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. Samaks Verma" <samakshiverma.fet@ramauniversity.ac.in>, "Dr. Renu Verma" <renuverma.fet@ramauniversity.ac.in>, "Dr. Deek Ranjan" <drdeeksha.fet@ramauniversity.ac.in>, "Dr. Vivek Srivastava FET" <drviveksrivastava.fet@ramauniversity.ac.in>

Dr

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 Science
(Biotechnology)

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

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

Website: www.ramauniversity.ac.in

Ref: RU/FET/BT/BOS/2025/004 **Dated: 21.08.2025**

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

The Board of Studies meetings of M. Sc. 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/MSC/001**	To consider and approve the changes in Syllabus for M.Sc. Biotechnology students to be admitted in the Academic Session 2025–2026	The Board of Studies (BOS) recommended continuing the same syllabus and evaluation scheme for Academic Session 2025–2026, with the following modifications across all semesters: In the **1st semester**, MSBT-114 shall be restructured with updated topics, while Unit V of the same course will be shifted to MSBT-211 in the 2nd semester. In the **2nd semester**, Unit I of MSBT-212 will be rearranged and supplemented, and Unit III of MSBT-212 will undergo revision and renaming for improved clarity. For the **3rd semester**, DNA isolation and synthesis in MSBT-314 will be reorganized, and Unit I of

			MSBT-313 will be revised with new, updated topics. Finally, in the **4th semester**, the contents of MSBT-411 will be rearranged and enriched with additional material to reflect emerging trends in the discipline.
2	**RU/FET/BT/BOS/2025/MSC/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/MSC/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 requirement.

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. ..... 21/08/25

Name: Dr. Neeraj

Signature: 2..... 21/8/2025

Name: Dr. Ajay Kumar

Signature: 3.....

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.Sc. (
202

ORDINANCE

For

PROGRAMME

M.Sc. (Biotechnology)

2025-26

1. Program Name & Code

- **Program Name:** Master of Science in Biotechnology (M. Sc. Biotechnology)
- **Program Code:** 1005

2. Eligibility Criteria

Candidates who have passed B. Sc. Biotechnology/Biosciences/ Agricultural are eligible for admission of 2 years M.Sc. program offered by Faculty of Engineering & Technology, Rama University, Kanpur.

3. Number of seats

Number of students to be admitted each year and the number of batches shall be decided and notified by the University from time to time; based upon the Rules, instructions and Notifications issued by UGC.

4. Admission Procedure

1. 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.
2. Reservation policy as per Government of Uttar Pradesh/University norms will be followed.
3. Final selection will be subject to verification of original documents and fulfillment of eligibility criteria.

5. Duration of Program

i. The Program shall consist of regular study for a minimum period of 4 semesters in two academic years, after undergraduates.
ii. The course of study shall be by regularly attending the requisite number of lectures, tutorials and practical training.
iii. The 1st and 3rd semesters shall ordinarily be from 1st July to 31stDecember; however, the First semester shall ordinarily begin from 1st August. The remaining semesters shall be from 1st January to till 30th June subject to change, if any notified by the Vice Chancellor and other competent authorities; from time to time. The periods are inclusive of the time for examinations.
iv. Total duration of the M.Sc. course shall be 2 years, each year comprising of two semesters. Each semester shall normally have teaching for the 90 working days or as prescribed by UGC from time to time.
v. A candidate, who has failed twice in first year due to any reason (either due to his/her non-appearance or he/she being not permitted to appear in semester examinations) shall not be allowed to continue his/her studies.

6. 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.

7. Curriculum

i. The 2 Year curriculum has been divided into 4 Semesters and shall include lectures, tutorials, practical's, seminars and projects etc. in addition to industrial training and educational tour etc. as defined in the scheme and executive instructions issued by the University from time to time.

ii. The curriculum will also include such other curricular, co-curricular and extra- curricular activities as may be prescribed by the University from time to time.

8. Minimum Requirement to Continue in the Program

The M. Sc. Program has a total of 92 credits and students are required to complete all courses. On completion of all courses, the students shall earn 92 credits and would be eligible for award of the M. Sc. Degree.

9. Fee

A student shall pay the fee prescribed by the University from time to time

10. Medium of Instruction

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

11. Structure of the Program

The program shall follow the model of UGC curriculum framework for Postgraduate Biotechnology education, comprising:

S. No.	Category	UGC Suggested Credits (M.Sc.)	Credits Achieved by Department
1.	Core Courses + Project Work	80-85	87

2.	Open Elective Courses	10-15	5
Total Credits		**90-100**	**92**

1. **Core Courses**

Biomolecules, Microbiology, Bio-analytical Techniques and Biostatistics, Cell Biology, Molecular Biology, Biology of Immune System, Genetics, Enzymology and Enzyme Technology, Bioenergetics and Metabolism, Bioinformatics, Plant Biotechnology, Animal Biotechnology, Industrial Biotechnology, Genetic Engineering, Environmental Biotechnology, IPR, Patent, Trademarks, GI and Bioethics, Project work and their Associated Labs are Microbiology Lab, Bio-Chemical Analysis and Techniques Lab, Cell and Molecular Biology Lab, Immunology Lab, Enzyme Technology Lab, Bioinformatics Lab, Plant Biotechnology Lab, Genetic Engineering Lab.

2. **Departmental Elective Courses**

Departmental Electives I – IV (any 4 may be offered based on specialization: Nanotechnology, Food Processing and Biotechnology, Bioprocess Engineering, Medical and Pharmaceutical Biotechnology and their associated Labs are Nanotechnology Lab, Food Processing and Biotechnology Lab, Bioprocess Engineering Lab, Medical and Pharmaceutical Biotechnology Lab.

Credit Requirement for Award of Degree (M.Sc. Biotechnology): 92 credits will be achieved after completion of M. Sc Program.

12. Marks/Credits Distribution

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

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

   Continuous Assessment (CA): 20 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 = 20, 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 (CA = 30, MTE = 20).

For **Project Work** evaluation will follow a specific pattern:

MTE distribution as per specific weightage (e.g., Project Work: CA = 50, MTE = 50). Final evaluation based on progress, mid-term presentation, viva-voce, and report.

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

   End-Term Examination (ETE): 60 marks for all theory course and 50 marks for all practical courses. ETE distribution as per specific weightage (e.g., Project Work: 200).

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

13. 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 100 marks. The marks obtained by each student in courses shall be converted to Grade-Points. Uniform Grading system to be followed with uniform CGPA requirements for award of degrees at all levels and uniform conversion formulae to be followed for

declaration of I, II and III divisions, distinctions etc. Declaration of division in the degree certificate to be made compulsory.

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:

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, practical's 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, practical's 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. To qualify a subject a student is required to secure a minimum of 30% marks in both internal as well as external separately and grand total required for a subject is minimum 40%. A student who secure less than 50% of marks in aggregate in a semester shall be deemed to have failed in that semester.

v. The minimum pass marks in a project/practical subject (including sessional marks if any) shall be 50% (internal 50%, External 50% and aggregate 50%).

vi. A candidate, in order to pass, must secure 50% marks in the aggregate in a particular academic year inclusive of each semesters of the academic year.

vii. The minimum pass marks in Seminar, Industrial Training and Educational Tour, Viva-Voice etc shall be 50%.

viii. In Non-Credit Courses (Non grading courses) a student's must secure 40% marks to qualify the courses.

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.Sc. 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.

14. Rules for Backlogs / Supplementary Exams

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

15. Special Academic Requirements

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

16. Other Specific Rules

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

17. Exit Options (in Line with NEP Guidelines)

Not Applicable

18. Carryover System

i. A candidate who satisfies the requirements of clause 15.2 (a) will be required to appear in those theory papers / practical's in which he/she failed. However, a candidate of first year will be allowed to appear in the second semester examination in those theory/ practical subjects in which he/she failed in the first semester examination, provided examination of those theory/practical subjects are held in second semester.
ii. A candidate satisfying clause 15.2 (b) shall be required to exercise his/her choice up to a maximum of Six theory papers in which he/she desires to appear in the examination to fulfill the requirements of clause 13.6. He/she shall inform the college about his/her choice within 15 days after the start of new session.
iii. The highest marks secured in any subject in various attempts (end semester and carryover examinations) shall be considered.

19. 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 Sessional, 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.

20. Re-admission

A candidate may be allowed for re-admission provided he/she satisfies one of the following conditions:

i. A candidate is declared fail.

ii. A candidate did not appear in a semester examination / or he/she was not granted permission to appear in the examination.
iii. A candidate has been detained by the department and subsequently has been permitted to take re-admission.
iv. A candidate as an ex-student passed the examination of the academic year or qualified for carryover system.
v. A candidate promoted with carry over subjects and he/she opted for re-admission.

21. Scrutiny and Revaluation

i. Scrutiny shall be allowed in maximum three theory papers only as University norms.
ii. Revaluation shall be allowed in maximum three theory papers only as University norms.

22. Unfair means

Cases of unfair means shall be dealt as per the rules of the University and The U.P. Public Examination (Prevention of Unfair means) Act if any in prevalence.

23. Cancellation of Admission

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

(i) He / She is not found qualified as per UGC/AICTE / State Government norms and guidelines or the eligibility criteria prescribed by the University.

or

(ii) He / She is found unable to complete the course within the stipulated time as prescribed in clause 2.vi

or

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

24. The Academic Council shall have the power to relax any provision provided in the ordinance in any specific matter/situation subject to the approval of Executive Council of the University & such decision(s) shall be reported to the Chancellor of the University.

COURSE STRUCTURE

M.Sc.

BIOTECHNOLOGY

2023-24

Course Curriculum (w.e.f. Session 2023-24)
M.Sc. Biotechnology
FET, Rama University

Credit distribution summary and comparison with UGC 2018 Model Curriculum

Year	1st Year		2nd Year	
Sem	1st Sem	2nd Sem	3rd Sem	4th Sem
Credit*	23	23	23	23
Contact Hour*	26	26	26	28

Course Curriculum (w.e.f. Session 2023-24)
M.Sc. Biotechnology
FET, Rama University

1st Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Program Core	MSBT-111	Biomolecules	4	0	0	4	20	20	60	100
2	Program Core	MSBT-112	Microbiology	4	0	0	4	20	20	60	100
3	Program Core	MSBT-113	Bio-analytical Techniques and Biostatistics	4	0	0	4	20	20	60	100
4	Program Core	MSBT-114	Cell Biology	4	0	0	4	20	20	60	100
5	Program Core	MSBT-115	Molecular Biology	4	0	0	4	20	20	60	100
6	Program Core	MSBT-161	Cell and Molecular Biology Lab	0	0	2	1	30	20	50	100
7	Program Core	MSBT-162	Biochemical Analysis and Techniques Lab	0	0	2	1	30	20	50	100
8	Program Core	MSBT-163	Microbiology Lab	0	0	2	1	30	20	50	100
	Total			20	0	6	**23**	190	160	450	800
			Theory	**5**	**Lab**	**3**					

Course Curriculum (w.e.f. Session 2023-24)
M.Sc. Biotechnology
FET, Rama University
2nd Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Program Core	MSBT-211	Biology of Immune System	4	0	0	4	20	20	60	100
2	Program Core	MSBT-212	Genetics	4	0	0	4	20	20	60	100
3	Program Core	MSBT-213	Enzymology and Enzyme Technology	4	0	0	4	20	20	60	100
4	Program Core	MSBT-214	Bioenergetics and Metabolism	4	0	0	4	20	20	60	100
5	Program Core	MSBT-215	Bioinformatics	4	0	0	4	20	20	60	100
6	Program Core	MSBT-261	Bioinformatics Lab	0	0	2	1	30	20	50	100
7	Program Core	MSBT-262	Immunology Lab	0	0	2	1	30	20	50	100
8	Program Core	MSBT-263	Enzyme Technology Lab	0	0	2	1	30	20	50	100
	Total			20	0	6	**23**	190	160	450	800

Theory	**5**	**Lab**	**3**

Course Curriculum (w.e.f. Session 2023-24)
M.Sc. Biotechnology
FET, Rama University

3rd Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Program Core	MSBT-311	Plant Biotechnology	4	0	0	4	20	20	60	100
2	Program Core	MSBT-312	Animal Biotechnology	4	0	0	4	20	20	60	100
3	Program Core	MSBT-313	Industrial Biotechnology	4	0	0	4	20	20	60	100
4	Program Core	MSBT-314	Genetic Engineering	4	0	0	4	20	20	60	100
5	Open Elective	MSBT 325 – MSBT 328	Open Elective (Opt any one)	4	0	0	4	20	20	60	100
6	Program Core	MSBT-361	Plant Biotechnology Lab	0	0	2	1	30	20	50	100
7	Program Core	MSBT-362	Genetic Engineering Lab	0	0	2	1	30	20	50	100
8	Open Elective	MSBT 363 to MSBT 366	Open Elective Lab (Opt any one)	0	0	2	1	30	20	50	100
			Total	20		6	**23**	190	160	450	800
			Contact Hour	**26**							
			Theory	**5**		**Lab**	**3**				

Open Elective	Specialization Theory			
Course Code	MSBT-325	MSBT-326	MSBT-327	MSBT-328
Course Name	Nanotechnology	Food Processing and Biotechnology	Bioprocess Engineering	Medical and Pharmaceutical Biotechnology
Specialization Practical				
Course Code	MSBT-363	MSBT-364	MSBT-365	MSBT-366
Course Name	Nanotechnology Lab	Food Processing and Biotechnology Lab	Bioprocess Engineering Lab	Medical and Pharmaceutical Biotechnology Lab

4th Semester

S. No	Course Type	Course Code	Course Name	L	T	P	Cr	CA	MTE	ETE	Total
1	Program Core	MSBT- 411	Environmental Biotechnology	4	0	0	4	20	20	60	100
2	Program Core	MSBT- 412	IPR, Patent, Trademarks, GI and Bioethics	4	0	0	4	20	20	60	100
3	Program Core	MSBT- 461	Project work	0	0	20	15	50	50	200	300
	Total			8	0	20	**23**	90	90	320	500
			Contact Hour	**28**							
			Theory	**2**	**Lab**	**20**					

Rama University Uttar Pradesh, Kanpur
Faculty of Engineering and Technology
Department of Biotechnology

COURSE STRUCTURE

M. Sc.

BIOTECHNOLOGY

2025-26

SEMESTER - I

MSBT-111 BIOMOLECULES

Objective: The objectives of this course are to build the knowledge of post graduate students about the classification, structure, properties, functions and interactions of different biomolecules. The course shall make the students aware of significance of various biomolecules necessary to maintain the living organisms.

Credits: 04 **Semester I** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Physical and chemical Properties of water, Molecular Interactions: Non-covalent interactions, Electrostatic, Hydrogen bonding, Vander Waals interactions, Hydrophobic and Hydrophilic interactions. Disulphide bridges. pH, pK, acid base reactions and buffers.	10
II	Carbohydrates – Structure, Properties, and Biological Roles, Structure and Properties of Monosaccharides-, Disaccharides-, and Polysaccharides (starch, glycogen, cellulose and chitin) and glycosaminoglycans (chondroitin sulfate and Hyaluronic acid).Carbohydrate microarray and applications.	10
III	Amino Acids: Classification, Structure, and Properties. Protein isolation and purification. Primary and Secondary Structure of Proteins- determination of amino acid composition and sequence. Secondary structure-α-helix, β-pleated sheet, collagen triple helix, β-bends and structural motifs. Tertiary and quaternary structures of proteins. Solid phase peptide synthesis. Derived proteins.	10
IV	Lipids: Classification, structure, properties and functions of fatty acids, triglycerides, phospholipids, sphingolipids. Terpenes, Cholesterol and eicosanoids. Structure and functions of vitamins – A, D, E, K and B-complex and Vitamin C.	10
V	Nucleic Acids: DNA: Basic unit of DNA, Structure and properties of DNA, Alternative forms of DNA: A-DNA, B-DNA, Z-DNA Circular DNA and DNA supercoiling, RNA: Basic unit of RNA, Structure and properties of different types of RNA.	10

Outcome: At the end of the course the student understands

1. Understand the role of non-covalent interactions in biomolecules.
2. Understand the chemical structure and biological functions of carbohydrates
3. Understand the chemical structure and biological functions of proteins and nucleic acids.
4. Understand the chemical structure and biological functions of lipids and vitamins

Reference Books/ Text Book / Cases:

1. Lehninger, A. L. (1982). Principles of biochemistry (4th ed.). New York, NY: Worth
2. Voet, D., &Voet, J. G. (2004). Biochemistry (4th ed.). Hoboken, NJ: J. Wiley & Sons. Biochemistry and Molecular Biology, Third Edition by William H. Elliott and Daphne C. Elliott, Oxford University press

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	L	H	M	-
CO2	-	L	H	M	-
CO3	-	L	H	M	-
CO4	-	L	H	M	-

H = Highly Related; M = Medium; L = Low

MSBT-112 MICROBIOLOGY

Objective: The historical concept of spontaneous generation used to establish the link between a microorganism and a disease, describe some of the activities of microorganisms that are beneficial to humans.

Credits: 04 **Semester I** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
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. Bergey's classification of bacteria, classification of Achaea, Sterilization -physical, chemical and radiation methods.	8
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, Numerical taxonomy, chemotaxonomy and ribotyping. Culture independent techniques-metagenomics	8
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.	8
IV	Bacterial recombination - Transformation, conjugation and transduction. Mapping of prokaryotic genome. Transposons, Insertion sequences, and mechanism of transposition, retrotransposons and Plasmids; Clinically important bacteria - S.aureus, V.cholera, M. tuberculi, Fungi - Candidiosis. SCP, economic importance of algae and fungi.	8

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.	8

Outcome: At the end of the course the student understands

1. Identify and classify the taxon of bacteria based on various characteristic features
2. Learn various microscopic techniques to study ultrastructure of microorganisms and their diversity
3. Understand the effect of physical factors that influence the microbial growth

Reference Books/ Text Book / Cases:

1. Microbiology, Authors- Pelczar, Chan andKreig.
2. Microbiology- an Introduction- (8th Edn), Authors- Tortora, G.J., Funke, B.R., Case, C.L.
3. Microbiology, Authors- Presscott, Herley andKlein.
4. Textbook of Microbiology, Authors- Dubey andMaheshwari.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	L	L	H	H	H
CO2	L	M	H	H	L
CO3	M	H	H	M	M

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-113 BIOANALYTICAL TECHNIQUES AND BIOSTATISTICS

Objective: To make the students aware of the principle, operation and applications of various techniques used to analyse biomolecules. To understand the description, tabulation and graphical representation of scientific data by means of statistical tools.

Credits: 04 **Semester I** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Principles and applications of chromatographic techniques: paper chromatography, thin layer chromatography, gel filtration, ion-exchange chromatography, affinity chromatography, GC, HPLC and GC-MS.	8
II	Principles and concepts of electrophoretic techniques: native PAGE, SDS PAGE, agarose gel electrophoresis, capillary electrophoresis, isoelectric focusing, two dimensional, pulse field and diagonal electrophoresis.	8
III	Principles and applications of UV-Visible, Raman, infrared, ORD, CD, X-ray diffraction, NMR, ESR, Mass spectrometry, MALDI-TOF and fluorescence spectroscopy. Principles and applications of preparative and analytical ultracentrifuges	8
IV	Radioactive and non-radioactive tracer techniques and their applications in biological sciences. Detection and measurement of radioactivity. Principles of electrochemical techniques – operation and applications of pH, oxygen, ion-selective and gas sensing electrodes. Biosensors - principle, design and applications.	8
V	Scientific data description, tabulation and graphical representation. Measures of central tendency and dispersion - mean, median, mode, range, standard deviation, variance. Types of errors and level of significance. Tests of significance - F and t - tests, chi-square tests, ANOVA. Simple linear regression and correlation.	8

Outcome: At the end of the course the student understands

1. Understand the separation and purification of various biomolecules using these techniques.
2. Understand the separation of biomolecules based on spectroscopic techniques.

3. Be familiar with the principle, operation and applications of various electrodes and biosensors.
4. To apply the knowledge of statistics in representing the scientific data in various formats.

Reference Books/ Text Book / Cases:

1. Biophysical chemistry principles and techniques by Upadyay Upadyay&Nath, Himalaya publishing House.
2. Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson & John Walker, 7th Edition, Cambridge University Press.
3. Mahajan B. K., Methods in Biostatistics, Jaypee Brothers Pub., New Delhi, 2010.
4. Fundamentals of Biostatistics by Khan & Khanum, Ukaaz publications.
5. Biostatistics by Daniel, 10th Edition, Wiley Publishers.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	L	M	M	M	M
CO2	L	-	M	H	H
CO3	H	L	M	H	-
CO4	H	M	-	H	M

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-114 CELL BIOLOGY

Objective: To familiarize the students with the basic concepts of cell structure and cell division. To enable students understand classical genetics and concepts of population genetics. Students will be exposed to different theories of evolution.

Credits: 04 **Semester I** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Ultrastructure of bacterial, plant and animal cells: Cell Wall, Extracellular matrix, plasma membrane, Functions of different membrane: membrane channels and pumps, membrane transport, Cell organelles: Structure and functions of- mitochondria, chloroplast, endoplasmic reticulum, golgi, lysosomes, ribosomes and structure and function of cytoskeleton elements.	8
II	Structure and function of nucleus, Different types of chromosomes, Structure of chromosomal organization in the nucleus: Heterochromatin and euchromatin.	8
III	Cell cycle: Different phases(G1-S-G2-M) of cell cycle, Types and mechanism of cell division - amitosis, mitosis and meiosis. Regulation of cell division.	8
IV	Signal transduction. G proteins, Secondary messenger concept - cAMP, cGMP, calcium, phosphotidyl inositol, nitric oxide, membrane receptor tyrosine kinases and growth factor signaling cascades.	8
V	Signal transduction: Cell-cell communication, cellular response to the environment. Signaling via G-protein linked cell-surface receptors, adenylatecyclase system, inositol phosphate pathway, role of Ca2+ ions; Signalling via enzyme-linked surface receptors, tyrosine kinases; Steroid receptors.	8

Outcome: At the end of the course the student understands

1. To apply knowledge of cell biology in various cellular functions.
2. Acquire basic knowledge on cell structure and function, transport in a cell, protein trafficking in the cell
3. Understand the cell-cell communication, cell division, and cell death.

Reference Books/ Text Book / Cases:

1. The cell: A Molecular Approach byG.M. Cooper
2. Molecular Cell biology by Lodish et al
3. The world of Cell by Becker et al
4. Cell and Molecular Biology: concepts and Experiments by Gerald Karl
5. The Cell: Bruce Alberts

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	M	-	M	M	L
CO2	L	H	H	H	-
CO3	L	H	H	H	-

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-115 MOLECULAR BIOLOGY

Objective: The objectives of this course are to make students understand how molecular machines are constructed and regulated so that they can accurately copy, repair, and interpret genomic information in prokaryotes and eukaryotic cells. Further, to appreciate the subject of molecular biology as a dynamic and ever-changing experimental science.

Credits: 04 **Semester I** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Nature of genetic material, organization of genetic material in prokaryotes and eukaryotes. Structure of chromatin, Fine structure of the gene. Different kinds of genes- split genes, overlapping, assembled, polyprotein and nested genes. Gene amplification and polytene chromosome. C-Value paradox, Mitochondrial and plastid genomes.	8
II	DNA replication – Types of DNA polymerases. Mechanism of DNA replication. Enzymes and accessory proteins involved in DNA replication. Replication of telomeres and its significance. Differences in prokaryotic and eukaryotic DNA replication and regulation. DNA damage and repair.	8
III	Transcription in prokaryotes and eukaryotes. Mechanism of transcription, types of RNA Polymerases and Promoter-Polymerase interactions. Transcriptional factors. Processing of mRNA, tRNA and rRNA. RNA editing and transport. Molecular Tools- Run-Off Transcription and G-Less Cassette Transcription. Nuclear Run-On Transcription, Reporter Gene Transcription	8
IV	Translation in prokaryotes and eukaryotes: Genetic code, translational machinery, mechanism of initiation, elongation and termination. Regulation of translation, Co- and Post- translational modifications. Leader sequences and protein targeting. Measuring Protein Accumulation in vivo. Methods for studying DNA-protein interactions: EMSA, DNase I footprinting, methylation interference assay and CHIP. Methods for studying protein-protein interactions: Co-immunoprecipitation, Pull-down assay, Cross-linking protein interaction analysis, Label transfer protein interaction analysis, Far–western blot analysis.	8
V	Regulation of gene expression in prokaryotes and eukaryotes- the operon concept, Negative and Positive control and Attenuation. Role of Enhancers,	

	Cis-trans elements, DNA methylation and Chromatin remodeling in gene expression. Environmental regulation of gene expression. RNAi and gene silencing, Genome editing mechanisms- ZFNs, TALENS, CRISPR-Cas9.	8

Outcome: At the end of the course the student understands

1. To develop basic knowledge on molecular architecture of prokaryotic and eukaryotic genomes
2. To understand various molecular events that lead to duplication of DNA
3. To learn the basic mechanism and methods to measure rate of gene expression and functional product formation
4. To identify molecular mechanisms behind different modes of gene regulation in bacteria and eukaryotes.

Reference Books/ Text Book / Cases:

1. Biochemistry by L Stryer, 8th Edition, WH Freeman publishers.
2. Lewin's Genes XI by JE Krebs, ES Goldstein & ST Kilpatrick, Student Edition, Jones &
3. Bartlett publishers.
4. Cell and Molecular Biology by DeRoberties & DeRoberties, 8th Edition, S Chand & Co..
5. Freifelder's Essentials of Molecular Biology by GM Malacinski, 4th Edition, Jones & Bartlett.
6. DNA Science: A First Course by DA Micklos et al., 2nd Edition, Carolina Publishing Company.
7. Molecular Biology of the Gene by JD Watson et. al., 7th Edition, Benjamin-Cummings Pub. Co
8. Molecular Biology by Robert F Weaver, 5th Edition, McGraw-Hill.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	M	-	M	M	L
CO2	L	H	H	H	-
CO3	L	H	H	H	-
CO4	L	H	H	M	-

H = Highly Related; M = Medium; L = Low

MSBT-161 CELL AND MOLECULAR BIOLOGY LAB

Objective: The course aims at providing students with the methodological concepts and tools needed to acquire top-level skills in the field of cell and molecular biology.

Credits: 01 **Semester I** **L-T-P: 0-0-2**

Module No.	Contents	Lab Hours
I	• Chromosome preparation: Mitosis-Onion root tip/human lymphocytes • Chromosome preparation: Meiosis- Rat/mouse testis/Grasshopper testis/ anthers. • Estimation of DNA content in the given sample by diphenylamine method • Determination of Tm of DNA and RNA. • Isolation of bacterial/fungal Plasmid and genomic DNA. • Isolation of plant DNA. • Purification of DNA through columns. • Polyacrylamide Gel Electrophoresis or Agarose gel electrophoresis of DNA	30

Outcome: At the end of the course the student understands

1. Use and explain the bio analytical instruments for the identification and separation different cells and biomolecules.
2. Utilize their knowledge for the research work during their higher studies.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	L	M	M
CO2	L	M	-	-	-

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-162 BIOCHEMICAL ANALYSIS AND TECHNIQUES LAB

Objective: The objectives of this course are to provide hands on experience to post graduate students on quantitative analysis and separation of biomolecules by chromatography techniques and analysis of biomolecules by spectroscopy.

Credits: 01 **Semester I** **L-T-P: 0-0-2**

Module No.	Contents	Lab Hours
I	• Determination of molar extinction coefficient of aromatic amino acid • Estimation of proteins by Lowry methods • Estimation of carbohydrate by Anthrone method • Determination of iodine value of oils • Separation of amino acids by paper chromatography • Separation of lipids by thin layer chromatography • Separation of amino acids by ion exchange chromatography • Separation of proteins by gel filtration chromatography • Separation of proteins by SDS PAGE and determination of molecular weight • Purification of protein by affinity chromatography	30

Outcome: At the end of the course the student understands

1. Quantify the biomolecules.
2. Understand the principle of various biochemical separation techniques. Appreciate the principle and biochemical analysis by spectroscopy.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	L	M	M
CO2	L	M	-	-	-

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-163 MICROBIOLOGY LAB

Objective: This course is formulated to provide exposure to the students with media preparation techniques and basic concepts of sterilization.

Credits: 01 **Semester I** **L-T-P:0-0-2**

Module No.	Contents	Lab Hours
I	• Basic laboratory techniques for isolation, cultivation and cultural characteristics of bacteria, isolation of pure culture from mixed population. • Biochemical and enzymatic activities of bacteria. • Cultivation of molds and other fungi. • Physical and chemical methods for sterilization. • Microbiological analysis of Food Products (viable count). • Microbial analysis of water – Presumptive test, Determination of most potable number of coliform bacteria, confirmed test and completed test	30

Outcome: At the end of the course the student understands

1. Identify microbiological techniques, the defining characteristics of the major groups of microorganisms and apply to study microbial phylogeny
2. Classify the methods to measure microbial growth.
3. Evaluate how microorganisms interact with the environment in beneficial or detrimental ways
4. Identify industrially important microbes

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	L	H	L
CO2	H	M	L	H	L
CO3	H	M	M	H	M
CO4	H	M	M	H	M

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

SEMESTER - II

MSBT-211 BIOLOGY OF IMMUNE SYSTEM

Objective: Student will understand the immune response manifested by different components. Students will learn about the response of immune system in different pathological conditions and also learns about different techniques based on antigen and antibody interactions

Credits: 04 **Semester II** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Introduction to Immune system-innate Immunity and adaptive immunity. Immunological barriers. Pattern recognition receptors. Toll like receptors. Cells of the immune system - lymphocytes, macrophages, neutrophils, NK, NKT cells. Lymphoid organs. Antigens, Immunogens, Adjuvants, Haptens. Factors contributing to antigenecity. Superantigens. B and T cell epitopes.	8
II	B cell ontogeny–Development, maturation, activation and memory. BCR. Types of B cells. Antibodies: structure, functions and classification. Antigenic determinants-isotypes, allotypes and idiotypes. Cell mediated and humoral response. Complement system–Classical, alternate and mannose binding lectin pathways.	8
III	T cell ontogeny–Development, maturation, activation and memory. T cells: Structure, fuction and classification. T Cell Receptor. MHC: Structure, fuction and classification, & HLA-Types, structure and properties. Antigen processing and presentation. Cytokines: Properties and biological functions. JAK-STAT Signaling Pathway. Proliferation of B and T cells. Hypersensitivity-Mechanism and pathophysiology of different types of hypersensitivity, Immune responses against infectious agents.	8
IV	Immunological tolerance-Factors involved in maintaining tolerance. Autoimmune diseases- Organ specific and Systemic. Transplantation-Types of graft, Immune response in transplantation. Cancer immunology-Antigens involved in tumors, Immune response to tumours. Evasion of tumors from the immune system.	8
	Cancer Biology: Apoptosis, Carcinogenesis, agents promoting carcinogenesis. Cancer Immunotherap:. Immunological techniques: principles of antigen and	

V	antibody interactions-Affinity, Avidity, Antibody valency, agglutination, precipitation. Gel diffusion methods-Single and double immunodiffusion, Complement fixation test, ELISA, ELISPOT, Immunoelectrophoresis.	8

Outcome: At the end of the course the student understands

1. Provide sequential and conceptual thinking and paradigms of cellular and molecular basis of immune system and their applications
2. Evaluate the usefulness of immunology in different pharmaceutical companies
3. Apply their knowledge and design molecular diagnostic kits for detection of diseases.
4. Design and analyze the experiments related with the different molecules involved in immunology.

Reference Books/ Text Book / Cases:

1. Immunology by Kubyet al., 5th Edition, WH Freeman and Co.
2. Immunology and immunotechnology by Ashim k. Chakravarty (Oxford University Press).
3. Infection & Immunity by John Playfair& Gregory Bancroft (Oxford university Press).
4. Essentials of immunology by Roitt (Blackwell scientific publication).
5. Immunology a short course by E Benjamin and S Leskowitz, Wiley Liss NY.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	M	-	M	M	L
CO2	L	M	H	H	M
CO3	L	H	M	H	H

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur
Faculty of Engineering and Technology
Department of Biotechnology
MSBT-212 GENETICS

Objective: Genetics provides the knowledge of Medelian laws, extrachromosomal inheritance, genome organization, their function and disorders related to chromosomes. To enable the students to understand classical genetics and concepts of population genetics.

Credits: 04 **Semester II** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Fundamentals of Genetics: Gene: unit of inheritance; Mendel's law and their limitations, Mendel's experimental design; Gene Interactions: Allelic and non allelic, Non-Mendelian inheritance, Genomic imprinting; Mendelian Genetics in humans: Pedigree analysis; Extensions of Mendelian Genetics: Modification of dominance relationships.	8
II	Complex inheritance-genetic and environmental variation; Heritability; Behavioral traits; Analysis of quantitative traits; Linkage & crossing over, models of genetic recombination, gene conversion, Tetrad analysis; Genome organization	8
III	Mutations: Nonsense, missense & point mutations; Frameshift mutations; Mutagens; Molecular mechanism of mutations; Suppressor mutation; Transposon mutagenesis, transposons as genetic tools: insertional inactivation, P- elements as genetic tool; Cytogenetics: Karyotype analysis, chromosome banding techniques; Cell division & errors in cell division	8
IV	Chromosomal abberations: Structural and numerical, chromosomal abberations: Polyploidy, aneuploidy, Meiotic consequences in structural heterozygotes, role in speciation and evolution. Sex determination; Role of Y chromosome; Disorders of sex chromosomes & autosomes; Molecular cytogenetics. Model systems in Genetic Analysis: Bacteriophage, E. coli, Arabidopsis, Drosophila, C. elegans, Zebra fish, Homo sapiens - General outline of life cycle, importance in Genetic analysis	8
V	Quantitative inheritance – Concept, Genes and Environment - heritability, penetrance and Expressivity. Extra-chromosomal inheritance - episomes, mitochondria and chloroplast. Genepool, gene frequency, genetic equilibrium and Hardy-Weinberg law, QTLs. Basics of developmental genetics.	8

Outcome: At the end of the course the student understands

1. Learn Mendel's laws with limitations and mechanism of sex-linkage and mapping concepts.
2. Understand interactions of genes and crossing over.

3. Understand Extra-chromosomal inheritance State functions of packaging.
4. Appreciate the basic concepts of classical genetics and developmental genetics.

Reference Books/ Text Book / Cases:

1. Cell Biology, Genetics, Molecular Biology by Verma,P.S.
2. Principles of Genetics by Gardner EJ, Simmons M.J., Snustad D.P.
3. Principles of Genetics by Tamarin, Macgra hill.
4. Genetics by Strickberger, Phi Learning.
5. Genetics by PK Gupta, Rastogi Publications.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	L	M	L	L	-
CO2	H	M	M	-	L
CO3	H	M	H	-	L
CO4	H	M	H	L	L

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-213 ENZYMOLOGY AND ENZYME TECHNOLOGY

Objective: To educate students about the fundamental concepts of Enzymology & Enzyme Technology and its related commercial applications, thus preparing them to meet the challenges in medicine and industry. Improve the basic knowledge and to bring awareness on enzyme inhibition and regulatory processes. To improve the knowledge about the enzyme immobilization.

Credits: 04 **Semester II** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Basic Concepts: Nomenclature and classification of enzymes, Enzyme specificity, Factors effecting enzyme activity: enzyme concentration, substrate concentration, pH, temperature and metal ions. Enzyme assay and units of enzyme activity. Coenzymes and metallo-enzymes.	8
II	Enzyme Kinetics: Determination of initial velocity, Michaelis - Menten equation and Steady state assumption theory, Significance of Km, Vmax and Kcat, Lineweaver - Burk plot. Enzyme inhibition: Irreversible inhibition and Reversible inhibition & kinetics - competitive, noncompetitive and uncompetitive inhibition.	8
III	Active site determination / investigation; Mechanism of enzyme action of Carboxypeptidase A and Ribonuclease - A. Multienzyme systems (PDH complex & Fatty acid synthase complex). Isolation and purification of enzymes. Enzyme regulation: Allosteric enzymes, Zymogen activation, Covalent modification and isoenzymes.	8
IV	Techniques of enzyme immobilization: adsorption, entrapment, covalent binding and cross linking. Properties and applications of Immobilized enzymes, Application of enzymes in medicine and industry.	8
V	Abzymes – Types and strategies for designing abzymes. Ribozymes – Types and mechanism of action. Synzymes, Enzyme engineering by site directed mutagenesis. Production of extracellular microbial enzymes: protease and amylase.	8

Outcome: At the end of the course the student understands

1. Gain clear understanding in isolation, purification and characterization of enzymes
2. Understand enzyme engineering technologies
3. Employ the knowledge of enzyme immobilization technology in medicine and industry

4. Gain knowledge about design strategies for making abzymes.

Reference Books/ Text Book / Cases:

1. Lehninger, A. L. (1982). Principles of biochemistry (4th ed.). New York, NY: Worth
2. Understanding Enzymes: T. Palmer
3. Voet, D., &Voet, J. G. (2004). Biochemistry (4th ed.). Hoboken, NJ: J. Wiley & Sons.
4. Biochemistry and Molecular Biology, Third Edition by William H. Elliott and Daphne C. Elliott, Oxford University press
5. Biochemistry by L Stryer, 8th Edition, WH Freeman publishers
6. Harper's Biochemistry by Robert K Murray, 28th Edition, McGraw Hill-Lange Publishers.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	L	H	M	-
CO2	-	L	H	M	-
CO3	-	L	H	M	-
CO4	-	L	H	M	-

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-214 BIOENERGETICS AND METABOLISM

Objective: The objectives of this course are to build the knowledge of post graduate students about the metabolic significance of various catabolic and anabolic pathways and their integration. The course shall make the students awareof significance of metabolism and its regulation and disorders of metabolic pathways.

Credits: 04 **Semester II** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Principles of bioenergetics – free energy concept, enthalpy, entropy, redox potential, phosphate group transfer potential. Coupled reactions, high energy compounds in biological systems. Substrate level phosphorylation, electron transport -oxidative phosphorylation and photophosphorylation.	8
II	Glycolysis and its regulation. Alcoholic and homolactic fermentation. TCA cycle and its regulationamphibolic nature of TCA cycle, anapleurotic reactions. Significance of gluconeogenesis, HMP shunt and glyoxylate cycle.Glycogen metabolism-glycogenesis, glycogenolysis and their regulation. Glycogen storage diseases.	8
III	Saturated and unsaturated fatty acids - synthesis, β-oxidation and regulation. Ketone bodies. Synthesis of triacylglycerides, phospholipids, and cholesterol. Sphingolipids - synthesis and storage disorders	8
IV	Protein turnover, transamination and oxidative deamination, urea cycle. Biosynthesis and degradation of aromatic and branched chain amino acids. Inborn errors of amino acid metabolism.	8
V	Synthesis and regulation of purine nucleotides by *denovo* pathway. Salvage of purine nucleotides. Synthesis and regulation of pyramidine nucleotides. Formation of deoxyribonucleotides and their regulation. Degradation of purines and pyrimidine nucleotides, disorders of nucleotide metabolism, Lesch-nyhan syndrome, Gout and Severe combined immunodeficiency disorder (SCID).	8

Outcome: At the end of the course the student understands

1. Understand the Principles of Bioenergetics
2. Understand the role of high energy compounds in biological systems
3. Gain fundamental knowledge in metabolic pathway.
4. Understand the energy pathways of metabolism.
5. Appreciate the integration of metabolism.

Reference Books/ Text Book / Cases:

1. Lehninger Principles of Biochemistry by Nelson, D and Cox, D. –7th Edition. Mcmillan Pub.
2. Biochemistry by L.Stryer– 8th Edition. (Freeman-Tappan).
3. Biochemistry by D.Voet and J.G.Voet– 4th Edition. (John weily).
4. Harper's Biochemistry by Robert K. Murray et al., – 30thEdition. (Langeman).
5. Biochemistry by U.Satyanarayana—4thEdition. (Elsevier)

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	-	L	H	M	-
CO2	-	L	H	M	-
CO3	-	L	H	M	-
CO4	-	L	H	M	-

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT- 215 BIOINFORMATICS

Objective: To expose students with essential elements of bioinformatics, viz. structural bioinformatics, functional bioinformatics, database searching and scope of various biological databases.

Credits: 04 **Semester II** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Introduction and scope of bioinformatics, Introduction to Biological Databases:Nucleotide databases at NCBI (GenBank, ESTs, SNP, UniGene, STS, RefSeq), File Formats, Access to Information via Entrez Gene at NCBI, Other databases: PubMed, OMIM etc.	8
II	Taxonomy Chemical classification of amino acids, Principles of protein structure (Primary, Secondary, Tertiary and Quaternary); Protein 2D structure prediction: Chou – Fasman algorithm; Protein 3D structure prediction: homology modeling, its advantage and limits; Concept of structure optimization and energy minimization, Structural Databases (PDB, MMDB)	8
III	Techniques in Bioinformatics; Sequence Alignment: Global Alignment vs. Local Alignment, Dynamic Programming, and Concept of amino acids scoring matrices in Alignment: Dayhoff PAM matrices, BLOSUM Matrices, Database similarity searching: BLAST, variations of BLAST, Multiple Sequence Alignment: Evolutionary significance of sequence alignment.	8
IV	Structural and Functional Bioinformatics; Identification of Protein Motif and Domain using MSA, Motif databases: PROSITE, PRINT, BLOCKS, InterPro; Introduction to Micro array technology (cDNA), Text Mining for information extraction from Biomedical Literature	8
V	Introduction to proteomics, Insilico protein sequence analysis – primary, secondary, tertiary (homology modeling), Drug designing and Molecular docking.	8

Outcome: At the end of the course the student understands

1. Understand fundamental knowledge of bioinformatics tools and techniques and how to effectively utilize these resources in life science research

2. State and comprehend the fundamental concepts of database system and its architecture, importance of biological database in the current time
3. Gain knowledge about the techniques for molecular modelling and drug designing
4. Demonstrate concept about Biological problem solving, regarding to sequence alignment and Genome editing, motif finding with the help of specific algorithms

Reference Books/ Text Book / Cases:

1. Bioinformatics: Principles & Application by Zhumur,Ghosh
2. Computational Methods in Biotechnology – Salzberg S. L. et al., ElsevierScience
3. Statistical Methods in Bioinformatics-Evens & Grants, Springer-Verlag,NY.
4. Computational Molecular Biology- Setubal and Meidanis, PWS publishing Co.
5. Protein Structure Prediction-A Practical Approach, MJE Sternberg, OxfordUniversity Press.
6. Purifying Protein for Proteomics, Richard J. Sinpson, I.K. International Pvt.Ltd

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	L	M	M	M	M
CO2	L	-	M	H	H
CO3	H	L	M	M	-
CO4	H	M	-	M	M

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-261 BIOINFORMATICS LAB

Objective: To inculcate skill-sets among the students to navigate biological databases and utilize bioinformatics software and ascertain them computational possibilities in biotechnology/microbiology.

Credits: 01 **Semester II** **L-T-P: 0-0-2**

Module No.	Contents	Lab Hours
I	• Database searching against a query sequence and selection of orthologous sequences using BLAST • Multiple Sequence Alignment using ClustalW • Prediction of Open Reading Frames using ORF Finder • 3-Dimensional Structure of protein using Deep View • Phylogenetic Analysis using Phylip (Neighbor Joining and Maximum Likelihood) • Bio programming using Practical Extraction and Reporting Language (PERL)	15

Outcome: At the end of the course the student will

1. Be able to use tools and techniques of bioinformatics effectively
2. Describe the contents and properties of most important bioinformatics databases

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	M	-	-
CO2	-	-	-	-	-

H = Highly Related; M = Medium; L = L

Rama University Uttar Pradesh, Kanpur
Faculty of Engineering and Technology
Department of Biotechnology
MSBT-262 IMMUNOLOGY LAB

Objective: The main objective of this course is to well verse the students with practical knowledge of immunology. In addition to this emphasis will be on the mechanisms involved in immune system.

Credits: 01 **Semester II** **L-T-P: 0-0-2**

Module No.	Contents	Lab Hours

I	• To detect the blood group of the given sample
	• Preparation of antigen
	• Raising of antisera for agglutination
	• Immunoprecipitation methods- ODD and RID.
	• Gel diffusion test-
	  • Radial diffusion test.
	  • Ouchterlony diffusion test.
	  • Rocket electrophoresis.
	  • Immunoelectrophoresis.
	• Slide agglutination test.
	• ELISA Test-
	  • Indirect ELISA.
	  • Sandwich ELISA.
	  • Competitive ELISA.
	  • ELISA Test.
	• Haemagglutination test.
	• Haemagglutination inhibition test.
		30

Outcome: At the end of the course the student understands

1. Apply knowledge of immunology, inculcate a knowledge of immunological techniques
2. Design and conduct experiments, as well as to analyze and interpret data of different immunological methods.
3. Use the techniques, skills, and modern tools necessary for detection of the immunological diseases, design immunology research project, collect and analyze data, and interpret results.
4. Understand about different techniques based on antigen and antibody interactions

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	H	H	L
CO2	H	M	M	M	-
CO3	M	L	H	H	L
CO4	H	M	H	H	-

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-263 ENZYME TECHNOLOGY LAB

Objective: The course aims at providing students with the methodological concepts and tools needed to acquire top-level skills in the field of enzyme technology.

Credits: 01 **Semester II** **L-T-P: 0-0-2**

Module No.	Contents	Lab Hours
I	• To carry out qualitative analysis of protein and amino acids • To carry out estimation of DNA by Diphenyl amine method • To carry out estimation of protein by Biuret method • To find out the activity or amount of enzyme alkaline phosphatase in unit per gram of potato tissue • To determine value of Km and Vmax of an enzyme alkaline phosphatase	30

OUTCOME: At the end of the course the student understands

1. Enhance knowledge of biochemistry in various macromolecules; inculcate knowledge of various issues related to life processes.
2. To design and analyse the experiments related with the different molecules involved in biochemistry and to study the kinetics and rationale behind each phenomenon.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	H	H	M	L
CO2	H	M	M	M	L

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

SEMESTER - III

MSBT-311 PLANT BIOTECHNOLOGY

Objective: To impart theoretical knowledge on various techniques of plant biotechnology like tissue culture, plant genetic transformation, molecular markers, marker assisted selection, bio-fertilizers and their application in Agri-biotech industries.

Credits: 04 **Semester III** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Plant tissue culture: Historical perspective, Sterilization techniques, media preparation – nutrients and plant hormones. Establishment of in vitro cultures- callus culture, cell suspension culture, organogenesis, somatic embryogenesis and cyto-differentiation. Mode of action and significance of Phytohormones.	8
II	Micropropagation - Stages and applications. Methods to detect pathogens in propagation sources, procedures to eliminate pathogens from plant parts. Production of haploids - Anther, Pollen, Embryo and Ovule culture and their applications. Protoplast isolation, culture and usage. Somatic hybridization - methods and applications, cybrids, somaclonal variations, artificial seeds and germplasm conservation.	8
III	Methods of gene transfer in plants - Agrobacterium mediated (Ti and Ri plasmids, T-DNA transfer), PEG - mediated, Particle bombardment gene gun transformation. Advanced methodologies – cis genesis, intra genesis and genome editing. Identification of transgenic plants. Molecular markers (RFLP, RAPD, AFLP and SSR) - Principle and their applications in crop Improvement. Marker assisted selection (MAS) - strategies for introducing genes of agronomic importance.	8
IV	Transgenic crop technology: Development of herbicide resistant transgenic crops; insect resistance – Bt toxin, Protease inhibitor and other plant derived insecticidal genes; crop engineering for disease resistance (bacterial, fungal and viral) and genetic improvement of abiotic stress tolerance. Molecular Pharming: Production and applications of edible	8

	vaccines and plantibodies in plants.	
V	Engineering for nutritional quality - Improved seed storage proteins, improving and altering the composition of starch and plant oils. Enhancement of micro-nutrients - beta carotene and iron. Introduction, types and industrial improtance of Plant Secondary metabolites. Types of nitrogen fixing microorganism - Rhizobium, Azotobacter, Azolla, Cyanobacteria and Fungal biofertilizers, nif gene. Mode of action of Biofungicides (Trichoderma, Pseudomonas fluorescens) and Bioinsecticides (Bacillus thuringiensis, Baculoviruses).	8

Outcome: At the end of the course the student understands

1. Gain fundamental knowledge in plant biotechnology and their applications
2. Apply the principles, practices and application of plant biotechnology, plant tissue culture, plant genomics, genetic transformation, and molecular breeding of plants in several areas.
3. Understand the mode of action of various biofertilizers and enhancement of crop yield by its application.
4. Develop and understand the types and importance of Plant secondary metabolites.

Reference Books/ Text Book / Cases:

1. Plant Biotechnology: The genetic manipulation of plants by A Slater, NW Scott & MR Fowler, 2nd Edition, Oxford University press.
2. Biotechnologies of Crop Improvement, Volume 1: Cellular Approaches by SS Gosal & SH Wani, Reprint 2018, Springer.
3. Plant Breeding principles & Methods by BD Singh, Reprint 2015, Kalyani Publishers.
4. Plant Cell and Tissue Culture by JW Pollard & JM Walker, Springer Publishers.
5. Agricultural biotechnology by SS Purohit, 3rd Edition, Agrobios Publications.
6. An Introduction to Plant Tissue Culture by MK Razdan, 3rd Edition, Oxford and IBH Publishing.
7. Introduction to Plant Biotechnology by HS Chawla, 3rd Edition, Oxford and IBH Publishing.
8. Molecular Biotechnology: Principles and Applications of Recombinant DNA by Glick & Pasternak, 4th Edition, ASM Press.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	H	-	-
CO2	H	L	H	-	-
CO3	H	L	H	-	-
CO4	M	M	M	L	L

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-312 ANIMAL BIOTECHNOLOGY

Objective: Student will learn techniques of cell, tissue and organ culture and learns about stem cells and induced pluripotency. Student will learn about aquaculture practices and human reproductive physiology in vitro fertilization methods. Student will learn about different methods used in the production of transgenic plants/animals.

Credits: 04 **Semester III** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Basic techniques of cell, tissue and organ culture. Primary culture and subculture of cells. Kinetics of cell growth. Properties of transformed cells. Role of carbondioxide, serum, and other supplements in cell culture. Different types of culture media- natural media, BSS, MEM, serum free media. Different methods for the estimation of cell viability and cytotoxicity. Applications of cell culture. Different types of microbial contamination and eradication	8
II	Stem cells– embryonic and adult stem cells. Isolation and culture of stem cells. Cancer stem cells. Stem cell markers. Induced pluripotency. Stem cell plasticity and differentiation. Application of stem cells in medicine. Apoptosis- mechanism and significance with reference to degenerative diseases – Parkinson's disease, stroke and diabetes.	8
III	Reproductive physiology of male and female-Menstrual cycle, Oogenesis, Ovulation and Spermatogenesis. Types and causes of male and female infertility. In vitro fertilization methodology in humans. Sperm collection, and superovulation. Embryo culture and transfer. Cryopreservation. Artificial insemination. Amniocentesis, immunocontraception.	8
IV	Concept of aquatic biotechnology. General cultural practices of fish, prawn and shrimp. Pearl culture technology. Fish byproducts. Induced breeding techniques. Hypophysation and Eyestalk oblation. Economically important aquatic resources	8
V	Production of transgenic animals-mouse, sheep, cattle and fish by microinjection, retroviral vector method and embryonic stem cell method. Animal cloning-somatic cell nuclear transfer and embryonic stem cell nuclear transfer methods. Biopharming and gene knockout.	8

Outcome: At the end of the course the student understands

1. Basic requirements for cell, organ and tissue culture and culture kinetics
2. To acquire knowledge in properties and types of stem cells and cancer stem cells
3. Reproductive physiology of male and females and artificial insemination
4. Benefit with fundamental knowledge in animal biotechnology and their applications
5. Utilize the principles, practices and application of animal biotechnology, animal tissue culture, animal genomics, genetic transformation, and molecular breeding of animals in numerous areas.

Reference Books/ Text Book / Cases:

1. Culture of Animal cells; A manual of Basic techniques by R Ian Freshney, 6th Edition, Wiley Blackwell publishers.
2. Molecular Biotechnology: Principles and applications of recombinant DNA technology by BR Glick, JJ Pasternak & CL Patten, 4th Edition, ASM Press.
3. Elements of Biotechnology by PK Gupta, Rastogi Publications.
4. Biotechnology by U Satyanarayana, 3rd Edition, Books and Allied Sciences Publishers.
5. Concepts of Biotechnology by Balasubrahmanianet al., Revised edition, University press.
6. Aquaculture: Principles and practices by TVR Pillay, Reprint 1993, Wiley publishers.
7. Coastal aquaculture in India by Santhanam, CBS Publishers.
8. A Textbook of Fisheries Science and Indian Fisheries by CBL Srivatsava, Kitab Mahal publishers.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	M	M	H	-
CO2	H	L	L	L	H
CO3	M	H	M	H	-

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur
Faculty of Engineering and Technology
Department of Biotechnology
MSBT-313 INDUSTRIAL BIOTECHNOLOGY

Objective: In this course students will learn an introduction to industrial Bioprocess, Production of industrial products. To impart knowledge on various industrially important microorganisms, fermentation technology, biotechnological products and secondary metabolites.

Credits: 04 **Semester III** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Basics of Industrial microbiology, Culture media; types and composition, Industrial microbial processes; different types of Substrates and their sources, Industrial microorganisms: Isolation, screening, Selection of mutants; Process optimization techniques	8
II	Process technology for the production of various Products: Primary metabolite: ethanol, citric acid, vinegar and amino acid; Production of alcoholic beverages: wine and beer; Secondary metabolites: Antibiotics; Process technology for the production of microbial biomass.	8
III	Introduction and production of secondary metabolites with some case study. Production of bioplastics (PHB, PHA), bio-insecticides, bio-herbicides, biopolymers, bio-fertilizers and biological weapons with reference to anthrax	8
IV	Production of industrially important enzymes: Solid state fermentation, submerged fermentation, Extraction, Purification and characterization of industrial enzymes, industrial process using enzymes for production of drugs and fine chemicals, Enzyme based biosensors	8
V	Downstream processing, removal of microbial cells and solid matter, cell disruption, extraction, concentration, purification, drying and crystallization of the products, In-situ recovery of the products.	8

Outcome: At the end of the course the student understands

1. To explain the steps involved in the production of bio-products and methods to improve modern biotechnology
2. To apply basic biotechnological principles, methods and models to solve biotechnological tasks
3. To identify and debate the ethical, legal, professional, and social issues in the field of biotechnology
4. Explore the biological and technological principles which govern actual and potential bio-business

Reference Books/ Text Book / Cases:

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

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	L	-	M	H	-
CO2	L	L	H	M	H
CO3	H	M	-	M	H
CO4	H	M	H	L	-

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-314 GENETIC ENGINEERING

Objective: To enlighten the knowledge of the students on r-DNA technology. To teach students the various approaches in conducting genetic engineering and their application in biotechnology industry.

Credits: 04 **Semester III** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Basics of Genetic engineering: Enzymes used in genetic engineering. Restriction endonucleases and Restriction mapping, DNA Ligase, DNA polymerase I, Taq polymerase, Reverse transcriptase, Sl nuclease, Terminal nucleotide transferase, Alkaline phosphatase, Polynucleotide Kinase, Polynucleotide phosphorylase.	8
II	Cloning vectors: Salient features, plasmid vectors, phage vectors, cosmids, phagemids (Lambda and M13 phages), viral vectors (SV40, Baculo virus and CMV), Artificial chromosomes - BAC, YAC and MAC. Ligation of DNA to vectors - cohesive end, blunt end, homopolymer tailing, linkers and adaptors.	8
III	Gene transfer Techniques - Transformation, Transfection, Microinjection, Electroporation, Lipofection and Biolistics. Reporter gene assay, selection and expression of rDNA clones, purification of recombinant proteins by affinity tags. Polymerase Chain Reaction, Variants of PCR and their applications.	8
IV	Construction of genomic libraries and cDNA libraries. Colony and Fluorescent in situ hybridization, Southern, Northern and Dot blotting techniques. Nucleic acid probes and probe construction. DNA microarray technology	8
V	DNA sequencing by Chemical, Enzymatic, Automated and NGS methods. Salient features of human genome project. Applications of genetic engineering in Agriculture, Animal husbandry, Medicine and Industry.	8

Outcome: At the end of the course the student understands

1. Understand the impact of genetic engineering in modern society
2. Gain strong theoretical knowledge of this r-DNA technology.

3. Understand the concept of DNA sequencing and appreciate the salient features of human genome project.
4. In conjunction with the practical's in molecular biology & genetic engineering, the students should be able to take up biological research as well as placement in the relevant biotech industry.

Reference Books/ Text Book / Cases:

1. From genes to clones by Winneker, 3rd Edition, VCH Publishers.
2. Molecular Biotechnology: Principles and applications of recombinant DNA technology by
3. BR Glick, JJ Pasternak & CL Patten, 4th Edition, ASM Press.
4. Gene cloning and DNA analysis an introduction by TA Brown, 5th Edition, Blackwell publishers.
5. Genomes by TA Brown, 3rd Edition, Garland Science publishers.
6. Principles of Gene Manipulation by Old & Primrose, 7th Edition, Blackwell Publishers.
7. Recombinant DNA: Genes and Genomes - A Short Course by Watson, 3rd Edition, Cold
8. Spring Harbor Laboratory Press.
9. Lewin's GENES XI by JE Krebs, ES Goldstein & ST Kilpatrick, 11thEdition, Jones and
10. Bartlett Learning Publishers.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	L	-	H	H	L
CO2	L	-	H	H	L
CO3	M	L	H	M	-
CO4	M	M	H	M	M

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

OPEN ELECTIVE SUBJECTS

MSBT-325 NANOTECHNOLOGY

Objective: The mission of the nano-biotechnology program is to provide a multidisciplinary education in nanoscale science and technology.

Credits: 04 **Semester III** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Nanomaterials: Introduction, examples of nanomaterials – quantum dots, metal nanoparticles, magnetic nanoparticles, carbon nanotubes and nanowires. Introduction to "Top – Down" and "Bottom – Up" approaches of synthesis of nanomaterials. Synthesis of nanostructures using Sol– gel process. Biological products of nanoparticles using fungi, bacterial, yeast and actinomycetes.	8
II	Characterization of nanomaterials: nanoscale probes: X-ray crystallography, Mossbauer spectroscopy, infrared spectroscopy, Raman spectroscopy, scanning electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy and scanning probe microscopy.	8
III	Protein based nanostructures: chemistry and structure of S-Layers, self-assembly, recrystallisation methods, lipid chips. Magnetosomes: magnetotactic bacteria, magnetic crystals in magnetosomes, biochemistry and gene expression in magnetosome formation, applications of magnetosomes. Bacteriorhodopsin: structure, function, properties and applications.	8
IV	DNA based nanostructures: DNA- protein nanostructures: oligonucleotide- enzyme conjugates, DNA – streptavidin conjugates, multifunctional protein assembly, DNA – protein conjugates in microarray technologies. DNA – based metallic nanowires and networks: Template design, DNA as biomolecular template, metallization, gold cluster – oligonucleotide conjugates, DNA nanowires, metal cluster labels with platinum, palladium, tungstanates and iridium.	8
V	Nanometals in medicine: introduction to nanocarriers, interactions of nanocarriers with blood stream, cellular targeting, biological and chemical reagents for cell – specific targeting. Bio-distribution of liposomes, dendrimers and nanoparticles, toxicity of nanoparticles, drug delivery, tissue regeneration, cancer detection, luminescent nanoparticles probes for bio-imaging and diagnostics.	8

Outcome: At the end of the course the student understands

1. Understand the fundamentals of nanoscience, nanotechnology and biology with in detail knowledge of different nanomaterial types and properties.
2. Acquire the knowledge on different nano-fabrication methods. Skilled in various characterization techniques
3. Recognize and relate to the structural and functional principles of bio-molecular interactions to nanomaterials.
4. Able to apprehend and explain use of nanomaterials in different medical/environmental applications. Analyse the possible impact of this technology on society, industry and environment.

Reference Books/ Text Book / Cases:

1. Nanobiotechnology: Concepts, Applications and Perspectives by CM Niemeyer & CA Mirkin, Wiley-VCH publishers.
2. Nanobiotechnology II: More concepts and Applications' by CM Niemeyer & CA Mirkin, Wiley–VCH publishers.
3. Nanobiotechnology by PC Trivedi, 1st Edition, Pointer Publishers.
4. The hand book of Nanomedicine by KK Jain, 2nd Edition, Humana Press

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	M	L	M	-	-
CO2	M	M	M	H	M
CO3	M	-	H	H	-
CO4	M	M	H	M	H

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-326 FOOD PROCESSING AND BIOTECHNOLOGY

Objective: This paper emphasizes on understanding the role of micro- organisms in the preservation and spoilage of different food stuffs.

Credits: 04 **Semester III** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
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.	8
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.	8
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.	8
IV	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.	8
V	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).	8

Outcome: At the end of the course the student understands

1. Obtain a good understanding of food biotechnology.
2. Define microorganisms and their products in foods, understand causes of food spoilage and predict the microorganisms that can spoil a given food, when prepared, processed, and stored under given conditions
3. 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
4. Foresee the necessary measures to control the spoilage and pathogenic microorganisms in food

Reference Books/ Text Book / Cases:

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

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	L	-	M	H	-
CO2	L	L	H	M	H
CO3	H	M	-	M	H
CO4	M	M	H	H	M

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-327 BIOPROCESS ENGINEERING

Objective: Bioprocess engineering is associated with the utilization of different biochemical, physical, Biological and microbial concept in production of different fermented and bioprocessed product.

Credits: 04 **Semester III** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Introduction to Bioprocesses Engineering. Kinetic of microbial growth Bioreactors: Principle, types, design, and application. Aeration and Agitation systems for bioreactor. Measurement and control of bioprocess parameters. Types of fermentation processes: Batch, Fed- batch and continuous bioreactors,	8
II	Culture Media for industrial fermentation. Carbon and Nitrogen Sources. Sterilization processes, Biochemistry of Fermentation, Safety in fermentation laboratory.	8
III	Upstream Processing, Strain improvement of industrially important microorganism, Optimization of various parameters for biochemical production, Mass and energy balance in bioprocesses system.	8
IV	Downstream processing: Introduction, removal of microbial cells and solid matter. Foam reparation, precipitation, centrifugation, cell disruption, chromatography, Ultrafiltration. Product recovery processes and Unit operations. Safety consideration in down-stream processing	8
V	Production, feedback control and factors affecting the commercial production of following products – Ethanol, citric acid and Acetic acid, glycerol, Antibiotics (penicillin, streptomycin. tetracycline), Amino acids (lysine, glutamic acid), Single Cell Protein	8

Outcome: At the end of the course the student understands

1. Understand the growth kinetics, Monod equation and explain the role of various factors affecting the process of growth.
2. States the significance of application of process technology on enzyme production, enzyme kinetics, solve the mass balance of production process.
3. Collect the proficient knowledge of design of fermenter and operation of fermentation process, methods of translation of laboratory data to pilot scale process.

Reference Books/ Text Book / Cases:

1. Principles of Fermentation Technology by Whilteker,A
2. Process Engineering in Biotechnology, JacksonA.T.
3. Manual of Industrial Microbiology & Biotechnology by Arnold *etal*
4. A Text Book of Industrial Microbiology by Cruger andCruger
5. Industrial Microbiology by Prescott &Dunn

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	L	-	M	H	-
CO2	L	L	H	M	H
CO3	H	M	-	M	H

H = Highly Related; M = Medium; L = Low

MSBT-328 MEDICAL AND PHARMACEUTICAL BIOTECHNOLOGY

Objective: This course helps to understand about the production and applications of health care products and Hybridomas. It gives a view on the design of vaccines and problems associated with the development of vaccines against some of the diseases. This course critically examines the design and metabolism of drugs and the synthesis of nanoparticles and the applications of nano-biotechnology.

Credits: 04 **Semester III** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Production of recombinant health care products- insulin, growth hormone, factor VIII, tissue plasminogen activator, urokinase, interferons, lymphokines and Hepatitis-B vaccine. Tissue Engineering: - production of artificial skin, liver and pancreas, advantages and disadvantages of tissue engineering and the ethical issues.	8
II	Hybridoma technology - production and applications of monoclonal antibodies. Antibody engineering, chimeric antibodies. Vaccines and vaccination technology-strategies for development of vaccines against HIV and malaria. Current development in diagnosis of tuberculosis, malaria and HIV. Disease diagnosis using DNA and enzyme probes. Molecular probes in forensic medicine. Gene therapy.	8
III	Drug discovery & drug delivery: Drug discovery without a lead, lead discovery (random Screening, targeted screening). Lead modifications – identification of active part (Pharmacophore) and functional group modifications. Structural modifications to increase potency. Drug delivery: oral delivery systems, pulmonary delivery systems, transmucosal and transdermal delivery systems. Ligand based targeting approach. Programmable drug delivery systems.	8
IV	Drug metabolism: Analytical methods in drug metabolism (isolation, separation, identification, quantification). Oxidative, reductive, hydrolytic and conjugative metabolism of drugs. Pharmacogenetics: genetic polymorphism in drug metabolism. Genetic polymorphism in drug transport and drug targets.	8
V	Nanobiotechnology: synthesis of nanostructures using sol-gel process and biological production using fungi and bacteria, yeast and actinomycetes.	8

	Introduction to nanocarriers. Interaction of nanocarriers with blood stream. Cellular targeting of nanocarriers. Drug delivery and toxicity of nanocarriers.	

Outcome: At the end of the course the student understands

1. Understand basics of research and development in the fields of medical biotechnology and pharmaceutical biotechnology.
2. Apply knowledge gained in respective fields of pharmaceutical industry. Understand about drug discovery, drug metabolism and various drug delivery systems. Be able to understand the synthesis of nanoparticles by different methods; nanocarriers and their toxicity.
3. Describe basic science behind the properties of materials at the nanometer scale, and the principles behind advanced experimental techniques for studying.

Reference Books/ Text Book / Cases:

1. Molecular Biotechnology: Principles and applications of recombinant DNA technology by BR Glick, JJ Pasternak & CL Patten, 4th Edition, ASM Press.
2. Gene cloning and DNA analysis an introduction by TA Brown, 5th Edition, Blackwell publishers.
3. Fundamentals of Ecology by EP Odum& GW Barrett, 5th Edition, McGraw Hill publishers.
4. Biotechnology by U Satyanarayana, 3rd Edition, Books and Allied Sciences Publishers.
5. Biotechnology and genomics by PK Gupta, Rastogi Publications.
6. Pharmaceutical biotechnology, concepts and applications by G Walsh, John Wiley publications.
7. Drug metabolism in drug design and development by D Zhang et al., Wiley publications.
8. The organic chemistry of drug design and drug action by RB Silverman & MW Holladay, 3rd Edition, Academic press

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	L	-	M	H	-
CO2	L	L	H	M	H
CO3	H	M	-	M	H

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-361 PLANT BIOTECHNOLOGY LAB

Objective: Practical knowledge of plant biotechnology in the theory and provide hands on training on practical techniques of plant tissue culture related practical.

Credits: 01 **Semester III** **L-T-P: 0-0-2**

Module No.	Contents	Lab Hours
I	• Preparation of media for plant tissue culture (MS and B5). • Laboratory set-up of a plant tissue culture lab • Sterilization techniques used in the plant tissue culture laboratory • Viability testing of seeds under different environmental conditions • Establishment of Callus cultures • Isolation of nitrogen fixing microorganisms like Cyanobacteria and Rhizobium and their characterization. • Measurement of nitrate reductase from *Nostoc muscorum*. • Analysis of total protein content of seeds by TCA precipitation method.	30

Outcome: At the end of the course the student understands

1. Lab organization & measures adopted for aseptic manipulation and nutritional requirements of cultured tissues.
2. Apply knowledge for large scale clonal propagation of plants through various micro-propagation techniques.
3. Develop skill in raising transgenic resistant to biotic & abiotic stresses & quality characteristics.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	H	L	H	-	-
CO2	H	L	H	-	-
CO3	L	L	H	-	-

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-362 GENETIC ENGINEERING LAB

Objective: The objective of this laboratory is to train students in the practical aspects of genetic engineering and to provide knowledge about the basic tools and techniques used in genetic engineering.

Credits: 01 **Semester III** **L-T-P: 0-0-2**

Module No.	Contents	Lab Hours
I	• Amplification of DNA by PCR. • DNA restriction digestion and separation of DNA fragments by Agarose gel • electrophoresis. • Elution of DNA from agarose gels. • Ligation of DNA fragments. • Bacterial transformation and identification of transformants by blue white colony / GFP. • RAPD and RFLP analysis.	15

Outcome: At the end of the course the student understands

1. Students would gain hands on expertise in genetic engineering techniques and experiments
2. Students will be able to understand the importance of PCR, and its application in forensic medicine by RAPD method.
3. Students would be able to successfully transfer and detect nucleic acids (DNA and RNA)

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	M	H	H	-	-
CO2	L	H	M	L	L
CO3	L	M	M	-	-

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

OPEN ELECTIVE LAB

MSBT-363 NANOTECHNOLOGY LAB

Objective: The objective of this laboratory includes synthesis, production and applications of nanoparticles.

Credits: 01 **Semester III** **L-T-P:0-0-2**

Module No.	Contents	Lab Hours
I	• Chemical synthesis of silver nanoparticle (sodium borohydride) • Chemical Synthesis of silver Nano Particles (tri-sodiumcitrate) • Characterization of silver nanoparticles (UV spectrophotometer) • Antibacterial activity of silver nanoparticles • Biological Synthesis of silver nanoparticles and gold nanoparticles • Chemical Synthesis of Gold nanoparticles (CitrateSynthesis) • Characterization of Gold Nanoparticles (UV spectrophotometer) • Antibacterial activity of silver and gold nanoparticles	15

Outcome: At the end of the course the student understands

1. Students will have study the properties of nanomaterial and characterization techniques of nanoparticles
2. Students will be able to use the tools and techniques used to produce nanoparticles
3. Students will have an understanding of the impact of nanomaterials on the environment

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	M	H	H	-	-
CO2	L	H	M	L	L
CO3	L	M	M	-	-

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-364 FOOD PROCESSING AND BIOTECHNOLOGY LAB

Objective: The objective of this laboratory estimation of sugars and carbohydrates and the isolation of fungus and bacteria responsible for the spoilage of food.

Credits: 01 **Semester III** **L-T-P: 0-0-2**

Module No.	Contents	Lab Hours
I	• Isolation and study of fungus responsible for food spoilage. • Analysis of total protein content of seeds by TCA precipitation method. • Estimation of total carbohydrates using Anthrone method. • Estimation of reducing sugar by Nelson-Somogyi method. • Estimation of invisible lipids. • Experiment to prepare jelly by using commercial pectin • Effect of temperature on taste • Extraction of iron from cereal grains	15

Outcome: At the end of the course the student understands

1. Students will have knowledge of nano-material properties and characterization
2. Students will be able to use the tools, techniques and skills necessary to practice
3. Students will have an understanding of the impact of nano-materials on the environment

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	M	H	H	-	-
CO2	L	H	M	L	L
CO3	L	M	M	-	-

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-365 BIOPROCESS ENGINEERING LAB

Objective: The objective of this course is to impart hands on training in handling of enzymes and bioreactors.

Credits: 01 **Semester III** **L-T-P: 0-0-2**

Module No.	Contents	Lab Hours
I	• Growth kinetics in Batch culture. • Study of Enzyme kinetics of invertase • Determination of Enzyme activity for cellulase • Effect of pH on Enzyme kinetics • Enzyme immobilization by different methods • Sodium sulphite oxidation method for determination of Mass Transfer coefficient • Ethanol production from *Saccharomyces cerevisiae* • Pre-treatment technique for ligno – cellulosic biomass for ethanol production	15

Outcome: At the end of the course the student understands

1. After completion of the laboratory students will be able to study enzyme kinetics, handle bioreactors.
2. After completion of this course student will be able to perform optimize the process parameters.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	M	H	H	L	H
CO2	M	H	H	L	H

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-366 MEDICAL AND PHARMACEUTICAL BIOTECHNOLOGY LAB

Objective: The objective of this course is to impart a brief knowledge about the basic microbiological and molecular biological techniques used in Medical and Pharmaceutical industries.

Credits: 01 **Semester III** **L-T-P:0-0-2**

Module No.	Contents	Lab Hours
I	1. Basic Laboratory Procedure – Instrument Introduction and Handling, Maintenance, Aseptic condition maintenance, Sterilization, Microscopy, etc. 2. Basic Microbiology Practicals: Culturing and harvesting of microbes, Staining and identification. Culture maintenance. 3. Isolation of human DNA, quality assessment by spectrophotometer and gel electrophoresis, restriction digestion of DNA, and separation of DNA fragments by gel electrophoresis, staining of bands with ETH-Br, DNA visualization. 4. Isolation of RNA from microbial sources and estimation.	15

Outcome: At the end of the course the student understands

1. After completion of the laboratory students will be able to study enzyme kinetics, handle bioreactors.
2. After completion of this course student will be able to perform optimize the process parameters.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	M	H	H	L	H
CO2	M	H	H	L	H

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

SEMESTER IV

MSBT-411 ENVIRONMENTAL BIOTECHNOLOGY

Objective: Environmental Biotechnology is the conservation of resources via the recycling of waste materials. The recoveries products such as metals andoils are important aspects of this technology.

Credits: 04 **Semester IV** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Introduction to Environmental Biotechnology, Microorganisms in the Environment, Biogeochemical Cycles and Microbial Ecology, Environmental pollutants: Introduction and different types of pollutants, parameters of pollution monitoring. Waterborne infectious agents, detection and control of pathogenic microbes in water	8
II	Wastewater treatment methods – Preliminary treatment, clarification, coagulation; aerated lagoons; oxidation ponds; trickling filters; rotating biological contractors; wastewater treatment efficiency assessment,	8
III	Municipal techniques for prevention and biomedical solid wastes and their treatment, innovative techniques for prevention and control of pollution Biodegradable compounds: Biofertilizers, biopesticides, compost &vermicomposting.	8
IV	Phytoremediation; pharmaceutical industries. Biodegradation of xenobiotic compounds: Simple aromatics, chlorinated polyaromatic petroleum products & pesticides	8
V	Bioleaching of metals, microbially enhanced oil recovery. Bio-indicators. Environmental challenges & sustainable development; Environmental Laws & Acts.	8

Outcome: At the end of the course the student understands

1. Apply advanced knowledge on environmental waste management (waste water and solid waste).
2. Design techniques for bioremediation process.
3. Identify and evaluate the importance of biofuels and organic farming.

Reference Books/ Text Book / Cases:

1. Biotechnology by Dubey,R.C.
2. Comprehensive Biotechnology Vol. – 4. Murray MooYoung.
3. Environmental Microbiology. R. M. Maier, I. L. Pepper & G. P.Gerba.

4. Environmental Biotechnologies and Cleaner Bioprocess by Eugenia J Olguuin etal.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	M	M	H	M	L
CO2	M	M	H	M	M
CO3	M	M	H	M	M

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-412 IPR, PATENT, TRADEMARKS, GI AND BIOETHICS

Objective: Intellectual property rights enlighten the student knowledge towards the development of novel ideas and goods in the field of biotechnology.

Credits: 04 **Semester II** **L-T-P: 4-0-0**

Module No.	Contents	Teaching Hours
I	Introduction to IPR, History of IPR in India. International harmonization of patent laws – WTO, GATT, TRIPs, WIPO. India and TRIPs, Protection of biotechnological inventions, IPR in developing countries, Broad patents in biotechnology, Choice of IPR protection.	8
II	Patent and patent filing, Copyright, Trademark, Trade secret and Geographical Identification (GI).	8
III	Introduction to Biosafety, Definition and objectives of biosafety guidelines. Risk Assessment- Assessment of risk during laboratory research, Risk Assessment of Biotechnology products. Risk regulation.	8
IV	Containment- Physical containment, Biological containment. Biosafety guidelines in India, Biosafety Level – BL1, BL2, BL3 and BL4.	8
V	Bioethics in Biodiversity Resource management – Definition, Ethical issues of biodiversity. Ethical issues in genetically modified organisms- Introduction, History of genetic modification, Techniques of genetic modification, Uses of genetic modification.	8

Outcome: At the end of the course the student understands

1. To understand and follow the regulatory framework important for the product safety and benefit for the society.
2. To devise business strategies by taking account of IPRs
3. To acquire adequate knowledge in the use of genetically modified organisms and its effect on human health
4. To gain more insights into the regulatory affairs.

Reference Books/ Text Book / Cases:

1. Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rdEd) Academic press. ISBN-1555811804,9781555811808

2. Thomas, J.A., Fuch, R.L. (1999). Biotechnology and safety assessment (3rd Ed). CRC press, Washington. ISBN: 1560327219, 9781560327219
3. Law and Strategy of biotechnological patents by Sibley. Butterworth publication (2007) ISBN: 075069440, 9780750694445
4. Intellectual property rights-Ganguli-Tat McGrawhill. (2001) ISBN-10:0074638602
5. Intellectual Property Right-Wattal-Oxford Publication House. (1997) ISBN:0195905024

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	L	M	H	M	-
CO2	M	H	L	L	H
CO3	M	L	M	M	-
CO4	H	M	L	M	H

H = Highly Related; M = Medium; L = Low

Rama University Uttar Pradesh, Kanpur

Faculty of Engineering and Technology

Department of Biotechnology

MSBT-461 PROJECT WORK

Objective: Intellectual property rights enlighten the student knowledge towards the development of novel ideas and goods in the field of biotechnology.

Outcome: At the end of the course the student understands

1. To understand and follow the regulatory framework important for the product safety and benefit for the society.
2. To devise business strategies by taking account of IPRs
3. To acquire adequate knowledge in the use of genetically modified organisms and its effect on human health
4. To gain more insights into the regulatory affairs.

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

CO	PO1	PO2	PO3	PO4	PO5
CO1	L	M	H	M	-
CO2	M	H	L	L	H
CO3	M	L	M	M	-
CO4	H	M	L	M	H

H = Highly Related; M = Medium; L = Low

Annexure -1

Master of Science (Biotechnology) First Semester **(I Year)** Batch **(2024-25)**

S. No.	Paper Code	Name of Paper	No. of Students			Pass (%)
			Appeared	Pass	Fail	
1.	MSBT-111	Biomolecules	7	7	0	100
2.	MSBT-112	Microbiology	7	7	0	100
3.	MSBT-113	Bioanalytical Techniques And Biostatistics	7	7	0	100
4.	MSBT-114	Cell Biology	7	7	0	100
5.	MSBT-115	Molecular Biology	7	6	1	85.71
6.	MSBT-161	Cell and Molecular Biology Lab	7	7	0	100
7.	MSBT-162	Biochemical Analysis and Techniques Lab	7	7	0	100
8.	MSBT-163	Microbiology Lab	7	7	0	100

Main Result:

1.	No. of Students Appeared	7
2.	No. of Students Passed	7
General / Overal Pass %		**100**

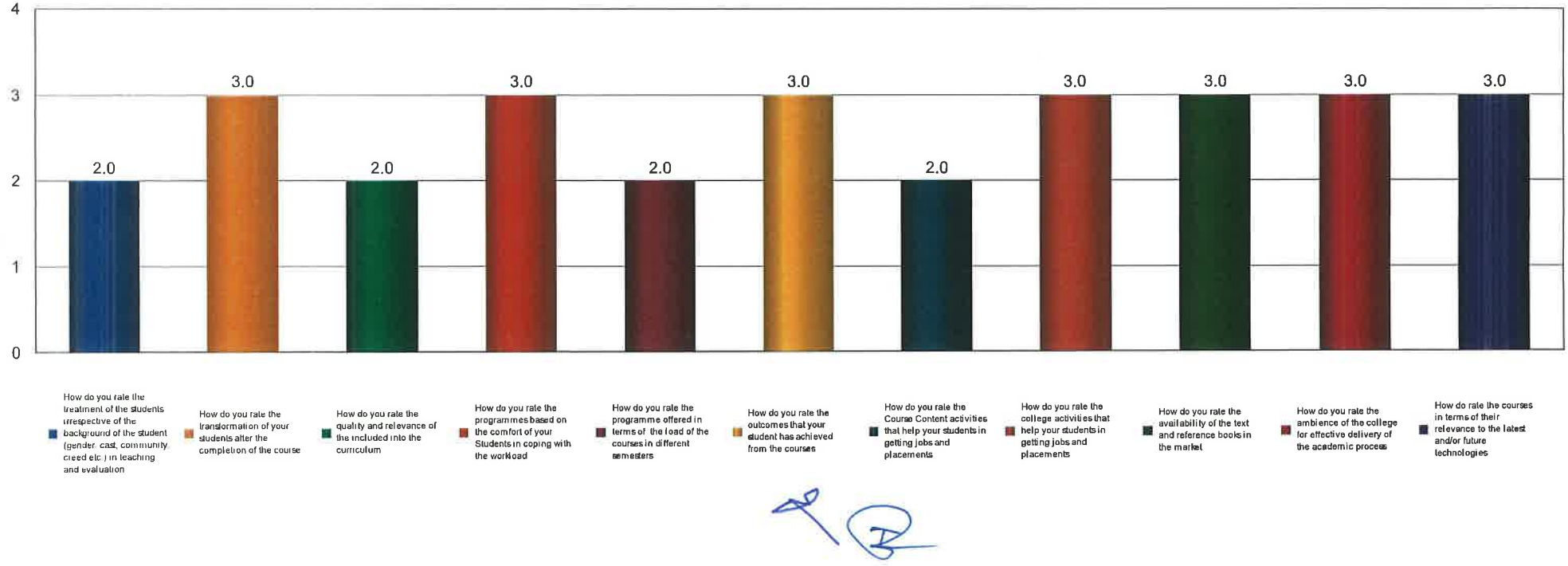
Master of Science (Biotechnology) Third Semester (**II Year**) Batch (**2024-25**)

S. No.	Paper Code	Name of Paper	No. of Students			Pass (%)
			Appeared	Pass	Fail	
1.	MSBT-311	Plant Biotechnology	4	4	0	100
2.	MSBT-312	Animal Biotechnology	4	4	0	100
3.	MSBT-313	Industrial Biotechnology	4	4	0	100
4.	MSBT-314	Genetic Engineering	4	4	0	100
5.	MSBT-327	Bioprocess Engineering	4	4	0	100
6.	MSBT-361	Plant Biotechnology Lab	4	4	0	100
7.	MSBT-362	Genetic Engineering Lab	4	4	0	100

Main Result:

1.	No. of Students Appeared	4
2.	No. of Students Passed	4
General / Overall Pass %		**100**

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 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.SC	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0