be done during the first week of the next semester.

(f) From the second semester onwards, all students have to enroll on a specified day at the beginning of a semester. A student is eligible for enrolment if he has paid all the dues for the semester.

6.(a) MINIMUM REQUIREMENT TO CONTINUE IN THE PROGRAM

(i) The M. Tech. Program has a total of 84 credits and students are required to complete all courses. On completion of all courses, the students shall earn 84 credits and would be eligible for award of the M.Tech. Degree.

(ii) A student should have a minimum CGPA of 5.0 calculated for the courses successfully completed at the end of each semester. If CGPA continues to be less than 5.0, then his/her name will be struck off.

6.(b) SEMESTER DURATION

(i) An academic year shall be of two semesters, each of about 20 weeks duration. There shall be a break of 3 to 5 weeks after autumn semester and 6 to 10 weeks after the spring semester.

The Academic Calendar shall be notified by the University each year before the start of the Academic Session.

(ii) The academic break-up of the semesters shall be as follows:

Theory and Practical Classes (including Mid-Sem. tests) 16 – 18 Weeks

Semester-end Examination, including Practical / - 02 - 04 Weeks
Laboratory Examination

7. Examination:

7.1 The performance of a student in a semester shall be evaluated through continuous evaluation and end semester examination. The continuous evaluation shall be based on Mid Term Examination, assignments/tutorials, quizzes/viva-voce and attendance. The marks for continuous evaluation (Sessional marks) shall be awarded at the end of the semester. The end semester examination shall be comprised of written papers, practicals and viva-voce, inspection of certified course work in classes and laboratories, project work, design reports or by means of any combination of these methods.

7.2 The distribution of marks for Sessional, end semester theory papers, practicals and other examinations, seminar, project, industrial training shall be as prescribed.

7.3 The marks obtained in a subject shall consist of marks allotted in end semester theory paper, practical examination and sessional work.

7.4 The minimum pass marks in each theory subject (including sessional marks) shall be 50% with a minimum of 40% marks in each theory paper in the end semester examination. If there is no provision of sessional marks in any subject, the minimum pass marks in that subject shall be 50% in the end semester examination.

7.5 The minimum pass marks in a project/practical subject (including Sessional marks if any) shall be 50%.

7.6 A candidate, in order to pass, must secure 50% marks in the aggregate in a particular academic year inclusive of both semesters of the academic year subjected to conditions as bye laws.

7 (a) Carryover System:

A candidate satisfying university clause shall be required to exercise his/her choice upto a maximum of four theory papers in year which he/she desires to appear in the examination to fulfill the requirements of clause . He/she shall inform the college about his/her choice within 15 days after the start of new session.

The highest marks secured in any subject in various attempts (end semester and carryover examinations) shall be considered.

7.(b) Ex-studentship:

A candidate opting for ex-studentship shall be required to appear in all the theory & practical subjects in the end semester examinations of both semesters of the same academic year. However, the marks pertaining to Seasonal, Industrial Training, and Seminar shall remain the same as those secured earlier.

A candidate opting for ex-studentship shall be required to apply to the FET by paying only examination fee within 15 days from the start of new session.

7(c) Re-admission:

- A Candidate may be allowed for re-admission provided he/she satisfies one of the following conditions:
- A candidate is declared fail.
- A candidate did not appear in a semester examination / or he/she was not granted permission to appear in the examination.
- A candidate has been detained by the department and subsequently has been permitted to take re-admission.
- A candidate as an ex-student passed the examination of the academic year or qualified for carryover system.
- A candidate promoted with carry over subjects and he/she opted for re- admission.

8. ATTENDANCE

All students are normally expected to have attendance of 100% in each subject (Lectures, Tutorials and Practical's). The attendance can be condoned upto 25% for genuine reasons. The Director of the concerned Institute/ Programme Coordinator may give further relaxation up to 10% on account of illness and other pre-approved occasions. Vice Chancellor may further condone attendance shortage up to 5% on genuine grounds. However, under no circumstances, a student with an attendance of less than 60% in a subject shall be allowed to appear in the semester-end examination of that subject. Provided that the late admitted students in the first semester of any course maintain at least 80% attendance (including medical and other reasons) from the date of their admission.

Director/Dean of the Institute / Programme Coordinator shall announce the names of all such students who are not eligible to appear in the subject(s) of semester-end examination, at least one week before the start of the semester-end examination and simultaneously intimate the same to the Controller of Examinations.

In case any student appears in the Examinations by default, who in fact has been detained by the Institute, his/ her result shall be treated as null and void.

9. Assessment Criteria (M.Tech.)

All courses of M.Tech. shall be evaluated for 150 marks, of which 50 marks shall be for Internal Assessment and 100 for Comprehensive sem End Examination. Internal Assessment for 50 marks shall be as per the criteria given below:

Criteria	**Marks**
Class Test I	15
Class Test II	15
Assignments, class participation and discussion	10
Attendance	10
Total Internal Assessment	**50**

Marks for Practical Assessment shall be awarded as per the criteria given below:

Criteria	**Marks**
Attendance	5
File Record	5
Practical Perform/Execution	5
Viva-Voce	5
Total Practical Assessment	**20**

All students should have a minimum of 75% attendance in all subjects, in order to appear in term end examination / viva voce. The 75% criterion includes all leaves of absence – whether approved or not approved.

Students failing to obtain 75% attendance shall be required to repeat the course in the subsequent year, along with the next batch, to make up for the shortage of attendance.

Under extraordinary circumstances, a student with attendance below 75% shall be allowed to appear in the term end exams / viva voce. This will be at the discretion of the Vice Chancellor of the University. Circumstances when such leniency shall be shown include:

a. Death of a blood relative – father, mother, grandfather, grandmother, brother or sister.
b. Extreme cases of health adversity requiring hospitalization of the student.

In such cases, the student shall be required to give a written application to the Vice Chancellor of the University, along with appropriate proof. In case of death of blood relative, an application from the parent(s) shall be considered.

All faculty members shall maintain appropriate records and make them available to the University's Examination Centre at the end of the semester.

Credits

The M. Tech. Program has a total of 80 credits and students are required to complete all courses. On completion of all courses, the students shall earn 80 credits and would be eligible for award of the M.Tech. Degree.

Final Year Dissertation-I Work (M. Tech 3rd Semester)

During the 3rd semester, each student shall undertake a pre thesis work to be pursued by him/ her under the supervision of a guide/ supervisor. The guide/ supervisor shall be appointed by the Dean, Faculty of Engineering & Technology. Minimum four copies of Project Report along with one soft copy on a CD shall be submitted at least two weeks prior to the commencement of the Term End Examination of the 3rd Semester. The Dissertation-I Work shall carry 250 marks and shall be evaluated by a Board of Internal and External Examiners, appointed by the Dean. The Dissertation-I Work shall be evaluated in the following manner:

Criteria	Internal	External	Total
Pre-Thesis Report	80	100	180
Viva Voce	20	50	70
Total	100	150	**250**

Note: to move into fourth semester, the candidate will have to opt minimum E Grade in Dissertation-I.

Final Year Dissertation-II Work (M.Tech. 4th Semester)

During the fourth semester, each student shall undertake a Thesis work to be pursued by him/ her under the supervision of a guide/ supervisor. The guide/ supervisor shall be appointed by the Dean, Faculty of Engineering & Technology. Minimum four copies of Project Report along with one soft copy on CD shall be submitted at least two weeks prior to the commencement of the Term End Examination of the 4th Semester. The Dissertation-II Work

shall carry 500 marks and shall be evaluated by a Board of Internal and External Examiners, appointed by the Dean/ VC. The Board shall be consisting of two Internal Faculty Members. The Dissertation-II work shall be evaluated in the following manner:

Criteria	Internal	External	Total
Thesis Report	150	200	350
Viva Voce	50	100	150
Total	200	300	**500**

Note: for getting degree, the candidate will have to opt minimum E grade in Dissertation-II.

Guide Lines for Dissertation Work:

Student will follow any one of given below to complete M.Tech. Dissertation Work:

1. Candidate should present/ publish at least two papers in International Conferences.
2. Candidate should publish at least one paper in International Journals.
3. Candidate should publish at least one paper in National Journals & at least one paper present/ publish in International/ National Conferences.

Note: Dissertation Work Report should be documented in University Format & Norms.

Calculation of Grade Point and Grade Point Average

Relative grading shall be adopted at the Faculty of Engineering & Technology, Rama University. The list of alphabet grades, the grade points associated with them are given below:

Grade	Grade Point
A^+	**10**
A	**9**
B	**8**
C	**7**
D	**6**
E	**5**
F	**4**

In order to arrive at these alphabet grades, the total marks in a particular course for all the students pursuing the course are tabulated in the descending order (equivalently a histogram). The performance of the course is analyzed in terms of the highest, lowest and the average

marks and the dividing lines between the clusters of students.

Gaps and dips between the clusters and the nature of the clusters guide in drawing the dividing lines between the grades. In a normal class of large size, the C grade usually covers the average performance. This is, however not a hard and fast rule and exceptions may arise in case of small classes, skewed histogram etc. Borderline cases may be considered individually on the basis of regularity and the attendance, class room discussions, progressive good performance throughout the semester, etc.

How to Calculate of Semester Grade Point Average:

- Computation of the Semester Grade Point Average (SGPA) and Cumulative Performance Index (CPI):

  The SGPA is an indicator of the overall academic performance of a student in all the courses he/she has registered during a given semester. It is computed as follows: If the grades awarded to a student are G_1, G_2 etc in courses with corresponding credits C_1, C_2 etc, the SGPA is given by:

$$SGPA = \frac{C_1 \times G_1 + C_2 \times G_2 + \cdots + C_n \times G_n}{C_1 + C_2 + \cdots + C_n}$$

- The CPI indicates the overall academic performance of a student in all the courses registered upto and including the latest completed semester/summer term. It is computed in the same manner as the SGPA, considering all the courses (say, n) and is given by:

$$CPI = \frac{\sum_{i=1}^{n} C_i \times G_i}{\sum_{i=1}^{n} C_i}$$

- Percentage conversion of CPI :

$$Percentage\ of\ Marks = CPI \times 10$$

- Students should get a minimum grade E in each subject with 5CPI to clear the semester.
- CPI conversion

≥8 CPI	**Ist Division with Honours**
≥6 CPI	**Ist Division**
≥5 CPI	**IInd Division**
<5 CPI	**Fail**

- In case a student gets a F grade in more than one subject, he / she has to repeat one or more of the subjects by registering for "Guided Study" in the semester the courses are offered. Registration for Guided Study shall be made on the payment of Rs. 500 per subject as well as registering for the examination with a payment of Rs. 1000 per subject.

- If the students get F grade in four subjects in an academic session then he/ she will repeat the year.
- M. Tech. Course should be completed within Four Years. If a student does not complete the M. Tech. program in stipulated time, he / she will have to appear freshly in the program.

9 (b). Results:

- The result of a candidate shall be declared on the basis of performance of both semesters of the same academic year. However, a final year student, who is not permitted in any one of the final year semester examinations due to shortage of attendance, will be permitted in that particular semester of the next academic session to study as a regular student and appear at that semester examination.
- Result of the final year shall be declared on the basis of working out Grand Total by adding marks of all the years of study in the following ways:

Award of Division: The division shall be awarded on the basis of final year result.

10. CANCELLATION OF ADMISSION

The admission of a student at any stage of study shall be cancelled if:

(i) He / She are not found qualified as per the eligibility criteria prescribed by the University.

OR

(ii) He / She are involved in ragging.

OR

(iii) He / She are found involved in creating indiscipline in the Institute/Institute or in the University.

11. BOARD OF STUDIES

The constitution of the Board of Studies of each Institute shall be:

(a) The Director/ Dean of the Institute (Chairperson)
(b) Two Professors
(c) Two Associate Professors
(d) Two Assistant Professors
(e) Two External Expert Members

12. ACADEMIC PROGRAMME COMMITTEE

(a) There shall be an Academic Programme Committee in the Institute/ Department/ Constituent Institutions of the University.

(b) All the teachers of a Institute of Study shall constitute the Academic Programme Committee of which the Director of the Institute shall act as its Chairperson. This Committee shall coordinate the implementation of the courses for optimum utilization of resources and shall also take care of the coordination of the Institute's programmes with the other programmes run by the different Institutes of the University.

(c) The Academic Programme Committees shall also perform other tasks as assigned to it by the Board of Studies of the concerned Institute of the University.

(d) The Academic Programme Committee shall meet as and when required but at least once every semester. The Chairperson of the Committee will convene the meetings.

The meeting concluded with a vote of thanks to the chair.

Date of the Next Meeting: to be decided and conveyed later

(Chairperson)

Signature .....

Name : Prof (Dr.) Ajay Kumar

Date :

Internal Members

Signature: 1..... 2.....

Name: Dr. Vivek Srivastava Dr. Samakshi Verma

3.....

Dr. Manoj Kumar Mishra

External Members

Signature: 1.....

Name: Dr. (Prof.) Sanjay Mishra

Date:

Annexure-1

Result anlysis of M. Tech Biotechnolog, Session- 2022-23

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Subject:- Result Analysis Pass Percentage before Declaration of Master of Technology (Biotechnology) First Year (I Semester) (Batch 2022-23) Main Examination Session, 2022-23

The result of the examination cited under subject above is ready for declaration. The subject wise and general pass percentage in respect of the same is given below -

S. No.	Paper Code	Name of the Paper	No. of Student			Pass (%)
			Appeared	Pass	Fail	
1	MTBT-502	ADVANCED MICROBIOLOGY	9	6	3	67
2	MTBT-011	ANALYTICAL TECHNIQUES	9	9	0	100
3	MTBT-501	APPLIED BIOCHEMISTRY& MOLECULAR BIOLOGY	9	9	0	100
4	MTBT-021	ENZYME TECHNOLOGY & INDUSTRIAL APPLICATION	9	9	0	100
5	MTBT-552	ADVANCED MICROBIOLOGY LAB	9	9	0	100
6	MTBT-551	BIOCHEMISTRY & MOLECULAR BIOLOGYLAB	9	9	0	100
7	MTBT-553	SEMINAR I	9	9	0	100

Main Result:

1	No. of Students Appeared	9
2	No. of Students Passed	6
	General/Overall Pass %	66.67

The above subject wise and general pass percentage is submitted of the University which may kindly be perused and submitted to the Vice-chancellor for approval before the results of the above examination is declared.

Amishka Banakshi Sunita

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Subject: Result Analysis Pass Percentage before Declaration of **Master of Technology (Biotechnology)** Second Year **(III Semester)** (Batch 2021-22) Main Examination **Session, 2022-23**

The result of the examination cited under subject above is ready for declaration. The subject wise and general pass percentage in respect of the same is given below:-

S. No.	Paper Code	Name of the Paper	No. of Student			Pass (%)
			Appeared	Pass	Fail	
1	MTBT-701	ADVANCED BIOPROCESS ENGINEERING & TECHNOLOGY	9	9	0	100
2	MTBT-052	DIAGNOSTIC TECHNIQUES IN BIOTECHNOLOGY	9	9	0	100
3	MTBT-753	BIOPROCESS ENGINEERING & TECHNOLOGY LAB	9	8	1	89
4	MTBT-751	DISSERTATION-I	9	9	0	100
5	MTBT-752	PROJECT WORK REVIEW-I	9	9	0	100

Main Results-

1	No. of Students Appeared	9
2	No. of Students Passed	8
	General/Overall Pass %	88.89

The above subject wise and general pass percentage is submitted of the University which may kindly be perused and submitted to the Vice-chancellor for approval before the results of the above examination is declared.

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Subject:- Result Analysis Pass Percentage before Declaration of **Master of Technology (Biotechnology)** First Year **(IInd Semester)** (Batch 2021-22) Main Examination **Session: 2021-22**

The result of the examination cited under subject above is ready for declaration. The subject wise and general pass percentage in respect of the same is given below:-

S. No.	Paper Code	Name of the Paper	No. of Student			Pass (%)
			Appeared	Pass	Fail	
	MTBT-601	BIOINFORMATICS	9	9	0	100
2	MTBT-602	GENETIC ENGINEERING	9	9	0	100
3	MTBT-042	INDUSTRIAL BIOTECHNOLOGICAL PRODUCTS	9	7	2	78
4	MTBT-032	QUALITY CONTROL IN BIOTECHNOLOGY	9	8	1	89
5	MTBT-651	BIOINFORMATICS LAB	9	9	0	100
6	MTBT-652	GENETIC ENGINEERING LAB	9	9	0	100
7	MTBT-653	SEMINAR-II	9	9	0	100

Main Results-

1	No. of Students Appeared	9
2	No. of Students Passed	7
	General/Overall Pass %	77.78

The above subject wise and general pass percentage is submitted of the University which may kindly be perused and submitted to the Vice-Chancellor for approval before the results of the above examination is declared.

RAMA UNIVERSITY UTTAR PRADESH, KANPUR

Subject - Result Analysis Pass Percentage before Declaration of **Master of Technology (Biotechnology)** 2nd Year **(IVth Semester)** (Batch 2020-21) Main Examination **Session. 2021-22**

The result of the examination cited under subject above is ready for declaration. The subject wise and general pass percentage in respect of the same is given below:-

S. No.	Paper Code	Name of the Paper	No. of Student			Pass (%)
			Appeared	Pass	Fail	
1	MTBT-401	PROJECT WORK REVIEW-II	8	8	0	100
2	MTBT 402	DISSERTATION-II	8	8	0	100

Main Result:

1	No. of Stucents Appeared	8
2	No. of Students Passed	8
	General/Overall Pass %	**100.00**

The above subject wise and general pass percentage is submitted of the University which may kindly be perused and submitted to the Vice-chancellor for approval before the results of the above examination is declared

First Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			EVALUATION SCHEME			TOTAL MARKS	CREDITS	CONTACTS HRS/WK
			L	T	P	CA	MTE	ETE			
1.	MBT-101	Applied Biochemistry & Bioenergetics	3	1	0	30	20	100	150	4	4
2.	MBT-102	Microbiology and Virology	3	1	0	30	20	100	150	4	4
3.	MBT-011-013	Departmental Elective - I	3	1	0	30	20	100	150	4	4
4.	MBT-021-023	Departmental Elective - II	3	1	0	30	20	100	150	4	4
PRACTICALS											
5.	MBT-151	Applied Biochemistry & Bioenergetics Lab	0	0	4	-	20	30	50	2	4
6	MBT-152	Microbiology and Virology Lab	0	0	4	-	20	30	50	2	4
7.	MBT-153	Seminar I	0	0	4	-	20	30	50	2	4
		TOTAL	**12**	**4**	**12**	**120**	**140**	**490**	**750**	**22**	**28**

Second Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			EVALUATION SCHEME			TOTAL MARKS	CREDITS	CONTACTS HRS/WK
			L	T	P	CA	MTE	ETE			
1.	MBT-201	Computational Biology	3	1	0	30	20	100	150	4	4
2.	MBT-202	Molecular biology and Recombinant DNA technology	3	1	0	30	20	100	150	4	4
3.	MBT-031-033	Departmental Elective - III	3	1	0	30	20	100	150	4	4
4	MBT-041-043	Departmental Elective - IV	3	1	0	30	20	100	150	4	4
PRACTICALS											
5.	MBT-251	Computational Biology Lab	0	0	4	-	20	30	50	2	4
6.	MBT-252	Molecular biology and Recombinant DNA technology Lab	0	0	4	-	20	30	50	2	4
7.	MBT-253	Seminar II	0	0	4	-	20	30	50	2	4
		TOTAL	**12**	**4**	**12**	**120**	**140**	**490**	**750**	**22**	**28**

Third Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			EVALUATION SCHEME			TOTAL MARKS	CREDITS	CONTACTS HRS/WK
			L	T	P	CA	MTE	ETE			
1.	MBT-301	Bioprocess Engineering & Process Biotechnology	3	1	0	30	20	100	150	4	4
2.	MBT-051-053	Departmental Elective -V	3	1	0	30	20	100	150	4	4
PRACTICALS											
3.	MBT-351	Dissertation I	0	0	16	-	100	150	250	8	16
4.	MBT-352	Project Work Review I	0	0	4	-	20	30	50	2	4
5.	MBT-353	Bioprocess Engineering & Process Biotechnology Lab	0	0	4	-	20	30	50	2	4
		TOTAL	**6**	**2**	**24**	**60**	**180**	**410**	**650**	**20**	32

Fourth Semester

S. NO.	CODE	SUBJECT	TEACHING SCHEME			EVALUATION SCHEME			TOTAL MARKS	CREDITS	CONTACTS HRS/WK
			L	T	P	CA	MTE	ETE			
PRACTICALS											
1.	MBT-451	Project Work Review II	0	0	8	-	50	100	150	4	8
2.	MBT-452	Dissertation II	0	0	20	-	200	300	500	16	20
		TOTAL	**0**	**0**	**28**	**00**	**250**	**400**	**650**	**20**	**28**

Program Core

S. NO.	CODE	SUBJECT	TEACHING SCHEME				EVALUATION SCHEME			TOTAL MARKS	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J	CA	MTE	ETE				
THEORY													
1.	MBT-101	Applied Biochemistry & Bioenergetics	3	1	0	0	30	20	100	150	4	4	
2.	MBT-102	Microbiology and Virology	3	1	0	0	30	20	100	150	4	4	
3.	MBT-201	Computational Biology	3	1	0	0	30	20	100	150	4	4	
4.	MBT-202	Molecular Biology and Recombinant DNA technology	3	1	0	0	30	20	100	150	4	4	
5.	MBT-301	Bioprocess Engineering & Process Biotechnology	3	1	0	0	30	20	100	150	4	4	
PRACTICALS													
6.	MBT-151	Applied Biochemistry & Bioenergetics Lab	0	0	4	0	-	20	30	50	2	4	
7.	MBT-152	Microbiology and Virology Lab	0	0	4	0	-	20	30	50	2	4	
8.	MBT-251	Computational Biology Lab	0	0	4	0	-	20	30	50	2	4	
9.	MBT-252	Molecular Biology and Recombinant DNA technology Lab	0	0	4	0	-	20	30	50	2	4	
10.	MBT-353	Bioprocess Engineering & Process Biotechnology Lab	0	0	4	0	-	20	30	50	2	4	
Total			15	5	20	0	150	200	650	1000	30	40	

Departmental Elective I

S. NO.	CODE	SUBJECT	TEACHING SCHEME				EVALUATION SCHEME			TOTAL MARKS	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J	CA	MTE	ETE				
Bouquet: Elective I													
THEORY													
1.	MBT-011	Bio-Analytical Techniques	3	1	0	0	30	20	100	150	4	4	
2.	MBT-012	Molecular Immunology & Vaccine Technology	3	1	0	0	30	20	100	150	4	4	
3	MBT-013	Bio-Medical technology	3	1	0	0	30	20	100	150	4	4	

Departmental Elective II

S. NO.	CODE	SUBJECT	TEACHING SCHEME				EVALUATION SCHEME			TOTAL MARKS	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J	CA	MTE	ETE				
Bouquet: Elective II													
THEORY													
1.	MBT-021	Enzymology & Industrial Application	3	1	0	0	30	20	100	150	4	4	
2.	MBT-022	Pharmaceutical Biotechnology	3	1	0	0	30	20	100	150	4	4	
3	MBT-023	Animal and Plant Tissue Culture Technology	3	1	0	0	30	20	100	150	4	4	

Departmental Elective III

S. NO.	CODE	SUBJECT	TEACHING SCHEME				EVALUATION SCHEME			TOTAL MARKS	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J	CA	MTE	ETE				
Bouquet: Elective III													
THEORY													
1.	MBT-031	Food Biotechnology	3	1	0	0	30	20	100	150	4	4	
2.	MBT-032	Quality Control in Biotechnology	3	1	0	0	30	20	100	150	4	4	
3.	MBT-033	Agricultural Biotechnology	3	1	0	0	30	20	100	150	4	4	

Departmental Elective IV

S. NO.	CODE	SUBJECT	TEACHING SCHEME				EVALUATION SCHEME			TOTAL MARKS	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J	CA	MTE	ETE				
Bouquet: Elective III													
THEORY													
1.	MBT-041	Biological Waste Water Treatment, Biofuels and Bioenergy	3	1	0	0	30	20	100	150	4	4	
2.	MBT-042	Industrial Biotechnological Products	3	1	0	0	30	20	100	150	4	4	
3.	MBT-043	Nanotechnology for Medical and Healthcare	3	1	0	0	30	20	100	150	4	4	

Departmental Elective V

S. NO.	CODE	SUBJECT	TEACHING SCHEME				EVALUATION SCHEME			TOTAL MARKS	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J	CA	MTE	ETE				
Bouquet: Elective III													
THEORY													
1.	MBT-051	Advanced Fermentation Technology	3	1	0	0	30	20	100	150	4	4	
2.	MBT-052	Molecular Diagnostic Technology	3	1	0	0	30	20	100	150	4	4	
3.	MBT-053	Stem Cell Engineering	3	1	0	0	30	20	100	150	4	4	

Seminar

S. NO.	CODE	SUBJECT	TEACHING SCHEME			EVALUATION SCHEME			TOTAL MARKS	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	CA	MTE	ETE				
PRACTICALS												
1	MBT-153	Seminar I	0	0	4	-	20	30	50	2	4	
2	MBT-253	Seminar II	0	0	4	-	20	30	50	2	4	
TOTAL			**0**	**0**	**8**	**-**	**40**	**60**	**100**	**4**	**8**	

Projects

S. NO.	CODE	SUBJECT	TEACHING SCHEME				EVALUATION SCHEME			TOTAL MARKS	CREDITS	CONTACTS HR/WK	PRE-REQUISITES
			L	T	P	J	CA	MTE	ETE				
PRACTICALS													
1	MBT-351	Dissertation-1	0	0	8	0	-	100	150	250	8	16	
2	MBT-352	Project Work Review I	0	0	4	0	-	20	30	50	2	4	
3	MBT-451	Project Work Review II	0	0	8	0	-	50	100	150	4	8	
4	MBT-452	Dissertation-II	0	0	16	0	-	200	300	500	16	20	
TOTAL			**0**	**0**	**36**	**0**	**-**	**370**	**580**	**950**	**22**	**48**	

COURSE STRUCTURE

M. Tech.

BIOTECHNOLOGY

Under

Choice Based Credit System (CBCS)

2023-24

MBT-101 APPLIED BIOCHEMISTRY & BIOENERGETICS L: T: P

3: 1: 0

Objective:

The course provides insights about Basic knowledge of Bio molecules, their metabolism and Molecular Biology

UNIT I

Structures and functions of Bio-molecules: Carbohydrates: classification, mono, di, oligo and polysaccharides. Lipids: fatty acids, simple, complex & derived lipids.

UNIT II

Protein: Amino Acids Structure and function, Protein Structure Hierarchy. Nucleic acids: nucleosides, nucleotides, DNA & RNA.

UNIT III

Bioenergetics: Overview of principles of bioenergetics (free energy, enthalpy and entropy). Energy relationships between catabolic and anabolic pathways. Phosphoryl group transfers and ATP, Free-energy change for ATP hydrolysis.

UNIT IV

Metabolism: Glycolysis, Gluconeogenesis, Respiration and Introduction to the Citric Acid Cycle, Electron Transport, Oxidative phosphorylation,

UNIT V

Fatty Acid Catabolism: Fatty acid oxidation, Protein Metabolism: The Urea Cycle.

Text / Reference Books:

1. Biochemistry- L.Stryer , Third Edition
2. Biochemistry- Voet & Voet.
3, Principles of Biochemistry- A.Lehninger , CBS Publishers and Distributors , 1987.
4. Benjamin Lewin. Gene XII. Oxford University Press, Nelson Cox

Outcome: At the end of the course the student understands

CO1: Fundamentals of Biochemistry and Bioenergetics

CO2: Fundamentals of Bio molecules

CO3: Metabolism of Bio molecules

CO4: To understand the fatty Acid Metabolism

CO5: Strategies for Metabolic Control

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	2	1	2	3	1	2	3
CO2	3	1	2	3	1	3	3	2
CO3	2	3	3	2	3	3	2	1
CO4	3	1	3	1	1	3	3	3
CO5	1	3	2	1	3	1	1	2

MBT-102 MICROBIOLOGY AND VIROLOGY

L: T: P

3: 1: 0

Objective: To understand basic as well as advanced aspects of microbiology like Epidemiology and infectious diseases.

UNIT I

Introduction to microbiology - History, evolution and development. Diversity of microorganisms – scope and importance. Ultra structure of microorganisms, Microscopy - Principles and applications of light, phase, fluorescent and electron microscopy, confocal microscopy. Different methods of staining. Sterilization - physical, chemical and radiation methods.

UNIT II

Culture dependent techniques - concept of pure culture, enrichment culture techniques, single cell isolation. Preservation methods and maintenance of microbial cultures, Characterization and Identification of bacteria based on morphology, physiology, biochemistry, ecology, Culture independent techniques - metagenomics.

UNIT III

Microbial nutrition, nutritional types, types of nutrient media, microbial growth - principles, kinetics and methods. Synchronous, batch and continuous cultures. Bacterial reproduction and growth. Quantitative measurement of growth, factors affecting growth. Cultivation of aerobes and anaerobes. Toxic effects of oxygen.

UNIT IV

Bacterial recombination - Transformation, conjugation and transduction. Mapping of procaryotic genome. Transposons, Insertion sequences, and mechanism of transposition, retrotransposons and Plasmids

UNIT V

Viruses: ICTV, Baltimore classification, bacteriophages (Lytic And Lysogenic cycles) Isolation, Cultivation and purification of viruses, Transmission of viruses, Prions, Clinically important viruses HIV, Hepatitis, Influenza.

Text / Reference Books:

1. Microbiology by M. J. Pelczer, E. C. S. Chan, N. R. Kries. Tata McGrew Hill publications
2. Microbiology fundamentals and applications by S. S. Purohit. Agro botanical. Publications.
3. Microbiology by Prescott, Harley, Klein. Mc Graw-Hill publications

Outcome: At the end of the course the student understands

CO1: Understand the basic microbial structure and function of prokaryotes and eukaryotes cells and also understand the structural similarities and differences among various physiological groups of bacteria/archaea.

CO2: Know various culture media and their applications

CO3: Know general microbial techniques for isolation and identification of pure cultures of bacteria, fungi and algae.

CO4: Be able to perform routine culture handling tasks safely and effectively.

CO5: Understand the microbial metabolism and different modes of energy generation in microbes

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	3	3	3	3	3
CO2	1	2	3	3	3	1	2	
CO3	3	3	2	3	3	3	2	1
CO4	1	1	2	1	1			
CO5	3	3	3	3	3	3	3	2

Departmental Elective I

MBT-011 BIO-ANALYTICAL TECHNIQUES **L: T: P**

3: 1: 0

Objective: The objective of this course is to provide the Students with the understanding of various analytical techniques used in biotechnology based research and industry. The course will acquaint the Students with the various instruments, their configuration and principle of working, operating procedures, data generation and its analysis.

UNIT I

Microscopy: Principles of microscopy, Light, dark field, fluorescent, UV, transmission and Scanning electron microscopy, Confocal microscopy, microtomy and analysis and measurement of images

UNIT II

Introduction to chromatographic techniques: Theoretical basis of chromatographic separations. Column, thin layer, Paper, Normal phase and reverse phase chromatography, Ion-exchange, Affinity and Gas Chromatography, High performance liquid chromatography (HPLC)

UNIT III

Theory and application of polyacrylamide and agarose gel electrophoresis, electrophoresis of protein and nucleic acids, Capillary electrophoresis

UNIT IV

Centrifugation techniques: Introduction, Basic principle of sedimentation, Centrifuges and their uses, safety aspects in the use of centrifuges. Density gradient and analytical centrifugation.

UNIT V

Spectroscopic techniques: Theory and application of UV-VIS, IR, NMR, Fluorescence, Atomic absorption spectroscopy; X-ray diffraction. Introduction to mass spectroscopy. Radioisotopic techniques: Introduction to radioisotopes, detection, measurement and uses of radioisotopes, counting efficiency and autoradiography, biotechnological applications.

Text / Reference Books:

1. Freifelder D., Physical Biochemistry, Application to Biochemistry and Molecular Biology, 2nd Edition, W.H. Freeman & Company, San Fransisco, 1982.

2. Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press, 2000.

3. D. Holme & H. Peck, Analytical Biochemistry, 3rd Edition, Longman, 1998.

4. R. Scopes, Protein Purification - Principles & Practices, 3rd Edition, Springer Verlag, 1994.

Course Outcome: Students will be able to

CO1: apply basic principles of different analytical techniques in analytical work.

CO2: use microscopy, centrifugation and electrophoretic techniques.

CO3: demonstrate principle and working of various instruments

CO4: use various techniques for solving industrial and research problems.

CO5: Students may not have experience using lab equipment such as micropipettes, balance and centrifuges.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	3	3	3	3	
CO2	3	3	2	3	3	2	2	1
CO3	3	2	3	3	3	2	2	1
CO4	3	2	3	3	3	2	2	
CO5	3	3	3	3	3	3	3	

MBT-012 MOLECULAR IMMUNOLOGY & VACCINE TECHNOLOGY

L: T: P

3: 1: 0

Objective: The primary objective of this course is to describe the roles of the immune system in both maintaining health and contributing to disease.

UNIT I

Fundamental concepts and anatomy of the immune system, Components of innate and acquired immunity, Humoral and Cell mediated immunity, Haematopoesis, Antigens , immunogens, haptens, Major Histocompatibility Complex - MHC genes, MHC and immune responsiveness and disease susceptibility, HLA typing.

UNIT II

Immunoglobulins-basic structure, classes and subclasses of immunoglobulins, antigenic determinants, Multigene organization of immunoglobulin genes, Immunological basis of self – non-self discrimination; Kinetics of immune response, memory; B cell maturation, activation and differentiation; Generation of antibody diversity, Antigen processing and presentation- endogenous antigens and exogenous antigens.

UNIT III

A short history of vaccination, Active and passive immunization, General immunization practices, Vaccination of immune compromised hosts, Vaccination of human immunodeficiency virus- infected persons, Vaccines, Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines.

UNIT IV

Licensed vaccines, Viral Vaccine (Poliovirus vaccine-inactivated & Live, Rabies vaccines Hepatitis A & B vaccines), Bacterial Vaccine (Anthrax vaccines, Cholera vaccines, Diphtheria toxoid), Parasitic vaccine (Malaria Vaccine).

UNIT V

The vaccine industry, Vaccine manufacturing, Evolution of adjuvants across the centuries, Vaccine additives and manufacturing residuals, Regulation and testing of vaccines, Regulation of vaccines in developing countries, Vaccine safety and Legal issues.

Text / Reference Books:

1. Immunology and immunotechnology by Ashim K. Chakravarty (Oxford university Press)
2. Immunology by C.Fatima
3. Immunology by Kuby (Freeman publication)
4. Essentials of immunology by Roitt (Blackwell scientific publication)
5. Immunology by Benacera

Course Outcome: Students will be able to

CO1: Able to identify the cellular and molecular basis of immune responsiveness.

CO2: Able to describe the roles of the immune system in both maintaining health and contributing to disease.

CO3: Able to describe immunological response and how it is triggered and regulated.

CO4 Able to understand the importance of immunology as a foundation of transfusion medicine theory and practice.

CO5: Describe immunological response and how it is triggered and regulated.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	3	3	3	1	
CO2	3	3	3	3	3	2	1	
CO3	3	2	3	3	3	2		
CO4	3	3	3	3	3	3		
CO5	3	3	3	3	3	1	1	

MBT-013 BIO-MEDICAL TECHNOLOGY L: T: P

3: 1: 0

Objective: The objective of the course is to familiarize the students with the basic concepts of medical terms utilized in biotechnology.

UNIT I

Therapeutic Aspects of Bio-macromolecules: Introduction, Endogenous peptides and proteins, Modification of endogenous peptides and proteins. Immune System: Overview, Antibody-mediated response, Vaccines, Cell-mediated immune response, Cancer immunotherapy.

UNIT II

Oligonucleotides: Overview, Gene therapy, Antisense therapy, Ribozymes. Oligosaccharides: Overview, Oligosaccharide synthesis, Heparin, Glycoproteins, Polysaccharide bacterial vaccines, Approaches to carbohydrate-based cancer vaccines.

UNIT III

Radiological Agents: Radiosensitizers and Radioprotective agents. Cardiovascular Drugs: Myocardial infarction agents, Endogenous vasoactive peptides, Hematopoietic agents, Anticoagulants, anthrombotics and hemostatics.

UNIT IV

Chemotherapeutic Agents: Synthetic antibacterial agents, Lactam antibiotics, Anthelminitic agents, Anthelmintic agents, Antiamebic agents, Antiviral agents.Endocrine Drugs: Female sex hormones and analogs, Agents affecting the immune Response.

UNIT V

Drug Targeting Organ-Specific Strategies: Basic concepts and novel advances, Brain-specific drug targeting strategies, Pulmonary drug delivery, Cell specific drug delivery.

Text / Reference Books:

1. Pharmaceutical Chemistry by Christine M. Bladon. John Wiley & Sons, Ltd. (2002).
2. Burger's Medicinal Chemistry and Drug Discovery (5th edition) by Manfred E. Wolff. A Wiley & Sons, Inc. (2000).
3. Drug Targeting Organ-Specific Strategies by Grietje Molema and Dirk K. F. Meijer. Wiley-VCH. (2002).

Course Outcome: Students will be able to

CO1: Introducing the principle and concepts in medical biotechnology

CO2: Updating the role of biomolecules in healthcare

CO3: Studying the advanced developments in medical biotechnology

CO4 Discussing the various therapeutic method for cancer.

CO5: Therapeutic Aspects of Bio-macromolecules, Endogenous peptides and proteins

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	3	3	3	3	3	1	2
CO2	3	3	2	1	3	2	1	
CO3	2	2	2	3	1	2	2	2
CO4	3	3	3	1	1	3		
CO5	3	3	3	3	3	1	1	

Departmental Elective III

MBT-021 ENZYMOLOGY & INDUSTRIAL APPLICATION **L: T: P**

3: 1: 0

Objective: The primary objective of this course is to describe the roles of the enzyme.

UNIT I

Introductions: Enzymes- Michaelis-Menten kinetics. Kinetics and Statistics Inhibition- Effect of pH and temperature- Enzymology- Immobilized enzymes: Methods, Mass transfer considerations and Industrial enzymes.

UNIT II

Introduction to metabolism- Nutrient transport- Glycolysis - TCA cycle and other pathways - Control of metabolism. Factors affecting microbial growth - Stoichiometry- mass balances and energy balances. Growth kinetics, Measurement of growth.

UNIT III

Introduction to bioreactors - Batch and Fed-batch bioreactors, Continuous bioreactors, Immobilized cells.Bioreactor operation, Sterilization, Aeration, Sensors. Instrumentation, Culture- specific design aspects: plant/mammalian cell culture reactors.

UNIT IV

Biomass removal - Biomass disruption – Membrane based techniques. Extraction -solvent, aqueous two phases, super critical, and Adsorption. Chromatography, Precipitation (Ammonium Sulfate, solvent), Electrophoresis (capillary), Crystallization, Drying and Freeze drying

UNIT V

White Biotechnology: Few industrial process using enzymes for production of drugs and fine chemicals, Enzyme based biosensors, Enzyme in organic catalysis, Molecular Imprinting. Enzyme engineering, selection of chiral molecules and their enzymatic separation, functional expression of enzymes protein engineering by modification of protein folding invitro and invivo, Case study

Text / Reference Books:

1. Nelson, D.L. and Cox, M.M., Lehninger: Principles of Biochemistry, 6thed., W.H. Freeman and Company, New York,2013
2. Donald, V. and Judith G.V., Biochemistry , 4th ed., John Wiley & Sons Asia Pvt. Ltd. , New Jersey , 2011
3. Nicholas C.P. and Lewis S., Fundamentals of Enzymology 3rd ed., Oxford University Press Inc. New York,1999

Course Outcome: Students will be able to

CO1: Able to identify differences between enzymes and normal catalytic substances

CO2: Able to describe cofactor and coenzymes chemical structure

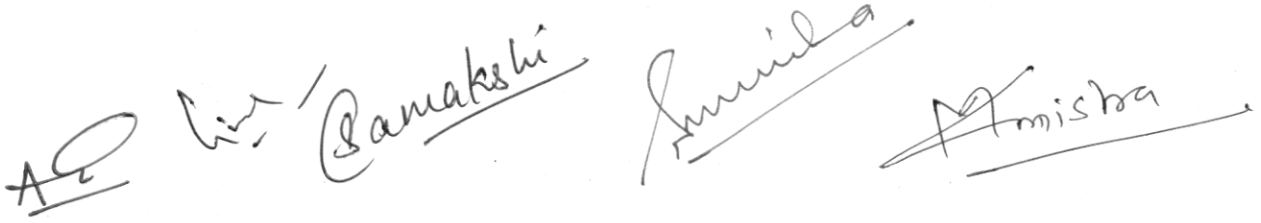
CO3: Able to describe Important coenzymes and the groups they transfer

CO4 Able to understand factors that effects enzyme activity

CO5: Understand enzyme science and technology and foster the abilities to apply the acquired knowledge of enzyme

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	3	3	3	3	3
CO2	1	2	3	3	3	1	2	
CO3	3	3	2	3	3	3	2	1
CO4	1	1	2	1	1			
CO5	3	3	3	3	3	3	3	2



MBT-022 PHARMACEUTICAL BIOTECHNOLOGY

L: T: P

3: 1: 0

Objective: The course will give knowledge about new drug development and approval process, ADMET of drugs.

UNIT I

Introduction to drugs and pharmacy: An overview and history of pharmaceutical industry. The business and the future of Biopharmaceuticals. Drug regulation and control. Scope and applications of biotechnology in pharmacy.

UNIT II

New drug development and approval process: Strategies for new drug discovery, finding a lead compound, combinatorial approaches to new drug discovery, pre-clinical and clinical trials..

UNIT III

Drug pharmacokinetics & pharmacodynamics: Routes of drug administration, membrane transport of drugs, absorption, distribution, metabolism and excretion of drugs. Factors modifying drug action, mechanism of drug action on human beings, receptor theory of drug action, pharmacogenomics, adverse effects of drugs and toxicology, Drug interactions.

UNIT IV

Pharmaceutical manufacturing: Drug dosage forms and their classification. Sterile dosage forms- parenteral and biologics, novel dosage forms and targeted drug delivery systems. Current good manufacturing practices and issues. Packaging material and techniques. Quality control of pharmaceutical products as per pharmacopoeia. Microbial assays of vitamins and antibiotics. Stability studies, Method validation.

UNIT V

Biotechnology derived pharmaceuticals. Production of pharmaceuticals by genetically engineered cells- hormones and vaccines. Regulatory issues in pharmaceutical products.

Text / Reference Books:

1. Allen, L.V., Popovich, N.G. and Ansel, H.C., Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, Lippincott Williams and Wilkins (2005).
2.Walsh, G., Biopharmaceuticals: Biochemistry and Biotechnology, Wiley (1998).
3. Tripathi, K.D., Essentials of Medical Pharmacology, Jaypee Brothers Medical Publishers (2008).

Course Outcome: Students will be able to

CO1: Explain the strategies and various steps of new drug discovery process.

CO2: Explain the concept of pharmacodynamics and pharmacokinetics

CO3: Apply the knowledge of pharmaceutical manufacturing in the production of biopharmaceuticals like antibiotics, vaccines, proteins and hormones

CO4: Carry out the quality control procedures in the production of various biopharmaceuticals

CO5: Explain the regulatory aspects in the development of pharmaceuticals.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	3	3	3	1	
CO2	3	3	3	3	3	3	1	
CO3	3	3	3	3	3	3	1	
CO4	3	3	3	3	3	3	1	
CO5	3	3	3	3	3	3	3	

MBT-023 ANIMAL AND PLANT TISSUE CULTURE TECHNOLOGY

L: T: P
3: 1: 0

Objective: The objective of the course is to make students familiar with the fundamental aspects tissue culture, Application of tissue culture for the society.

UNIT I

Basic cell culture techniques, Types of cell culture media; Ingredients of media; Physiochemical properties; CO2 and bicarbonates; Buffering; Oxygen; Osmolarity; Temperature; Surface tension and foaming; Balance salt solutions; Antibiotics growth supplements;

UNIT II

Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver and kidney culture; Secondary culture; Trypsinization; Cell separation; Continuous cell lines; Suspension culture; Organ culture etc.; Behavior of cells in culture conditions: division, growth pattern, metabolism of estimation of cell number; Development of cell lines;

UNIT III

Cell cloning and selection; Transfection and transformation of cells; Commercial scale production of animal cells, stem cells and their application; Application of animal cell culture for in vitro testing of drugs; Testing of toxicity of environmental pollutants in cell culture; Application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

UNIT IV

Fundamentals of plant tissue culture, plant regeneration: organogenesis. Somatic embryogenesis; somaclonal variation, its genetic basis and application in crop improvement. Cell/callus line selection for resistance to herbicide, stress and diseases.: Isolation, culture and plant regeneration, protoplast fusion, identification and characterization of somatic hybrids., Field techniques for propagation of regenerated plants.

UNIT V

Explant selection, sterilization and inoculation; Various media preparations; MS, B5, SH PC L- 2; Callus and cell suspension culture; Induction and growth parameters; Chromosomal variability in callus culture. Plant regeneration from embryo, meristem and callus culture. Androgenesis: Anther and pollen culture; Isolation and culture of protoplasts.

Text / Reference Books:

1. B. Hafez and E.S.E Hafez, Reproduction in farm animals, 7th Edition, Wiley Blackwell, 2000
2. G.E. Seidel, Jr. and S.M. Seidel, Training manual for embryo transfer in cattle (FAO Animal Production and Health Paper-77), 1st Edition, W.D. Hoard and sons FAO, 1991
3. Louis-Marie Houdebine, Transgenic Animals: Generation and Use 5th Edition, CRC Press, 1997.

Course Outcome: Students will be able to

CO1: Explain the basics of the physiological and molecular processes that occur during tissue culture and development and during environmental adaptations.
CO2: Understand how biotechnology has been used to develop knowledge of complex processes that occur in the tissue culture
CO3: Use basic biotechnological techniques to explore molecular biology of plants and animal cells
CO4: Understand the processes involved in the planning, conduct and execution of tissue culture experiments.
CO5: Explain how biotechnology is used for tissue culture and discuss the ethical implications of that use

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	2	2	3
CO3	3	2	3	3	3	2	2	3
CO4	3	2	3	3	3	2	2	3
CO5	3	3	3	3	3	3	3	3

MBT-151 APPLIED BIOCHEMISTRY & BIOENERGETICS LAB

L: T: P

0: 0: 4

1. Quantitative estimation of amino acids by ninhydrin reaction.
2. Quantitative estimation of proteins.
3. To separate lipids with the help of thin layer chromatography (TLC).
4. To verify the Lambert Beer's law with the help of UV absorption spectra of proteins.
5. Protein purification by ammonium sulfate precipitation.
6. Isolation of DNA and RNA from animal tissue and plant tissue.
7. Gel electrophoretic analysis of various DNA and their restriction digests
8. Transformation with plasmid and bacteriophage DNA
9. Restriction mapping of plasmid DNA
10. Blotting: northern blotting, southern blotting
11. PCR technique

MBT-152 MICROBIOLOGY AND VIROLOGY LAB

L: T: P
0: 0: 4

1. Techniques in microbiology; sterilization methods, isolation of pure culture, cultivation of aerobic and anaerobic bacteria, preservation and maintenance of pure culture

2. Staining techniques in bacteria; simple staining, Gram's staining, capsule staining, endospore staining,

3. Hanging drops techniques for demonstrating bacterial motility

4. Fungal isolation and identification

5. Identification of product of metabolic pathways in isolated bacterial culture; cellulose, catalase, peroxidase test, gelatin and starch hydrolysis.

6. Structure and morphological features of yeast, molds, bacteria, protozoa, actinomycetes, fungi.

7. Study of microbial growth kinetics.

8. Study of diauxic growth curve.

MBT-201 COMPUTATIONAL BIOLOGY

L: T: P

3: 1: 0

Objective: The first aim of bioinformatics is to store the biological data organized in form of a database. These allow the researchers an easy access to existing information and submit new entries. These data must be annoted to give a suitable meaning or to assign its functional characteristics. The databases must also be able to correlate between different hierarchies of information

UNIT I

Introduction to Bioinformatics, Need for informatics tools and exercises, Bioinformatics resources: NCBI, EBI, ExPASy, RCSB. Significance of databases towards informatics projects. Primary and Secondary Databases. GenBank, DDBJ, EMBL, PIR, Uniprot-KB, SWISS-PROT, TrEMBL. Specialized databases: Pubmed, OMIM, Medical databases, KEGG, EST databases; Genome databases at NCBI, EBI, TIGR, SANGER. Overview of other popular tools for various bioinformatics exercises.

UNIT II

Introduction, The evolutionary basis of sequence alignment, the Modular Nature of proteins, Optional Alignment Methods, Substitution scores, substitution matrices, PAM, BLOSUM, Gap penalties, Statistical significance of Alignments, Pair wise sequence alignment algorithms, Practical Aspect of Multiple Sequence Alignment, Progressive and Iterative Alignment Methods, CLUSTALW, Database similarity searching, FASTA, BLAST, Low-Complexity Regions. PSI- BLAST, PHI-BLAST.

UNIT III

Introduction to Phylogenetic analysis, rooted and unrooted trees, Elements of phylogenetic Models, Phylogenetic Data Analysis: Alignment, Substitution Model Building, Tree Building, and Tree Evaluation, Tree - Building Methods-Distance based and character based methods, Evaluating Trees and Data- Boot strapping (parametric and non parametric), Phylogenetic softwares (CLUSTALW, PHYLIP etc), Conceptual numerical.

UNIT IV

Restriction mapping, Utilities, DNA strider, MacVector and OMIGA, gene construction KIT, Vector NTI, Web based tools (MAP, REBASE); Primer design – need for tools, Primer design programs and software (PRIME3).

UNIT V

Sequencing methods, Bioinformatics tools and automation in Genome Sequencing, analysis of raw genome sequence data, Utility of EST database in sequencing, Bioinformatics in detection of Polymorphisms, SNPs and their relevance, Bioinformatics tools in microarray data analysis. Tools for comparative genomics: BLAST2, AVID, Vista, MUMmer, COG, VOG. Usages of visualization software available in public domain like VMD, Rasmol, Pymol, SpdbViewer, Chime, Cn3D and GRASP. Rotameric Structures of Proteins (Conformational Flexibility), Canonical DNA Forms (DNA Sequence Effects).

Text / Reference Books:

1. Bioinformatics (Sequence and Genome Analysis)- David W. Mount, Cold Spring Harbor Laboratory Press, 2001.
2.Bioinformatics- Zoe Lacroix, Terence Critchlow, Morgan Kaufmann Publishersm, 2004.
3. Bioinformatics – From Genomics to Drugs, Violume 1; Basic Technoliges, Thomas Lengauer, Wiley-VCH, 2001.

Course Outcome: Students will be able to

CO1: Knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics.

CO2: .Problem-solving skills, including the ability to develop new algorithms and analysis methods

CO3: an understanding of the intersection of life and information sciences

CO4: the core of shared concepts, language and skills the ability to speak the language of structure-function relationships

CO5: an understanding of the intersection of life and information sciences, , information theory, gene expression, and database queries.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	2	2	1
CO3	3	3	3	3	3	2	2	
CO4	3	3	3	3	3	2	2	1
CO5	3	3	3	3	3	3	3	2

MBT-202 MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY

L: T: P

3: 1: 0

Objective: In this course students will learn to apply their understanding of DNA to manipulate specific genes to produce desired traits in plants, animals and other organisms to express specific traits

UNIT I

DNA & RNA as a genetic material, packaging of DNA, DNA replication- Prokaryotic and eukaryotic DNA replication, Mechanism of replication. Telomeres, telomerase and end replication. Role of telomerase in aging and cancer. RNA, different types of RNA, Transcription, genetic code, reverse transcription, mRNA processing. Translation, Gene regulation, operons: Lac operon, Trp operon, transposons.

UNIT II

Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, Phagemids; Lambda vectors, Insertion and Replacement vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors; Expression vectors; Inclusion bodies; Methodologies to reduce formation of inclusion bodies; Baculovirus and pichia vectors system, Plant based vectors, Ti and Ri as vectors, Yeast vectors, Shuttle vectors.

UNIT III

Insertion of Foreign DNA into Host Cells; Transformation; Isolation of mRNA and total RNA; cDNA and genomic libraries and its construction; cDNA and genomic cloning; Expression cloning; Jumping and hopping libraries; Southwestern and Far-western cloning; Protein-protein interactive cloning and Yeast two hybrid system; Phage display; Principles in maximizing gene expression

UNIT IV

Enzymes used in Genetic Engineering; Cohesive and blunt end ligation; Linkers; Adaptors; Homopolymeric tailing; Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes; Primer design; Gene specific and degenerate primer design. Concept of PCR, Types of PCR, Application of PCR. Chimeric protein engineering by PCR. DNA-Protein Interactions-Electromobility shift assay; DNase I footprinting.

UNIT V

Sequencing methods; Enzymatic DNA sequencing; Chemical sequencing of DNA; Automated DNA sequencing; RNA sequencing; Chemical Synthesis of oligonucleotides; Introduction of DNA into mammalian cells; Transfection techniques; Gene silencing techniques; siRNA technology; Micro RNA; Construction of siRNA vectors; Principle and application of gene silencing; Gene Therapy; Suicide gene therapy; Gene replacement; Gene targeting; Transgenics; cDNA and intragenic arrays; Differential gene expression and protein array, CRISPR-Cas9.

Text / Reference Books:

1. T.A Brown (2006). Gene cloning and DNA analysis, WILEY-BLACKWELL
2. Genetic Engineering by Dr Smita Rastogi & Dr Neelak Pathak, Oxford University Press
3. S.B Primrose (2001). Molecular Biotechnology. Panima Publishing corporation, 2ndedition
4. Molecular Cloning, A laboratory Manual.Sambrook,J.,Fritsch,E.F.,Mariatis.3rdedition
5. Genetic Engineering, Principles & Practice by Sandhya Mitra, McGraw Hill Education

Course Outcome: Students will be able to

CO1: Able to understand the fundamental molecular tools and their use in DNA modification, manipulation and cloning.

CO2: Able to learn basic molecular biology concepts, including PCR, DNA isolation, manipulation, cloning, and sequencing.

CO3: Able to learn general techniques used by genetic engineers to modify DNA

CO4 : Recommend strategies of genetic engineering for possible application in Biotechnology and allied industry.

CO5: Able to analyze the benefits and drawbacks of manipulating an organism's DNA.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	3	3	3	3	
CO2	3	3	2	3	3	2	2	
CO3	3	3	3	3	3	2	2	
CO4	3	3	3	3	3	2	2	
CO5	3	3	3	3	3	3	3	

Departmental Elective III

MBT-031 FOOD BIOTECHNOLOGY **L: T: P**

3:1:0

Objective: This course deals with the basic knowledge of the understanding the basic principles of Food biotechnology.

UNIT I

Energy: Energy content of foods - physiological fuel value - review. Measurement of energy expenditure: BMR, RMR, thermic effect of feeding and physical activity, methods of measurement. Estimating energy requirements of individuals and groups.

UNIT II

Microorganisms in foods. Factors affecting the microbial growth. Microbial food borne diseases. Food poisoning, control measures for food poisoning out breaks. Analysis of microorganisms and their products in foods, Fermented foods, role of microbes in fermented foods and genetically modified foods..

UNIT III

Food groups, functions of foods. Nutritive value, composition, storage and preservation of cereals, pulses, nuts & oil seeds, milk & milk products, egg, fish, meat, vegetables, fruits, sugars, fats and oils. Food additives: Synthetic & natural colorants, natural & artificial sweeteners, stabilizers and emulsifiers. Applications of enzymes in food industry: Amylases, Proteases, Lipases, Glucose isomerase, lactase, pectinase and Renin in food industry. Production of bread, cheese, idly, beverages and appetizers. Food packaging methods and materials.

UNIT IV

Functional foods: Advances in Biotechnology for the production of functional foods; Probiotics, Regulatory aspects of food biotechnology; Future strategies for development of biotechnology- enhanced functional foods for human nutrition. Food safety, evaluation of food quality and quality assurance (PFA, FSSAI, HACCP, ISO and FSO systems).

UNIT V

Microbial production of vitamins (B2 and B12), antibiotics (penicillin, streptomycin, tetracycline); Enzymatic production of glucose, fructose, starch, SCP and mushrooms. GM foods: Introduction and controversies related to GMOs. Ethical issues concerning GM foods; testing for GMOs; current guidelines for the production, release and movement of GMOs; labelling and traceability; trade related aspects; biosafety; risk assessment and risk

management. Public perception of GM foods. IPR. GMO Act–2004. New products and processes in various food commodities including plant and animal products.

Text / Reference Books:

1. Text book of Human Nutrition by MS Bamji, 3rd Edition, Oxford and IBH publishing Pvt. Ltd.
2. Food Processing Principles & Applications by Ramaswamy and Marcotte, Taylor and Francis-CRC Publications.
3. Food Packaging: Principles and practice by GL Robertson, 3rd Edition, Taylor and Francis group.
4. Food Chemistry by LH Meyer, Affiliated East and west Press Ltd., Bombay, 1987.
5. FSSAI Training manual.
6. Nutrition Science by B Srilakshmi, 2nd Edition, New Age International (P) Ltd.
7. Food Science by B Srilakshmi, 2nd Edition, New Age International (P) Ltd.
8. Food facts and Principles by N Shakuntala Manay & M Shadakshara Swamy, New Age International Publishers (P) Ltd., 1987.
9. Food Microbiology by Frazier, 4th Edition, W.C. Mc Graw Hill Incorporation.

Course Outcome:

On completion of this course, students should be able to-

- Obtain a good understanding of food biotechnology
- Define microorganisms and their products in foods, understand causes of food spoilage and predict the microorganisms that can spoil a given food, when prepared, processed, and stored under given conditions
- Recognize the causes of food-borne microbial diseases and predict pathogens that can grow in each food, when prepared, processed, and stored under given conditions
- Foresee the necessary measures to control the spoilage and pathogenic microorganisms in food

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	1	1	1	1	2
CO2	3	3	3	1	3	1	1	1
CO3	2	1	3	1	1	2	1	2
CO4	3	3	3	2	2	1	1	1
CO5	1	1	1	1	1	1	1	2

MBT-032 QUALITY CONTROL IN BIOTECHNOLOGY

L: T: P

3: 1: 0

Objective: This course deals with the conditions under which the important pathogens are commonly inactivated, killed or made harmless in foods.

UNIT I

Concept and evolution of quality control and quality assurance. Total Quality Management, Philosophy of GMP and cGMP. Preparation of audit, Conducting audit, Audit Analysis, Audit Report and Audit follow up Quality control laboratory responsibilities: GLP protocols on non- clinical testing control on animal house, data generation, integration and storage, standard test procedure, retention of sample records. CPCSEA guidelines

UNIT II

Quality review and batch release document of finished products, annual product quality review and parametric release, Audits, quality audits of manufacturing processes and facilities, audits of quality control.

UNIT III

Good documentation practices, route cause analysis, corrective action preventive action (CAPA), out of specifications (OOS) and out of trend (OOT), Clinical studies- ICH GCP (E6) guidelines, post marketing surveillance, Pharmacovigilance..

UNIT IV

BABE (bioavailability and bioequivalence) studies, Concepts and management of contract manufacturing guidelines, Statistical Tools for Quality Control and Precision, Tools of Problem Solving and Continuous Improvement;

UNIT V

Introduction, scope and importance of IPR, Concept of trade mark, copyright and patents Product registration guidelines – CDSCO, USFDA, Concept of ISO 9001:2008, 14000, OSHAS guidelines, Quality Strategy for Indian Industry, Brief concept of IND, NDA, ANDA, SNDA and PAT.

Text / Reference Books:

1. Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4th Edn., McGraw Hill Book Co., New York
2. Mann &Trusswell , 2007. Essentials of human nutrition. 3rd edition .oxford universitypress.
3. Jay, J.M., 1987. Modern Food Microbiology, CBS Publications, NewDelhi
4. Lindsay, 1988. Applied Science Biotechnology. Challenges for the flavour and Food Industry. Willis Elsevier.
5. Roger, A., Gordon, B. and John, T., 1989. FoodBiotechnolog

Course Outcome: Students will be able to

CO1: Quality Management, Philosophy of GMP and cGMP.

CO2: Understand the quality audits of manufacturing processes.

CO3: Understand the post marketing surveillance.

CO4: Understand the Tools of Problem Solving and Continuous Improvement.

CO5: To understand copyright and patents Product.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	3	3	1	1	1	1	2
CO2	3	3	2	1	1	1	1	1
CO3	2	1	2	1	1	2	3	2
CO4	1	3	1	2	2	1	3	1
CO5	1	1	1	1	1	1	1	3

MBT-033 AGRICULTURAL BIOTECHNOLOGY

L: T: P
3: 1: 0

Objective: The objective of the course is to make students familiar with the fundamental aspects plant tissue culture, Application of Plant tissue culture for the society.

UNIT I

Agriculture and Agricultural Biotechnology, Clonal Germplasm: Micro propagation, In vitro production of pathogen and contaminant free plants.

UNIT II

Biotechnology-Methods of Crop Improvement, Development of genetically engineered transgenic plants: Molecular aspects of abiotic stress responses and genetic engineering for drought, salinity and Temperature. Insect resistance – BT gene applications. Non-BT like protease inhibitors, alpha amylase inhibitors and lectins. Virus resistance – coat protein mediated, nucleocapsid gene and RNAi approach. Fungal resistance – PR proteins-1- chitinase, -3 beta glucanases. Nematode resistance - Nematode infestation and engineering for nematode resistance. Long shelf-life of fruits and flowers: use of ACC synthase, polygalacturanase, ACC oxidase. Male sterile lines: barstar and barnase systems.

UNIT III

Genetic improvement of nutritional quality of oils- Molecular approaches, Molecular Pharming, Pheromone biotechnology, Molecular markers (RFLP, RAPD, AFLP, SSR) and their applications, QTL Mapping.

UNIT IV

Bioprospecting: the search for bioactive lead structures from herbs, Biotechnological approaches for the production of plant-based chemotherapeutics and secondary metabolites, selection of high-yielding cell lines, Production of therapeutic antibodies in plants.

UNIT V

Biofertilizers- Blue green algae, Azolla, Rhizobium, Mycorrhiza (VAM). Microbial Biopesticides, Biofungicides, Herbicides, and Agricultural antibiotic Biotechnology in Agriculture: Ethical Aspects and Public Acceptance, Animal farming.

Text / Reference Books:

1. Biotechnology by B.D.Singh, Kalyani Publication
2. Biotechnology – Fundamentals and applications by S.S.Purohit, Student Edition
3. Agricultural Biotechnology-Arie Altman, CRC Press
4. Biotechnology- An Introduction by Susan R. Barnum, Vikas Publishing House

Course Outcome: Students will be able to

CO1: Explain the basics of the physiological and molecular processes that occur during plant growth and development and during environmental adaptations.

CO2: Understand how biotechnology has been used to develop knowledge of complex processes that occur in the plant.

CO3: Use basic biotechnological techniques to explore molecular biology of plants

CO4: Understand the processes involved in the planning, conduct and execution of plant biotechnology experiments.

CO5: Explain how biotechnology is used for plant improvement .

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	2	2	3
CO3	3	2	2	3	3	2	2	3
CO4	3	2	2	3	3	2	2	3
CO5	3	3	3	3	3	3	3	3

Departmental Elective IV

MBT-041 BIOLOGICAL WASTE WATER TREATMENT, BIOFUELS AND BIOENERGY

L: T: P
3: 1: 0

Objective: The main objective of environmental biotechnology is the conservation of resources via the recycling of waste materials

UNIT I

Characteristics of Activated Sludge (aerobic and anaerobic); Analysis of Data– Mass Balance Analysis. Reactors used in waste water treatment- Up Flow Anaerobic Sludge Blanket (UASB), Two-stage, Aerobic UNI Tank System (TSU-System, Route Zone Treatment, Submerged Aerobic Fixed Film (SAFF) Reactor, and Fluidized Aerobic Bioreactor (FAB).

UNIT II

Biofilm process considerations; Trickling Filters and Biological Towers; Rotating Biological Contactors; Granular –, Media Filters; Fluidized Bed & Circulating Bed- Biofilm reactors. Hybrid Biofilm/suspended growth processes. Anaerobic Processes: Methanogenesis, process chemistry and microbiology; process kinetics and factors for the design of anaerobic digestors.

UNIT III

Technologies used in advanced treatment-Classification of technologies; Removal of Colloids and suspended particles-Depth Filtration, Surface Filtration, Membrane Filtration Absorption, Ion Exchange, Advanced oxidation process, Activated Carbon, Air Stripping, Heavy Metals Removal, Steam Stripping, Chemical Precipitation, and Electrolysis.

UNIT IV

Environmental regulations and technology- Regulatory Concerns, Technology; Laws, regulations and permits, Air, Water, Solid Waste, Environmental Auditing, National Environmental Policy act, Occupational Safety and Health Act (OSHA), Storm Water Regulations; Technology (waste water); Recycling of Industrial wastes: paper, plastics, leather and chemicals.

UNIT V

Biofuels in the global energy scene, Significance of biofuels and bioenergy. national biofuel policy and law.

Bio,structure and composition of biomass. Methods for biomass composition analysis. Biomass conversion technologies: Biomass to liquid fuels and gaseous fuels thermochemical and biochemical technologies and processes. Biomass degrading enzymes and microorganisms. First, second, third and advanced biofuels production technologies/process and challenges. Consolidated bioprocess engineering (CBP) for biofuels. Concept of Bio refinery: Biomass to value added compounds. Synthetic biology and metabolic engineering approaches (case studies) for biofuels production. Microbial fuel cells Standards of biofuels, Life Cycle assessment of biofuels, Exergy analysis of biofuels, Photo bioreactor

Text / Reference Books:

1. Wastewater Engineering: Treatment Disposal Reuse by Metcalf & Eddy
2. Environmental Biotechnology : Principles and Applications by Bruce E. Rittmann
3. Dahiya, A. (2015). Bioenergy: biomass to biofuels. Paperback ISBN: 9780124079090
4. Industrial Waste Water Managemnet Treatment and Disposal by Waste Water McGraw Hill III Edition 2008.
5. Biological Wastewater Treatment", Second Edition, Marcel Dekker, Inc., New York
6. Introduction to Waste Water Treatment- R. S. Ramalho, Academic Press.Environmental Biotechnology, B.C. Bhattacharya & Ritu Banerjee, Oxford Press, 2007.

Course Outcome: Students will be able to

CO1: Understand the biological treatment techniques for waste water.

CO2: Understand the principle of industrial waste management.

CO3: Describe the use of biotechnological processes to protect the environment

CO4: Contrast approaches to anaerobic digestion of wastes and solve related problems

CO5: Elaborate the standards and life cycle assessment of biofuels

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	1	1	1	3	2
CO2	3	3	3	1	2		3	1
CO3	3	1		3	2	2	1	2
CO4	3	3	2	3	2	1	3	1
CO5	3	1	1	1	1	1	1	2

MBT-042 INDUSTRIAL BIOTECHNOLOGICAL PRODUCTS

L: T: P
3: 1: 0

Objective: In this course students will learn an Introduction to industrial Bioprocess, Production of industrial products.

UNIT I

Different types of culture media; Substrates for industrial microbial processes; Industrially important micro-organisms: Isolation, screening, Selection of mutants; Process optimization techniques

UNIT II

Process technology for the production of various Products: Primary metabolite: ethanol, citric acid, vineger and amino acid; Production of alcoholic beverages: wine and beer; Secondary metabolites: Antibiotics; Process technology for the production of microbial biomass.

UNIT III

Introduction and production of secondary metabolites with some case study. Production of bioplastics (PHB, PHA), bioinsecticides, bioherbicides, biopolymers, Biofertilizers and biological weapons with reference to anthrax

UNIT IV

Production of industrially important enzymes: Solid state fermentation, submerged fermentation, Extraction, Purification and characterization of industrial enzymes, industrial process using enzymes for production of drugs and fine chemicals, Enzyme based biosensors.

UNIT V

Technological processes for industrial manufacture of selected foods of commercial importance from plants and animal sources. Process involved in preparation of Yoghurt, acidophilus milk, Koumis, kefir, cheese, bread, alcoholic beverage, vinegar and oriental fermented food. Food packaging, Equipment involved in the commercially important food processing methods.

Text / Reference Books:

1. Industrial Microbiology, Casida Jr. L. E. 1968) new Age International (P) Ltd. New Delhi.
2. Presott & Dunn's Industrial Microbiology. Ed. E.G. Reed (1987). CBS Publishers, New Delhi.
3. Biotechnology: A Text book of Induxctrial Microbiology 2nd Edition. Crueger, W. and Cruger, A. (2000) Panima Publishing Corporation, New Delhi.
4. Jr. M.J.: Chan E.C.S. and Krieg, N. R. (1993) Tata Mc Graw Hill, New Delhi.

Course Outcome: Students will be able to

CO1: To explain the steps involved in the production of bioproducts and methods to improve modern biotechnology.

CO2: To apply basic biotechnological principles, methods and models to solve biotechnological tasks.

CO3: To identify and debate the ethical, legal, professional, and social issues in the field of biotechnology.

CO4: To design and deliver useful modern biotechnology products to the Society.

CO5: Explore the biological and technological principles which govern actual and potential bio-business

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	2	2	1	1	1	1	2
CO2	3	3	3	1	2	1	1	1
CO3	3	2	3	3	1	2	1	2
CO4	3	3	2	2	2	1	1	1
CO5	3	1	1	1	1	1	1	2

MBT-043 NANOTECHNOLOGY FOR MEDICAL AND HEALTHCARE

L: T: P
3: 1: 0

Objective: To learn the fundamental biological principles and concepts essential to nanotechnology so that students are capable of taking more advanced courses in the field of nanobiotechnology

UNIT I

Introduction to Nanotechnology, Types of nanomaterials: Nanoparticles, Nanowires, Nanotubes, Thin films and Multilayers. Synthesis of nanomaterials by physical and chemical methods, Synthesis of nanomaterials by biological methods, Characterization of nanomaterials. Functionalization of nanomaterials for biological applications.

UNIT II

Nanomaterials and Nanoparticles: Carbon nanotubes and related structures, Properties, Synthesis, Applications, Bucky balls, Nanoparticles types and their synthesis, Application of Gold, Silver and Zinc oxide nanoparticles, Interaction of nanoparticles with biomembrane and genes.

UNIT III

Nanocharecterization tool and techniques: UV-visible spectrophotometry, Fourier transform infrared spectroscopy (FTIR), Scanning Electron Microscopy (SEM) , Scanning tunneling microscopy (STM), Transmission electron microscopy (TEM),Atomic force microscopy (AFM), Nanolithography techniques.

UNIT IV

Applications of nanomaterials in optical biosensors and imaging, quantum dots, Nanomaterials in electrochemical biosensors, Nanomaterials in bioseparation. Nanotechnology for cancer diagnosis. Nanostructures for drug delivery, Nanovesicles; Nanospheres; Nanocapsules, Magnetic nanoparticles; Liposomes; Dendrimers, Concepts, Targeting, Routes of delivery and advantages, Cellular uptake mechanisms of nanomaterials gene therapy.

UNIT V

Recent trends in nanobiotechnology, Biomolecules as Nanostructures, Molecular Motors, DNA nanotechnology, Nanotechnology in tissue engineering, Drug-Photodynamic therapy, Nanotoxicology

Text / Reference Books:

1. Nanobiotechnology: Concepts, Applications and Perspectives, Christof M. Niemeyer (Editor), Chad A. Mirkin (Editor) , Wiley Publishers, April 2004.
2. Nanotechnology: A Gentle Introduction to Next Big Idea, Mark Ratner and Daniel Ratner, Low Price edition, Third Impression, Pearson Education
3. Nanotechnology, William Illsey Atkinson, JAICO Publishing House, Second Impression-2008.
4. Bio molecular computation for Bio nanotechnology, Liu and Shimohara, Artech House-London, 2007

Course Outcome: Students will be able to

CO1: Develop a fundamental understanding of basic concepts of nano-biotechnology and its uses in the field of life sciences.

CO2: Evaluate applications of various concepts & techniques of nano-biotechnology to facilitate biotechnological advancement and innovations.

CO3: Account for interaction of biomolecules with surfaces of different chemical and physical species.

CO4: Account for production and the applications of various types of nanostructured materials.

CO5: Suggest methods for the design of enzyme reactors and other bioconjugates on surfaces and second carriers, and explain the carrier's influence on the activity of the biomolecule.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	3	3	2	1	3	1	3
CO2	2	2	1	2	1	2	1	3
CO3	3	2	3	1	1	2		1
CO4	2	3	2	1	1	1	1	3
CO5	1	2	1	1	1	1		1

MBT-251 COMPUTATIONAL BIOLOGY LAB **L: T: P**

0: 0: 4

1. To find out five similar sequences of any Protein and DNA query sequence.
2. To predict open reading frame of any given gene sequence.
3. To perform pair wise local and global sequence alignment for any two proteins and DNA sequences.
4. To perform multiple sequence alignment for any five sequences and predicts the Phylogenetic relationship among them.
5. To predict secondary structure for any given protein sequence using Chou-Fasman, GOR and Neural network algorithms.
6. To visualize tertiary structure of any given protein sequence using Rasmol/PyMol/PMV.
7. To visualize the genomic map of Human genome and find out the size, number of genes and number of proteins encoded on Chr-Y.
8. To predict the homology model of any protein sequence.
9. To find out the RMSD value from any two protein structure alignment.

MBT-252 MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY LAB

L: T: P

0: 0: 4

1. Isolation of DNA and RNA from animal tissue and plant tissue.
2. Gel electrophoretic analysis of various DNA and their restriction digests
3. Transformation with plasmid and bacteriophage DNA
4. Isolation of plasmid DNA
5. Determination of molecular weight of Nucleic acids by Gel Doc..
6. Isolation of Lambda phage DNA
7. Quantification of DNA by UV spectrophotometer.
8. Amplification of DNA - PCR.

MBT-301 BIOPROCESS ENGINEERING & PROCESS BIOTECHNOLOGY

L: T: P
3: 1: 0

Objective: To acquaint students with technical and biological aspect of microbial utilization for production of metabolites.

UNIT I

Historical development of bioprocess technology, An overview of traditional and modern applications of biotechnological processes, General requirements of fermentation processes, Basic design and construction of fermenter and ancillaries, Main parameters for monitoring & control of fermentation processes, Different raw materials used in fermentation industry and their pretreatment, Medium for plant cell culture and animal cell culture, Medium design of commercial media for industrial fermentations-Plackett burman design, response surface methodology, simplex design.

UNIT II

Stoichiometry of Cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients Energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth.

UNIT III

Mass transfer includes transport phenomena in bioprocesses, Factors affecting oxygen transfer rate in bioreactors, Techniques for measurement of volumetric oxygen transfer coefficient, Fluid rheology and factors affecting bioreactor processes, Flow Patterns in agitated tanks, Mechanism & Power requirements of mixing, Scale up of mixing systems.

UNIT IV

Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes, Induction, nutritional repression, carbon catabolite repression, Crabtree effect, feedback inhibition and feedback repression, Concept of Overproduction of metabolites, Case studies on production of Lactic acid, Glutamic acid, Penicillin, Microbial Lipase and Protease, Recombinant Insulin, Interferons, Hepatitis Vaccines etc. Case studies should deal with strain improvement, medium designs, process optimization technology.

UNIT V

Unit Operation: Filtration, filter aids, filtration Equipment and filtration theory, Centrifugation process and its equipments, Cell disruption, Aqueous Two-Phase Liquid Extraction. Adsorption process and its operations, Chromatography: Theory and mechanism, Scaling-up chromatography.

Text / Reference Books:

1. Principles of fermentation technology" by P F Stanbury and A Whitaker, Pergamon press.
2. Bioprocess Technology - Kinetics & Reactors" by A Moser, Springer-Verlag.
3. Bioprocess Engineering Principles" by Pauline M. Doran, Academic Press.
4. Biochemical Engineering- S. Aiba , A.E. Humphray, University of Tokyo Press.
5. Lee J.M, Biochemical Engineering 2nd ed, Prentice Hall, 2000.
6. Principles of Cell Energetics": BIOTOL series, Butterworth - Heinemann.

Course Outcome: Students will be able to

CO1: Productively translate both basic and frontiers research concepts relating to protein production and purification into a modern industrial bioprocess perspective

CO2: Apply engineering principles to address issues in bioprocesses.

CO3: Delineate problems associated biomolecules or biological cells from those associated with environmental conditions.

CO4: Analyze and identify limiting factors in a bioprocess and propose solutions to address biological and engineering problem

CO5: To understand the media design and formulation

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	2	2	1
CO3	3	3	3	3	3	3	3	
CO4	3	3	3	3	3	2	3	
CO5	2	3	3	3	2	2	3	

Departmental Elective V

MBT-051 ADVANCED FERMENTATION TECHNOLOGY

L: T: P
3: 0: 0

Objective: To learn and understand the applied concepts of advanced fermentation technology

UNIT I

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermenter and ancillaries, main parameters to be monitored and controlled in fermentation processes, Gaden's Fermentation classification

UNIT II

Design and operation of fermenters, Basic concepts for selection of a reactor, Rheology of fermenter. Fermentation Kinetics: Continuous fermentation, advantages and limitations, theory of single and two stage continuous fermentation systems application

UNIT III

Media formulation and preparations-complex and synthetic media, sterilization. Isolation, selection and improvement of cultures – screening methods, culture preservation. Studies on growth kinetics in batch, continuous and fed batch cultures. Details of Industrial manufacture of important biotechnological products.

UNIT IV

Bath culture, Continuous culture, Multistage system, Feedback systems, Comparison of batch and continuous culture in industrial process, Biomass productivity, Metabolite productivity Continuous brewing, Continuous culture and biomass production, Comparison of batch and continuous culture

UNIT V

Fed-batch culture, Variable volume fed-batch culture, Fixed volume fed-batch culture, Cyclic fed-batch culture, Application of fed-batch culture, Examples of the use of fed-batch culture, Ideal bioreactors, various configurations, Mechanical construction, various parts and accessories - Introduction to Mass and Heat transfer: Agitation and aeration, Modes of reactor operations, Wave bioreactors

Text / Reference Books:

1. Bailey, J.E. and Ollis D.F., Biochemical Engineering Fundamentals, Mcgraw Hill Higher Education; 2nd edition, 2001
2. Stanbury, P.E., Whitaker, A., Hall, S., Principles of Fermentation Technology 2nd edition, Butterworth-Heinemann, 2002

3. Pirt, S. J., Principles of Microbe and Cell Cultivation. Wiley, John & Sons, Reprint, 2005
4. Moo-Young, M., Comprehensive Biotechnology, Vol. 1–4, Pergamon Press, Reprint, 2004

Course Outcome: Students will be able to

CO1: Explain the chronological development of the fermentation industry

CO2: Outline working principle of various Bioreactors.

CO3: Demonstrate Fermentation kinetics

CO4: Formulate media for fermentation

CO5: Design and construction of bioreactor

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3					
CO2		2				
CO3				2		
CO4			3			
CO5						3

1: Slightly 2: Moderately 3: Substantially

MBT-052 MOLECULAR DIAGNOSTIC TECHNOLOGY

L: T: P
3: 1: 0

Objective: This course provides an overview of the principles of clinical molecular diagnostics, the use of molecular techniques to diagnose disease, quality assurance in the molecular lab and DNA based tissue typing.

UNIT I

Volumetric analysis, Balancing & Weighing, Concept of solute & solvent, Units of measurement. Specimen Collection & Processing: Specimen collection (Blood, urine, spinal fluid, saliva synovial fluid, Amniotic fluid), Preservation, transportation.

UNIT II

Clinical Enzymology: Principle of diagnostic enzymology, Digestive enzyme, Miscellaneous enzyme. General Function Tests: Liver function test, Cardiac Function Test, Renal Function Test, Thyroid Function test, Reproductive endocrime function test

UNIT III

Immunodiagnostics: Introduction, Antigen-Antibody Reactions, Conjugation Techniques, Antibody Production, Enzymes and Signal Amplification Systems, Separation and Solid-Phase Systems, Studies related to bacterial, viral and parasitic infections.

UNIT IV

Product Development: Immunoassay Classification and Commercial Technologies, Assay Development, Evaluation, and Validation, Reagent Formulations and Shelf Life Evaluation, Data Analysis, Documentation, Registration, and Diagnostics Start-Ups.

UNIT V

DNA based diagnostics: PCR, RFLP, SSCP, Microarrays, FISH, In-situ hybridization, Studies related to bacterial, viral and parasitic infections, Cell based diagnostics: Antibody markers, CD Markers, FACS, HLA typing, Bioassays.

Text / Reference Books:

1. Tietz Textbook of Clinical Chemistry, Carl A. Burtis, Edward R. Ashwood, Harcourt
2. Brace & Company Aisa Pvt. Ltd.
3. Commercial Biosensors: Graham Ramsay, John Wiley & Son, INC. (1998).
4. Essentials of Diagnostic Microbiology, Lisa Anne Shimeld.
5. Diagnostic Microbiology, Balley & Scott's.

6. Tietz Text book of Clinical Biochemistry, Burtis & Ashwood. 6. The Science of Laboratory Diagnosis, Crocker Burnett.

Course Outcome: Students will be able to

CO1: Compare and contrast DNA and RNA, including their structure, function, duplication, regulation, extraction, resolution and detection.

CO2: Define the term 'nucleic acid amplification.'

CO3: Explain the process of DNA sequencing.

CO4: Describe chromosomal structure.

CO5: List methods used to detect chromosomal mutations.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	3	3	3	3	3	1
CO2	3			3	3			1
CO3	3	3	3	3	3			1
CO4	3	2	3	3			2	1
CO5	3	3	3	3			3	2

MBT-053 STEM CELL ENGINEERING

L: T: P
3: 1: 0

Objective: This course provides an overview of the principles of Stem cell.

UNIT I

Cell Diversification in Early Animal Embryo: Process of fertilization & stages of development in Eukaryotes, pluripotency & formation of three germ layers, Differentiation, Organogenesis, ICM , cellular mechanism relating to these developments.

UNIT II

Stem cell differentiation: The process of stem cell differentiation leading to the formation of epidermal cells, Skeletal muscles. Transformation of stem cell into gametes/ fertilization entity, Spermatogenesis & oogenesis., Menstrual Cycle .

UNIT III

Hemopoietic Stem Cells: Classification and manifestation of Hemopoietic stem cell disorders, plastic hemopoietic stem cell disorders, myelo dysplastic, myelo proliferative disorders, complications involved in gene therapy, blood transfusion & marrow transplantations, preservation & clinical use of blood, hemapheresis & Apheresis procedures

UNIT IV

Concept of stem cells & their applications: Stem cells & their unique properties, Embryonic stem cells, Adult stem cells, induced pluripotent stem cells, epidermal stem cells & their applications hepatic stem cells & their role in liver regeneration, stem cell treatments, ethical issues of stem cell research.

UNIT V

Neurodegenerative diseases; Parkinson's, Alzheimer, Spinal Code Injuries and other brain Syndromes and Anti-ageing, Multiple sclerosis, Rheumatoid Arthritis. Applications of stem cells in medicine and different disease models, Biosafety and Stem cell research, Regulatory considerations and FDA requirements for stem cell therapy.

Text / Reference Books:

1. Developemental Biology by R.M.Twyman, Viva Books Pvt. Ltd., 2001
2. Hematology, William J. Willams, Ernest Beutler, Allan JU.Erslev, Marshall A. Lichman.
3. Essential Cell Biology, Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Kieth Roberts and Jamnes D. Watson, Garland Science, Taylor and Francis Group, 2nd Edition, 2003.
4. Stem Cell Biology, David Gottlieb, Cold Spring Harbor, 2002

Course Outcome: Students will be able to

CO1: Evaluate the need for stem cell therapy and tissue engineering.

CO2: Demonstrate understanding of stem cells types (somatic/ embryonic/pluripotent/ multipotent/Induced pluripotent), stem cell mobilization, stem cell transplantation, cloning and cell fusion.

CO3: Analyze the differences in tissue regeneration between mammals (adult and neonatal) and lower organisms (zebra fish)

CO4: Evaluate the regenerative potential of stem cells for ischemic cardiomyopathy and neurological degenerative disorders.

CO5 : Analyze and predict the federal regulations applicable for the development, approval, and clinical use of stem cell therapy

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2	3	2	2	1	1	1	2
CO2	2	2	1	2	1	2	1	2
CO3	2	2	2	1	1	2	1	1
CO4	2	2	2	1	1	1	1	1
CO5	1	2	2	1	1	1		1

MBT-353 BIOPROCESS ENGINEERING & TECHNOLOGY LAB L: T: P

0: 0: 4

1. Determination of kinetic parameters for batch cultivation of yeast under shake flask conditions.
2. Determination of volumetric oxygen transfer coefficient (KLa)
3. Determination of activation energy (Ea) of microbial strains.
4. Process optimization for enzyme production using specific experimental design.
5. Preparation of immobilized enzymes & cells and evaluation of kinetic parameters.
6. Computational Design of Fermentative Process.
7. Fermenter designing and the study of various parts of ferrmenter and their function for microbial cell culture.
8. Fermentative production of Penicillin by using *Penicilium chrysogenum*.
9. Microbial production of enzymes Cellulase & Protease.
10. Ethanol production from molasses or starchy raw material.
11. Fermentative production of Wine from grapes.
12. Separation and purification of microorganisms from yogurt and cheese.
13. Fermentative production of alpha amylase under solid & submerged conditions.
14. Protein profiling of fermentation broth through dialysis procedure.
15. To study the Scale-up and Sterilization in Bioreactors.