FACULTY OF ENGINEERING & TECHNOLOGY

RAMA UNIVERSITY UTTAR PRADESH KANPUR

Rama City, G.T. Road, Mandhana, Kanpur-209217

Ref No: FET/DO/2025/037 Date: 20.08.2025

NOTICE

This is to inform all concerned that the **Board of Studies (BOS) meeting** of the Department of Biotechnology, FET will be held on **21st August 2025** at 10:00 a.m in Dean Office, FET.

All members of the Board of Studies (BOS) are requested to kindly make it convenient to attend the meeting.

Regards,

Dr. Indrajeet Gupta
Convenor
Board of Studies
Faculty of Engineering & Engineering
Rama University, Kanpur

Copy to:

1. All members of the BOS through E-Mail
2. Vice Chancellor, Rama University Uttar Pradesh, Kanpur
3. Director, Rama University Uttar Pradesh, Kanpur
4. Registrar, Rama University Uttar Pradesh, Kanpur
5. Dean Academic & Planning

HOD BIO <hodbio.fet@ramauniversity.ac.in>

Revised-Regarding your valuable suggestions/input in upcoming Board of Studies (BoS) Biotechnology Meeting on 19th August 2025

3 messages

HOD BIO <hodbio.fet@ramauniversity.ac.in> Thu, Aug 14, 2025 at 11:09 PM
To: "lkumar@hbtu.ac.in" <lkumar@hbtu.ac.in>
Cc: Dean Engineering Rama University <deanengineering@ramauniversity.ac.in>, "Dr. Neeraj" <drneeraj.fet@ramauniversity.ac.in>, Ajay Kumar <drajay.fet@ramauniversity.ac.in>, Aman Pratap Singh <amanpratapsingh.fet@ramauniversity.ac.in>, "Dr. Shraddha Sahu" <drshraddha.fet@ramauniversity.ac.in>, "Dr. Samakshi Verma" <samakshiverma.fet@ramauniversity.ac.in>, "Dr. Renu Verma" <renuverma.fet@ramauniversity.ac.in>, "Dr. Deeksha Ranjan" <drdeeksha.fet@ramauniversity.ac.in>, "Dr. Vivek Srivastava FET" <drviveksrivastava.fet@ramauniversity.ac.in>

Dear Sir,

Greetings from the Department of Biotechnology, FET, Rama University!

It gives us great honor to invite you to serve as an esteemed member of the Board of Studies (BoS-Biotechnology) for upcoming meeting scheduled on 19th August 2025 (Tuesday) at 10:00 A.M, to be held at Dean Office, FET, Rama University.

The agenda for the meeting includes review and discussion of the following academic programs:

B.Tech (AICTE 2020): Curriculum restructuring in alignment with the latest AICTE Model Curriculum (2020) for Biotechnology. The syllabus and evaluation scheme of biotechnology core courses are attached for your reference. Your expertise in this updated framework will be useful in ensuring academic excellence and relevance and their open elective subject syllabus are under process, we will update you as early.

B.Sc. (NEP 2020): Newly designed Board of Studies (BoS) implemented from the academic year 2024-25. Revisions are limited to modifications in evaluation and assessment criteria as per NEP 2020 guidelines. Your validated assessment for quality assurance is required and the documents related are attached.

M.Sc. and M.Tech in Biotechnology: BoS implemented from the academic year 2023-24 academic year. Discussion will focus on minor updates and suggestions to further strengthen academic rigor and research integration in order to align programs more closely with industry trends and research advancements. PG Suggestions file is attached for your concern.

Your insights and domain expertise will play a crucial role in enhancing the quality and competitiveness of our academic programs.

We request you to kindly provide us with your recommendations for obtaining a refined and up to date curriculum that meet regulatory requirements, incorporate emerging trends, and enhance academic quality.

Looking forward to your kind acceptance and advantageous contributions.

With Regards

Vivek Srivastava

On Thu, Aug 14, 2025 at 5:03 PM HOD BIO <hodbio.fet@ramauniversity.ac.in> wrote:

Dear Sir,

Greetings from Department of Biotechnology, FET, Rama University!

It gives us great honor to invite you to serve as an esteemed member of the Board of Studies (BoS-Biotechnology) for our upcoming meeting scheduled on 19th August 2025 (Monday) at 10:00 A.M, to be held at Dean Office, FET, Rama University.

The agenda for the meeting includes review and discussion of the following academic programs:

B.Tech (AICTE 2020): Curriculum restructuring in alignment with the latest AICTE Model Curriculum (2020) for Biotechnology. The syllabus and evaluation scheme of biotechnology core courses are attached for your reference. Your expertise in this updated framework will be useful in ensuring academic excellence and relevance and their open elective subject syllabus are under process, we will update you as early.

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4 attachments

B. Tech BT Evaluation Scheme RR25 BOS.xlsx
29K

PG Suggestions.docx
15K

SYLLABUS NEW B. Tech 2025-26.docx
159K

B.Sc Biotechnology_Evaluation Scheme 2024-25(1).doc
365K

Lalit Kumar <lkumar@hbtu.ac.in> Tue, Aug 19, 2025 at 7:43 AM
To: HOD BIO <hodbio.fet@ramauniversity.ac.in>
Cc: Dean Engineering Rama University <deanengineering@ramauniversity.ac.in>, "Dr. Neeraj" <drneeraj.fet@ramauniversity.ac.in>, Ajay Kumar <drajay.fet@ramauniversity.ac.in>, Aman Pratap Singh <amanpratapsingh.fet@ramauniversity.ac.in>, "Dr. Shraddha Sahu" <drshraddha.fet@ramauniversity.ac.in>, "Dr. Samakshi Verma" <samakshiverma.fet@ramauniversity.ac.in>, "Dr. Renu Verma" <renuverma.fet@ramauniversity.ac.in>, "Dr. Deeksha Ranjan" <drdeeksha.fet@ramauniversity.ac.in>, "Dr. Vivek Srivastava FET" <drviveksrivastava.fet@ramauniversity.ac.in>

Dear Sir,
This is to inform you that the Orientation program of newly admitted students is scheduled today i.e. on 19th August 2025 in our University. As Dean Academic Affairs, I have to be there in the program, therefore not able to join the BoS meeting today. It is requested to please reschedule it after a few days.

Hope you understand the situation.
Thanks and regards

Prof. Lalit Kumar Singh
HoD, Biochemical Engineering &
Dean of Academic Affairs
HBTU Kanpur-208002

[Quoted text hidden]

HOD BIO <hodbio.fet@ramauniversity.ac.in> Wed, Aug 20, 2025 at 5:13 PM
To: Lalit Kumar <lkumar@hbtu.ac.in>
Cc: Dean Engineering Rama University <deanengineering@ramauniversity.ac.in>, "Dr. Neeraj" <drneeraj.fet@ramauniversity.ac.in>, Ajay Kumar <drajay.fet@ramauniversity.ac.in>, Aman Pratap Singh <amanpratapsingh.fet@ramauniversity.ac.in>, "Dr. Shraddha Sahu" <drshraddha.fet@ramauniversity.ac.in>, "Dr. Samakshi Verma" <samakshiverma.fet@ramauniversity.ac.in>, "Dr. Renu Verma" <renuverma.fet@ramauniversity.ac.in>, "Dr. Deeksha Ranjan" <drdeeksha.fet@ramauniversity.ac.in>, "Dr. Vivek Srivastava FET" <drviveksrivastava.fet@ramauniversity.ac.in>

Dear Sir,

As per our telephonic discussion, this is to formally invite you to attend the Board of Studies (BOS) meeting scheduled of Department of Biotechnology on 21st August 2025 (Thursday) at 10:00 AM.

Your valuable presence and expert inputs will greatly contribute to the discussions and academic deliberations.

Meeting details:
Date: 21st August 2025
Time: 10:00 AM
Venue: Dean Office, FET, Rama University

We look forward to your participation in the meeting.

Best regards,
Dr. Vivek Srivastava

[Quoted text hidden]

Office of the
Dean-Academic Affairs

RAMA UNIVERSITY UTTAR PRADESH, KANPUR
(vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))
Rama City, G.T. Road (Near Mandhana Railway Station)
Mandhana, Kanpur

Ref.No.: RU/DA/2025/025

DATE: 25.08.2025

NOTICE

To,

The Dean's
Faculty of Engineering & Technology.
Faculty of Agricultural Sciences & Allied Industries.
Faculty of Commerce & Management.
Faculty of Juridical Sciences.
Faculty of Pharmaceutical Sciences.
Faculty of Professional Studies.

Subject: Marks Distribution Criteria Based on Attendance.

This notice is to inform you that if attendance is selected as an assessment component for any course, the following rubrics will be applied:

Attendance Percentage	Marks
96%-100%	100% of attendance marks
91%-95%	80% of attendance marks
86%-90%	60% of attendance marks
81%-85%	40% of attendance marks
75%-80%	20% of attendance marks
Below 70%	0 Marks

It is requested to you kindly disseminate this information to all faculty members and implement the same from the current academic session.

Prof. (Dr.) Indrajeet Gupta
Dean- Academic Affairs

Dean- Academic Affairs
Rama University Uttar Pradesh
Kanpur

Minutes of Meeting
Board of Study
Master of Technology
(Biotechnology)

[Applicable w.e.f. Academic Session 2025-2026 till Revised]

FACULTY OF ENGINEERING & TECHNOLOGY
RAMA UNIVERSITY, UTTAR PRADESH, KANPUR

Website: www.[redacted]niversity.ac.in

Ref: RU/FET/BT/BOS/2025/002 **Dated: 21.08.2025**

Faculty of Engineering & Technology
Department of Biotechnology
Minutes of Meeting
Boards of Studies

The Board of Studies meetings of M. Tech. Biotechnology syllabus for coming session 2025-26 were held in the Dean's Office on 21.08.2025 at 10:00 a.m.

The following members were present:

1. Dr. Indrajeet Gupta - Convenor
2. Dr. Vivek Srivastava - Chairperson
3. Dr. Neeraj - Member
4. Dr. Ajay Kumar - Member
5. Dr. Deeksha Ranjan - Member
6. Dr. Shraddha Sahu - Member
7. Dr. Samakshi Verma - Member
8. Dr. Renu Verma - Member
9. Mr. Aman Pratap Singh - Member Absent (21/8/25)

The following members agreed to review the minutes.

1. Dr. Lalit Kumar Singh - External Member

Agenda:
Agenda Items

1. **Proposed Change in Syllabi**
   Examination and approval of revisions in existing syllabi to meet emerging technological trends.
2. **Incorporation of MOOCs in Syllabus**
   Integration of Massive Open Online Courses (MOOCs) into the curriculum to enhance learning outcomes.
3. **Incorporation of Flipped Classroom Approach**
   Adoption of flipped classroom methodology to improve student engagement and practical learning.
4. **Revision of External Examiner Panel**
   Review and update of the panel of external examiners for various courses and programs.

The BOS committee confirmed the minutes of the BOS meeting held on 21-Aug-2025

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

The BOS committee reviewed and confirmed the minutes of the BOS meeting held on 27/06/2024.
The BOS Committee discussed on Action Taken Report on the basis of result analysis of session 2024-25 (Odd).

2. To Review existing evaluation scheme and syllabus of existing programme.

S. No.	Item No.	Existing	Recommendation /Action Taken
1	**RU/FET/BT/BOS/2025/MTECH/001**	To consider and approve the changes in Syllabus for M.Tech. Biotechnology students to be admitted in the Academic Session 2025–2026	The Board of Studies (BOS) recommended to continue the same syllabus and evaluation scheme for the Academic Session 2025–2026, with the following modifications across all semesters: In **Semester I**, for course MBT-101 (Applied Biochemistry and Bioenergetics), it is recommended to update UNIT-V by including recent advances in metabolomics, systems biology approaches for understanding the mechanisms of metabolic diseases, and the use of computational tools for metabolic pathway 3odelling. Additionally, "Non-coding RNAs in gene regulation" should also be added to UNIT-V. For MBT-102 (Microbiology and Virology), UNIT-V should include content on clinically important viruses, particularly SARS-CoV-2

			variants. For MBT-011 (Bio-Analytical Techniques), UNIT-V should incorporate LC-MS/MS and MALDI/TOF techniques. In MBT-012 (Molecular Immunology and Vaccine Technology), it is recommended to add Mrna vaccines and nanoparticle-based vaccines in UNIT-III. UNIT-IV should include a case study on the COVID-19 vaccine. For MBT-013 (Bio-Medical Technology), UNIT-IV requires restructuring. The topics "Endocrine Drugs: Female sex hormones and analogs" and "Agents affecting the immune response" should be shifted from UNIT-IV to UNIT-I. The following topics should be removed from UNIT-IV: Chemotherapeutic agents including synthetic antibacterial agents, beta-lactam antibiotics, anthelmintic agents, antiamebic agents, and antiviral agents. In place of these, UNIT-IV should be updated with content on regenerative medicine (introduction), biomedical devices (case studies), biosensors, organ-on-a-chip, and the role of artificial intelligence in diagnostics. The course MBT-021 (Enzymology and Industrial Application) was found

			to have 50% of its syllabus irrelevant to enzyme technology. Therefore, it should be revised and restructured according to the suggested new syllabus. In MBT-022 (Pharmaceutical Biotechnology), UNIT-V should be updated to include an introduction to biosimilars. The syllabus for MBT-023 (Animal and Plant Tissue Culture Technology) was found satisfactory, and no changes are required. In **Semester II**, the syllabi for MBT-201 (Computational Biology) and MBT-202 (Molecular Biology and Recombinant DNA Technology) are deemed up-to-date, and no modifications are necessary. For MBT-031 (Food Biotechnology), UNIT-I should be revised to include topics on personalized nutrition and nutrigenomics. The syllabus for MBT-032 (Quality Control in Biotechnology) requires no changes. In MBT-033 (Agricultural Biotechnology), it was observed that there is uneven distribution of content in UNIT-I and UNIT-II. Therefore, biofortification should be added to UNIT-I, and the content on production of climate-resilient crops

			(drought, salinity, and temperature tolerance) should be moved from UNIT-II to UNIT-I to ensure consistency. For MBT-041 (Biological Waste Water Treatment, Biofuels & Bioenergy), UNIT-V should be revised to include content on biohydrogen production. In MBT-042 (Industrial Biotechnological Products), the following revisions are proposed: UNIT-I: Add content on process optimization techniques including Response Surface Methodology, Artificial Neural Network, Fuzzy Logic, and advanced statistical tools and software. Also, include high-throughput screening of industrial microbes. UNIT-II: In the section on primary metabolite production, include biopharmaceutical precursors, bioethanol from lignocellulosic feedstocks, and organic acids used for bioplastics such as lactic acid, succinic acid, and fumaric acid, along with vitamins and nutraceuticals. UNIT-III: In the secondary metabolites section, add content on next-generation bioplastics (PLA and PBS), their biodegradability assessment, circular bioeconomy, and

			production of anticancer compounds. Also, include biocontainment strategies related to GMOs in industrial biotechnology. UNIT-IV: Add case studies on industrial enzymes used in detergent, food, and pharmaceutical sectors. Include content on scale-up strategies, monoclonal antibodies, and recombinant proteins. For MBT-043 (Nanotechnology for Medical and Healthcare), UNIT-II should be updated with content on green synthesis of nanoparticles using plants and microbes. **In Semester III**, the courses MBT-301 (Bioprocess Engineering and Process Biotechnology) and MBT-051 (Advanced Fermentation Technology) require no modifications. For MBT-052 (Molecular Diagnostic Technology), UNIT-II needs correction to clearly state "Reproductive endocrine function test". UNIT-III should be expanded to include an overview of point-of-care rapid tests and their applications in infectious diseases. Lastly, in MBT-053 (Stem Cell Engineering), UNIT-III should include content on organoids and 3D bioprinting. UNIT-IV should include

			the latest ICMR guidelines for stem cell research in India. UNIT-V should be corrected to properly include spinal cord injuries.
2	**RU/FET/BT/BOS/2025/ MTECH /002** (In reference with Circular No: RU/DA/2025/020 Dated: 28 July 2025)	**Incorporation of MOOCs in Syllabus** Faculty and students requested flexibility to pursue online courses (SWAYAM, NPTEL, Coursera) for skill enhancement.	The committee took the decision to incorporate MOOCs in the curriculum, allowing credit transfer (up to 20%) as per AICTE norms.
3	**RU/FET/BT/BOS/2025/ MTECH /003**	**Incorporation of Flipped Classroom Approach** Students preferred interactive and practice-oriented sessions; faculty supported blended learning to increase participation.	The committee took the decision to formally introduce the flipped classroom pedagogy and circulate guidelines to faculty for effective implementation as per requirements.

3. Revision of External Examiner Panel: Faculty recommended updating the panel to include experts from both academia and industry. The committee took the decision to revise the external examiner panel, including industry experts and academicians from reputed institutions.

4. Question Paper Format: The question paper format, as per NAAC/NBA requirements, includes a dedicated column for CO (Course Outcome) mapping against each question. This ensures clear alignment of assessment items with defined learning outcomes, facilitates transparent evaluation, and supports accreditation compliance through measurable and outcome-based education practices.

5. Result Analysis: Summary of Result Analysis of the students performance in the semester examination 2024-25 was presented and it was suggested that the course instructors should conduct remedial classes for the students whose performance was not found satisfactory and the subjects where results are below standards. **(Annexure -1).**

6. Feedback Analysis: Analysis was performed based on summary of already collected feedback from students and the course instructors have been instructed for improvement in teaching pedagogy for better understanding of students in the cases where the feedback is below average.

7. Short term course: In upcoming session 2025-26, we have proposed short term course on **"Applied Microbiology and Molecular Biology"** which was approved previously will be continued in the upcoming session.

8. Any other issue with the permission of the Chair: No

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

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

Convenor

Signature: .....

Name: Dr. Indrajeet Gupta

Chairperson

Signature: .....

Name: Dr. Vivek Srivastava

Internal Members

Signature: 1. ..... 21/08/2025

Name: Dr. Neeraj

Signature: 2. .....

Name: Dr. Ajay Kumar

Signature: 3. ..... 21/8/2025

Name: Dr. Deeksha Ranjan

Signature: 4. ..... 21.08.2025

Name: Dr. Shraddha Sahu

Signature: 5. ..... 21/8/25

Name: Dr. Samakshi Verma

Signature: 6. ..... 21/08/25

Name: Dr. Renu Verma

Signature: 7. ABSENT (21/8/25)

Name: Mr. Aman Pratap Singh

External Members

Signature: 1. ..... 21/08/2025

Name: Dr. Lalit Kumar Singh

Date: 21/8/25

Encl.: Recommended Curricula attached for consideration and approval.

CC:

1. Dean
2. Registrar Office

Office of the
Dean Academic

RAMA UNIVERSITY UTTAR PRADESH, KANPUR
(Vide U.P. Act No. 1 of 2014 as passed by State Legislature and recognized by UGC U/s 2(f))
Rama City, G.T. Road (Near Mandhana Railway Station)
Mandhana, Kanpur

Ref.No.: RU/DA/2025/020

DATE: 28.07.2025

To,

1. All Deans/Except (Medical, Dental, Nursing, Paramedical and Pharma)
2. C.O.E.

Subject: MOOC Credit Exemption for Graduating Students in 2024-25 and Revised MOOC Integration

Following discussions with the Controller of Examinations (COE) in the Deans Meeting on July 23, 2025, and in relaxation of the conditions stated in notice **Ref No. R.U./Reg./2021/10 dated January 6, 2021**, it is decided that students who have completed their academic requirements for the AY 2024-25 are exempted from the mandatory MOOC course requirement. This exemption applies only to students graduating in the 2024-25 academic year.

All currently enrolled students are required to complete MOOC courses as per their year of study, proportional to the total program credits. The revised structure is as follows:

UG/PG Program Duration	Required/Desirable Credit Score*
2 Years	8
3 Years	12
4 Years	16
5 Years	20

*Concerned faculty/institutes (FET, FCM, FASAI, FPS) may decide to incorporate various learning modes, the AICTE Model Curriculum 2022 may be referred.

This decision has been taken with the approval of the Competent Authority.

Copy to: -

1- Secretary to Hon'ble Chancellor.
2- Secretary to Hon'ble Vice Chancellor
3- Hon'ble Director
4- Controller of Examination (COE)
5- Registrar for the necessary approval in AC & EC
6- Deputy Registrar/A.R./C.O.E.

Dr. Indrajeet Gupta
Dean Academic Affairs

Dean- Academic Affairs
Rama University Uttar Pradesh
Kanpur

RAMA UNIVERSITY

Faculty of Engineering & Technology

M.Te
2

ORDINANCE

For

PROGRAMME

M.Tech. (Biotechnology)

2025-26

1. Program Name & Code

- **Program Name:** Master of Technology in Biotechnology (M. Tech. Biotechnology)
- **Program Code:** 518

2. Eligibility Criteria

B.Tech. in Biotechnology, Chemical Engineering, Biochemical Engineering, Bioinformatics, Biomedical Engineering, Agricultural Engineering, Food Technology, etc. or an equivalent degree in the relevant branch of Engineering with a minimum of 50% marks from a recognized University.

OR

M.Sc. degree in Biotechnology, Microbiology, Biochemistry, Genetics, Molecular Biology, Life Sciences, Botany, Zoology, or related subjects. with 55% or higher aggregate marks from a recognized University.

3. Admission Procedure

i. Admission shall be made **strictly on the basis of merit** in the qualifying examination/entrance test conducted by Rama University (RUET) or as per guidelines of statutory bodies.

ii. Reservation policy as per Government of Uttar Pradesh/University norms will be followed.

iii. Final selection will be subject to verification of original documents and fulfillment of eligibility criteria.

4. Duration of Program

i. 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.

ii. 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.

5. Maximum Duration

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.

6. Curriculum

M.Tech. Biotechnology 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.

7. Minimum Requirement to Continue in the Program

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.

8. 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

9. Medium of Instruction

i. The medium of instruction and examination shall be English.
ii. Technical terms in Hindi may be used wherever necessary to enhance comprehension.

10. Structure of the Program

The program shall follow the model of AICTE/UGC curriculum framework for M. Tech Biotechnology, comprising:

S. No.	Category	Credits Achieved by Department
1.	Core Courses	30
2.	Departmental Elective Courses	20
3.	Project Work Review, Dissertation, Seminar	34
Total Credits		**84**

1. **Core Courses**

Applied Biochemistry & Bioenergetics, Microbiology & Virology, Computational Biology, Molecular Biology & rDNA Technology, Bioprocess Engineering & Process Biotechnology, Associated Labs Are Biochemistry Lab, Microbiology Lab, Computational Biology Lab, rDNA Lab, Bioprocess Lab.

2. **Departmental Elective Courses**

Departmental Electives I–V (Bio-analytical techniques, Molecular Immunology, Enzymology, Food Biotech, Nanotechnology, Stem Cell Engineering, etc.)

3. **Project Work Review, Seminar and Dissertation**

Seminar I & II, Dissertation I & II, Project Work Review I & II

Credit Requirement for Award of Degree (M.Tech. Biotechnology): 84 credits will be achieved after completion of M. Tech Program.

11. Marks/Credits Distribution

1. **Sessional (Internal Assessment):**

The internal assessment for each course will be based on the following components:

Continuous Assessment (CA): 30 marks (includes class tests, assignments, attendance, participation, quizzes, etc.)

Mid-Term Examination/ Pre-University Test (MTE/PUT): 20 marks (conducted centrally during the semester)

For **Theory courses**, internal assessment shall be carried out through includes class tests, assignments, attendance, participation, quizzes, etc. with the same distribution (CA = 30, MTE = 20).

For **Laboratory/practical courses**, internal assessment shall be carried out through regular performance, records, assignments, and viva-voce examinations, with the same distribution (MTE = 20).

For **Dissertation / Project Work review / Seminars**, evaluation will follow a specific pattern:

MTE distribution as per specific weightage (e.g., Seminar I & II: 20, Project Work Review I: 20, Project Work Review II: 50, Dissertation I: 100, Dissertation II: 200). Final evaluation based on progress, mid-term presentation, viva-voce, and report.

2. **Semester Examinations (External Evaluation):**

End-Term Examination (ETE): 100 marks for all theory courses. ETE distribution as per specific weightage (e.g., Seminar I & II: 30, Project Work Review I: 30, Project Work Review II: 100, Dissertation I: 150, Dissertation II: 300).

Guide Lines for Dissertation Work:

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

i. Candidate should present/ publish at least two papers in International Conferences.

ii. Candidate should publish at least one paper in International Journals.

iii. 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.

3. **Credit Calculation:**
1 Credit = 1 hour of theory per week OR 2 hours of practical per week.

Example: L-T-P of 3-1-0 = 4 credits; L-T-P of 3-0-2 = 4 credits. A "credit" is the academic unit measuring course workload and determines instructional hours required per week.

12. Evaluation Procedure

a. **Sessional:** The laboratory course sessional evaluations shall be performed continuously based on practicalperformed by a student. Such evaluation may involve periodic assessment of documentation of the practical exercise/experiment, precision of experiment etc. In the case of Project /Dissertation the Internal Assessment may be based on periodical progress report.

b. **Semester Examination:** The Semester Examination shall commence during the first week of December/May for the Odd semester/Even semester courses, respectively.

c. **Appointment of Examiners:** Head of the department shall normally appoint the examiners for differentcourses, selecting at least two other than the concerned teachers, randomly for theory courses in each of the semesters. In case of Lab/Projects/Viva-Voce examinations there shall be one internal and one external examiner. A sizable panel of external examiners shall be approved by the BOS on annual basis to facilitate the appointment of external examiners.

d. **Moderation:** A committee duly constituted by BOS as follows, shall moderate the examination papers andshall have the right to improve / change the questions to a considerable extent:

   i. Dean
   ii. Head of the department
   iii. Three Faculty Members nominated by the Dean

e. Examination & Evaluation System: All the evaluations shall be performed in terms of marks, adding finally for each course out of 150 marks. The marks obtained by each student in courses shall be evaluated into percentage.

f. Examination: Paper to be set by external: HOD shall ensure the coverage of syllabus. If needed moderation can be done. Evaluation to be done internally by the faculty other than the Course Instructor. Syllabus of the concerned course shall be sent to the external examiner, who shall prepare the question papers. For practical, it is recommended that examination shall be conducted by course instructor(s) and one teacher nominated by HOD.

i) Evaluation (Internal and External)

i. 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.

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

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

iv. 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.

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

vi. 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.

ii) Transcripts (Format): Based on the above recommendations on the conversion of marks into percentage, the Higher Education Institutions may issue the transcript for each semester and a consolidated transcript indicating the performance in all semesters in terms of percentage.

g. MOOCs Courses: As per the mandates of UGC, the students have to register in the MOOCs online Courses. By keeping in the mind, the credits of M.Tech. Biotechnology Postgraduates, they have to complete at least 8 credits MOOCs courses in their entire degree program.

h. Division and Position: The division shall be awarded on the basis of final year result as given below in Table.

Percentage (%)	Division
Below 50%	Fail
50%-59.99%	II Division
60%-74.99%	I Division
75% & above	I Division with Honors

In case a student gets a below 50% marks in more than one subject, he / she has to repeat one or more of the subjects by registering for "Guided Study" in that semester. 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. (as per University Norms)

- If the students get below 50% marks in six theory subjects in an academic session, then he/ she will repeat the year.
- Whenever a student is permitted to repeat, the percentage with star will replace the old percentage.

i. Review and Re-evaluation:
Review and re-evaluation of the answer sheets shall be as per the university rules.

13. Rules for Backlogs / Supplementary Exams

i. A student failing in one or more courses may appear in the **supplementary examination** conducted by the University.
ii. Supplementary exams will be held within the notified schedule and as per University rules.
iii. Maximum permissible backlogs for promotion: As per University promotion rules.
iv. Students failing to clear backlogs within the **maximum duration** will not be awarded the degree.

14. Special Academic Requirements

i. Internship is mandatory for degree award; absence or failure will require repetition in the next academic cycle.
ii. Students must maintain minimum 75% attendance in each course to be eligible for appearing in examinations.

15. Other Specific Rules

i. Ragging in any form is strictly prohibited and punishable under University and State laws.
ii. Students must adhere to the Code of Conduct prescribed by Rama University.
iii. Wearing of prescribed Uniform during practical/field work is mandatory.
iv. Use of unfair means in examination will lead to disciplinary action as per University Examination Ordinance.

16. Exit Options (in Line with NEP Guidelines)

Not Applicable

17. Ex-studentship

i. 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.

ii. 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.

18. Re-admission

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

19. 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.

COURSE STRUCTURE

M. TECH.

Biotechnology

Under

Choice Based Credit System (CBCS)

2023-24

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)

2025-26

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. Recent advances in metabolomics, Systems biology approaches for understanding the mechanisms of metabolic diseases, Use of computational tools for metabolic pathway modeling.

Text / Reference Books:

1. Biochemistry- L.Stryer , Third Edition
2. Principles of Biochemistry - Nelson, D.L. and Cox, M.M. Lehninger (8th Edition, 2021, Macmillan).
3. Biochemistry - Berg, Tymoczko, Gatto. (9th Edition, 2023, W.H. Freeman).
4. Benjamin Lewin. Gene XII. Oxford University Press, Nelson Cox
5. Palsson, B. Systems Biology: Constraint-based Reconstruction and Analysis (2nd Edition, 2020, Cambridge).

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, SARS-CoV-2 variants.

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.
4. Prescott's Microbiology - Willey, Sherwood, Woolverton. (12th Edition, 2022, McGraw Hill).
5. Virology: Principles and Applications - Carter, J. & Saunders, V. (2nd Edition, 2020, Wiley).

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, LC-MS/MS, MALDI/TOF. 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.
2. Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, 5th Edition, Cambridge University Press, 2000.
3. Analytical Chemistry: A Modern Approach (3rd Edition, 2021, Wiley-VCH).
4. Principles and Practice of Biological Mass Spectrometry - Dass, C. (2020, Wiley).

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, mRNA vaccines, and nanoparticle-based vaccine.

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), Case study of COVID-19 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. Janeway's Immunobiology - Murphy, K. & Weaver, C. (10th Edition, 2021, Garland).
3. Immunology by Kuby (Freeman publication)
4. Essentials of Immunology by Roitt (Blackwell Scientific Publication)
5. Cellular and Molecular Immunology - Abbas, A.K., Lichtman, A. & Pillai, S. (10th Edition, 2022, Elsevier).

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, Endocrine Drugs: Female sex hormones and analogs, Agents affecting the immune Response.

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

Regenerative Medicine- introduction, Biomedical devices- case studies, Biosensors, organ-on-a-chip, role of Artificial Intelligence in diagnostics

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, Grietje Molema and Dirk K. F. Meijer, Wiley-VCH. (2002).
4. Biomedical Engineering: Bridging Medicine and Technology - Saltzman, W. (3rd Editon, 2021, Cambridge).
5. Biomaterials Science: An Introduction to Materials in Medicine Ratner, B. (5th Edition, 2022, Elsevier).
6. Organ-on-a-Chip Engineering Zhang, X. (2020, Springer).

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

Classification (IUB system) and nomenclature of enzymes, Structure–function relationship, active site, cofactors, and coenzymes, Catalytic mechanisms: acid-base, covalent, metal ion catalysis, Michaelis–Menten and advanced kinetics (multisubstrate systems), Enzyme inhibition (competitive, non-competitive, uncompetitive).

Unit-II

Microbial, plant, and animal sources of enzymes, Strain selection and genetic improvement, Fermentation strategies: submerged vs. solid-state fermentation, Downstream processing: precipitation, chromatography, membrane filtration, Case study: amylase production using Bacillus species.

Unit-III

Principles and need for immobilization, Methods of immobilization: adsorption, covalent binding, entrapment, cross-linking, Effects on enzyme kinetics and operational stability, Enzyme stabilization: additives, protein engineering approaches, Applications of immobilized enzymes in continuous processes.

Unit-IV

Food industry: brewing, dairy, baking, juice clarification. Pharmaceutical industry: drug synthesis, diagnostics, mRNA therapeutics.Textile and leather industry: bioscouring, denim finishing, dehairing. Environmental applications: bioremediation, wastewater treatment. Agricultural applications: feed enzyme supplements, biopesticides.

Unit-V

Recombinant enzymes and expression systems (E. coli, yeast, insect cells), Enzyme engineering: site-directed mutagenesis, directed evolution, Artificial enzymes and nanobiocatalysts, Enzymes in biosensors

Text / Reference Books:

1. Principles of Biochemistry, Nelson & Cox. Lehninger (8th Edition, 2021, Macmillan)
2. Biochemistry, Donald, V. and Judith G.V, 4th Edition, John Wiley & Sons Asia Pvt. Ltd. , New Jersey , 2011
3. Fundamentals of Enzymology, Nicholas C.P. and Lewis S., (3rd Editon), Oxford University Press Inc. New York.
4. Industrial Enzymes: Microbiology and Biotechnology, Pandey, A. et al. (2nd Edition, 2022, Springer).
5. Directed Evolution: Bringing New Chemistry to Life, Arnold, F.H. (Nobel Lecture Collection, 2021).

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. An Introduction to Biosimilars

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.
3. Tripathi, K.D., Essentials of Medical Pharmacology, Jaypee Brothers Medical Publishers (2008).
4. Biopharmaceuticals: Biochemistry and Biotechnology, Walsh, G. (6th Edition, 2022, Wiley).
5. Handbook of Biosimilars with Comparative Price Analysis, Ahuja, S. & Dong, M. (2020, Elsevier).

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.
4. Plant Tissue Culture: Techniques and Experiments, Smith, R. (4th Edition 2020, Academic Press).
5. Animal Cell Culture: Essential Methods, Davis, J.M. (2nd Edition, 2020, Wiley).
6. Culture of Animal Cells, Freshney, R.I. (8th Edition, 2021, Wiley).

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.
4. Introduction to Bioinformatics, Lesk, A.M. (6th Edition, 2021, Oxford). - Pevsner, J.
5. Bioinformatics and Functional Genomics (4th Edition, 2022, Wiley).
6. Machine Learning in Bioinformatics, Zhang, W. et al. (2021, Springer).

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. Gene cloning and DNA analysis, T.A Brown (2006), (8th Edition, 2020, Wiley), 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, 2nd Edition
4. Molecular Biology of the Gene, Watson, J.D. et al. (8th Edition, 2022, Pearson).
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, Personalized nutrition, Nutrigenomics.

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. Food Processing Principles & Applications by Ramaswamy and Marcotte, Taylor and Francis-CRC Publications.
2. Nutrition Science by B Srilakshmi, 2nd Edition, New Age International (P) Ltd.
3. Food Science by B Srilakshmi, 2nd Edition, New Age International (P) Ltd.
4. Food Microbiology by Frazier, 4th Edition, W.C. Mc Graw Hill Incorporation.
5. Food Packaging: Principles and practice by GL Robertson, 3rd Edition, Taylor and Francis group.
6. Food Chemistry by LH Meyer, Affiliated East and west Press Ltd., Bombay, 1987.
7. FSSAI Training manual.

Course Outcome:

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

CO1 : Obtain a good understanding of food biotechnology

CO2: Define microorganisms and their products in foods, understand causes of food spoilage and

CO3: Predict the microorganisms that can spoil a given food, when prepared, processed, and stored under given conditions

CO4: 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

CO5: 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. Mann & Trusswell, 2007. Essentials of human nutrition. 3rd edition .Oxford University Press.
2. Applied Science Biotechnology, Lindsay, Challenges for the flavour and Food Industry. Willis Elsevier.
3. Quality Control and Validation in Pharmaceutical Industry, Mehta, R. (2021, Springer).
4. Pharmaceutical Quality by Design: A Practical Approach, O'Hara, M. et al. (2nd Edition, 2020, Springer).

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, Production of climate resilient crops-like drought, salinity and temperature, Biofortification.

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. Biotechnology- An Introduction by Susan R. Barnum, Vikas Publishing House
4. Plant Biotechnology and Agriculture: Prospects for the 21st Century, Altman, A. & Hasegawa, P.M. (2nd Edition, 2022, Elsevier).
5. Agricultural Biotechnology: Latest Trends, Bhattacharya, J. (2021, Springer).

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. Biostructure 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. Biohydrogen production. 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. Environmental Biotechnology: Principles and Applications, Bruce E. Rittmann
2. Dahiya, A. (2015). Bioenergy: biomass to biofuels. Paperback ISBN: 9780124079090
3. Industrial Waste Water Management Treatment and Disposal by Waste Water McGraw Hill (3rd Edition) 2008.
4. Biological Wastewater Treatmen, Second Edition, Marcel Dekker, Inc., New York
5. Introduction to Waste Water Treatment- R. S. Ramalho, Academic Press.Environmental Biotechnology, B.C. Bhattacharya and Ritu Banerjee, Oxford Press, 2007.
6. Biofuels and Bioenergy: Processes and Technologies, Lee, J. & Shah, Y. (2021, Springer).

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- Response Surface Methodology, Artificial Neural Network, Fuzzy Logic, Advanced Statistical Tools and Softwares. High Throuput Screening of Industrial microbes

UNIT II

Process technology for the production of various Products: Primary metabolite: ethanol, citric acid, vinegar, amino acid, Biopharmaceutical precursors, Bioethanol from lignocellulosic feedstocks, Organic acids for bioplastics (lactic acid, succinic and fumaric acid), Vitamins and Nutraceuticals. 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), Next generation bioplastics (PLA and PBS), their biodegradability assessment, circular bioeconomy, production of anticancer compounds, Bioinsecticides, Bioherbicides, Biopolymers, Biofertilizers and biological weapons with reference to anthrax, Biocontainment Strategies related to GMOs in industrial biotechnology

UNIT IV

Production of industrially important enzymes: case studies of from detergent, food and pharmaceuticals. Production of Monoclonal antibodies and Recombinant proteins, Solid state fermentation, submerged fermentation, Scale-up strategies. Extraction, Purification and characterization of industrial enzymes, industrial processes 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., New Age International (P) Ltd. New Delhi.
2. Presott & Dunn's Industrial Microbiology. Ed. E.G., CBS Publishers, New Delhi.

3. Biotechnology: A Text book of Industrial Microbiology 2nd Edition. Crueger, W. and Cruger, A. (2000) Panima Publishing Corporation, New Delhi.
4. Industrial Biotechnology: Microorganisms and Bioprocesses, R.S. Singh et al. (2021), Elsevier.
5. Bioprocessing for Value-Added Products from Renewable Resources - Pandey, A. et al. (2020) (2nd Edition), Elsevier).

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

Nanoparticles types and their synthesis, Green synthesis of nanoparticles using plants and microbes, Nanomaterials and Nanoparticles: Carbon nanotubes and related structures, Properties, Synthesis, Applications, Bucky balls,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. Biomolecular computation for Bio nanotechnology, Liu and Shimohara, Artech House-London, 2007
5. Nanotechnology in Drug Delivery and Tissue Engineering - Sahoo, S.K. and Labhasetwar, V. (2020, CRC Press).

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- P F Stanbury and A Whitaker, Pergamon press.
2. Bioprocess Technology - Kinetics and Reactors, A Moser, Springer-Verlag.
3. Bioprocess Engineering Principles- Pauline M. Doran, Academic Press.
4. Biochemical Engineering- S. Aiba, A.E. Humphray, University of Tokyo Press.
5. Biochemical Engineering, Lee J.M, 2nd Edition, Prentice Hall, 2000.
6. Principles of Cell Energetics: BIOTOL series, Butterworth - Heinemann.
7. Bioprocess Engineering: Basic Concepts, Shuler, M.L. & Kargi, F. (3rd Edition, 2020, Prentice Hall).

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
5. Advances in Fermentation Technology, R.S. Singh et al. (2021, Springer).

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 endocrine 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. Overview of Point-of Care rapid tests and their applications in infectitious diseases

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. Essentials of Diagnostic Microbiology, Lisa Anne Shimeld.
2. Commercial Biosensors: Graham Ramsay, John Wiley & Son, INC.
3. Molecular Diagnostics: For the Clinical Laboratorian, Coleman, W.B. & Tsongalis, G.J. (4th Edition, 2020, Springer).
4. The Science of Laboratory Diagnosis, Crocker Burnett.
5. Molecular Diagnostics, Patrinos, G.P. & Ansorge, W.J. (4th Edition, 2021, Academic Press).

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, Organoids and 3D Bioprinting.

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, ICMR guidelines for stem cell research in India.

UNIT V

Neurodegenerative diseases; Parkinson's, Alzheimer, Spinal Cord 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. Developmental Biology, R.M.Twyman, Viva Books Pvt. Ltd., 2001
2. Stem Cell Biology, David Gottlieb, Cold Spring Harbor, 2002
3. Principles of Regenerative Medicine, Lanza, R., Atala, A. (3rd Edition, 2020, Elsevier).
4. Cell Biology and Translational Medicine (Stem Cells and Regenerative Medicine series), Turksen, K. (2021–2023, Springer).
5. Engineering Stem Cells for Clinical Applications, Martin, U. (2021, Springer).

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

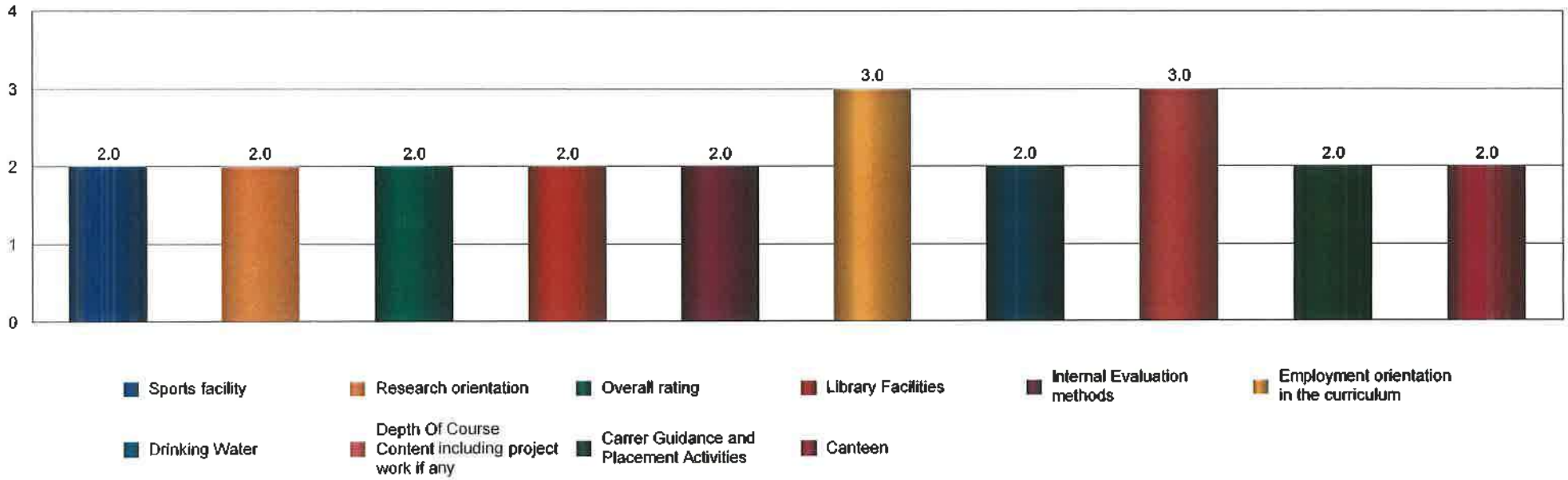
MBT-353 BIOPROCESS ENGINEERING & TECHNOLOGY LAB

L: T: P

0: 0: 4

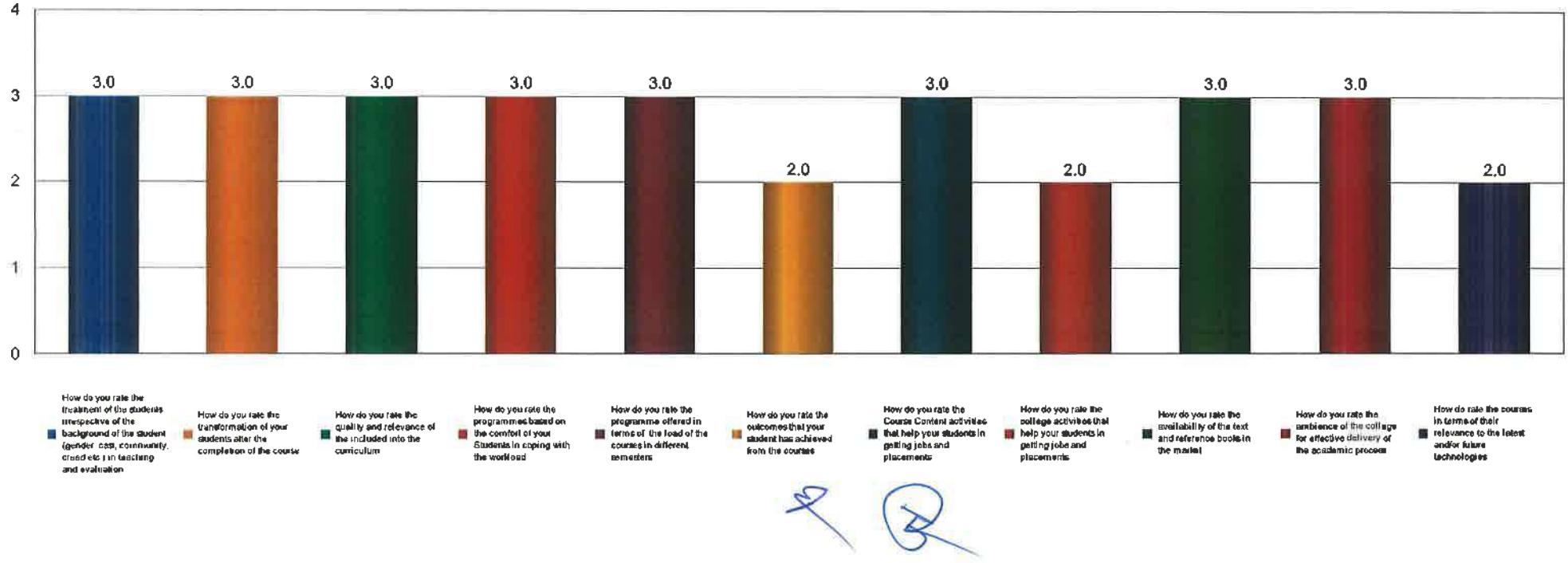
1. Determination of kinetic parameters for batch cultivation of yeast under shake flask conditions.
2. Determination of volumetric oxygen transfer coefficient (KLa)
3. Determination of activation energy (Ea) of microbial strains.
4. Process optimization for enzyme production using specific experimental 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.

Curriculum Program Feedback Analysis [Alumni Student], Session : 2024-2025



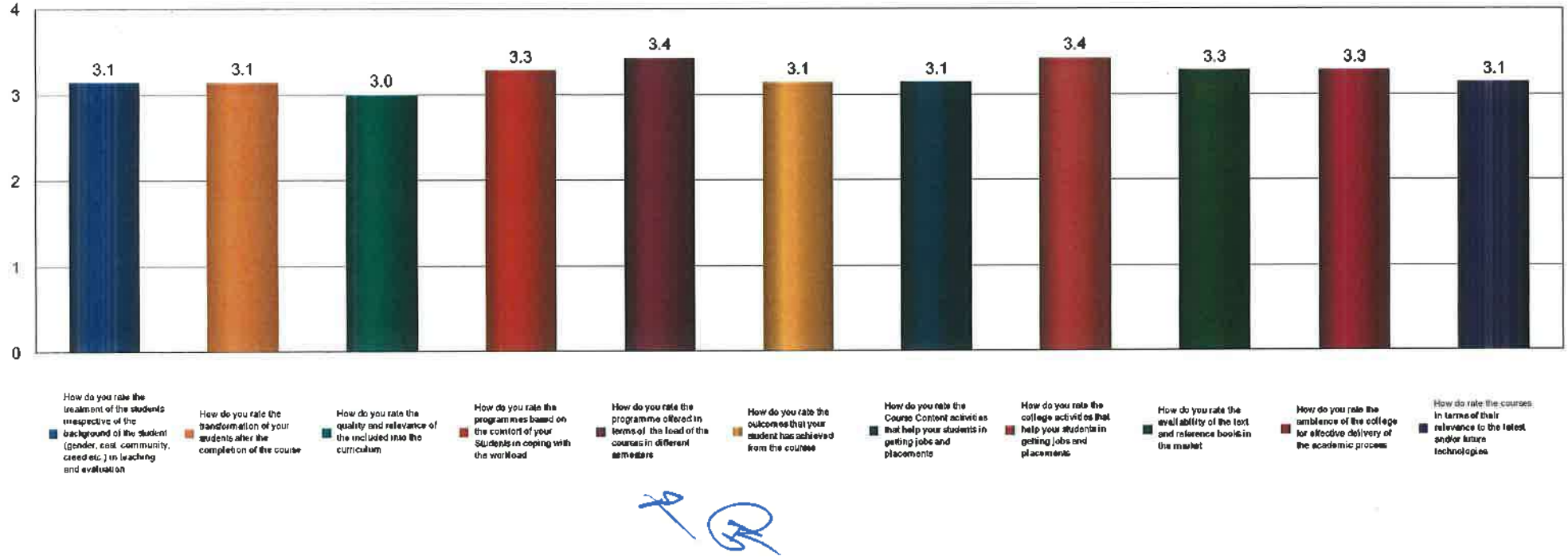
Department	Program	Sports facility	Research orientation	Overall rating	Library Facilities	Internal Evaluation methods	Employment orientation in the curriculum	Drinking Water	Depth Of Course Content including project work if any	Career Guidance and Placement Activities	Canteen
DEPARTMENT OF BIOTECHNOLO	M.TECH	2.0	2.0	2.0	2.0	2.0	3.0	2.0	3.0	2.0	2.0

Curriculum Program Feedback Analysis [Faculty], Session : 2024-2025



Department	Program	How do you rate the treatment of the students irrespective of the background of the student (gender, cast, community, creed etc.) in teaching and	How do you rate the transformation of your students after the completion of the course	How do you rate the quality and relevance of the included into the curriculum	How do you rate the programmes based on the comfort of your Students in coping with the workload	How do you rate the programme offered in terms of the load of the courses in different semesters	How do you rate the outcomes that your student has achieved from the course	How do you rate the Course Content activities that help your students in getting jobs and placements	How do you rate the college activities that help your students in getting jobs and placements	How do you rate the availability of the text and reference books in the market	How do you rate the ambience of the college for effective delivery of the academic process	How do rate the courses in terms of their relevance to the latest and/or future technologies
DEPARTMENT OF BIOTECHNOLO	M.TECH	3.0	3.0	3.0	3.0	3.0	2.0	3.0	2.0	3.0	3.0	2.0

Curriculum Program Feedback Analysis [Faculty], Session : 2024-2025



Department	Program	How do you rate the treatment of the students irrespective of the background of the student (gender, cast, community, creed etc) in teaching and	How do you rate the transformation of your students after the completion of the course	How do you rate the quality and relevance of the included into the curriculum	How do you rate the programmes based on the comfort of your Students in coping with the workload	How do you rate the programme offered in terms of the load of the courses in different semesters	How do you rate the outcomes that your student has achieved from the courses	How do you rate the Course Content activities that help your students in getting jobs and placements	How do you rate the college with ties that help your students in getting jobs and placements	How do you rate the availability of the text and reference books in the market	How do you rate the ambience of the college for effective delivery of the academic process	How do rate the courses in terms of their relevance to the latest and/or future technologies
DEPARTMENT OF BIOTECHNOLOGY	B.SC(HONS.)	3.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	B.TECH	2.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	M.SC	3.0	3.0	2.0	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0
	M.TECH	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING	B.TECH	4.0	3.0	3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0
	BCA	3.0	4.0	3.0	4.0	4.0	3.0	3.0	4.0	4.0	4.0	4.0
	MASTER OF COMPUTER APPLICATIONS	4.0	4.0	4.0	4.0	4.0	3.0	4.0	4.0	3.0	3.0	4.0