Rama University Uttar Pradesh, Kanpur

Faculty of Sciences

Ref: RU/FS/BT/PG/2014 /001 **Dated: 24.05.2014**

Minutes of Meeting

BOARD OF STUDIES

Department of Biotechnology

A meeting of Boards of Studies of M.Sc. Biotechnology in Department of Biotechnology held on 24.05 2014 at 10:30 AM in Director Office. The following members were present:

1. Mr. Ajit P. Singh Yadav — Chairperson
2. Mr. Anjani kumar Srivastava — Member
3. Mr. Vachaspati Rao — Member
4. Prof. (Dr.). R. K. Mishra — External Member
5. Dr. G. Sunil Babu — External Member

Agenda:

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

NA

2. Review of the existing programs and their curricula

S. No.	Item No.	Existing	Recommendation /Action Taken
1	To consider and approved the evaluation scheme for M.Sc. Biotechnology students admitted in the session 2014-15.		The BOS considered the curricula & courses and discussed the credit of each course should be added in detailed syllabus of every subject. The BOS committee has given following suggestions: 1. The course name Molecular Cell Biology (semester II) should be swapped by the course Molecular Biology (Semester I).

			2. The course name Intermediary metabolism (semester III) should be swapped by the course bioprocess engineering and Fermentation technology (Semester II). 3. The course name Immunology (semester VI) should be swapped by the course Industrial biotechnology (Semester IV). The BOS committee recommended curricula & courses after the above suggested points with their course code.

3. Question Paper Format.

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

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

(Chairperson)

Signature.....

Name : Ajit P. Singh Yadav

Date:

Internal Members

Signature 1.....

Name : Mr. Anjani kumar Srivastava

Date:

Signature 2.....

Name : Mr. Vachaspati Rao

Date:

External Members

Signature 1.....

Name : Prof. (Dr.) R. K. Mishra

Date:

Signature 2.....

Name : Dr. G. Sunil Babu

Date:

Encl.: Recommended Curricula attached for consideration and approval.

CC:

1. Dean
2. Registrar Office

M.Sc. Biotechnology

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO 1: To develop strong student competencies in biotechnology and its applications in a technology-rich, interactive environment.

PEO 2: To develop strong student skills in research, analysis and interpretation of problems and information relevant to modern biology.

PEO 3: To prepare the students to successfully compete for employment in biotech-based inquiry and development sectors, industrial sectors and teaching, and to provide a broad scope of experience in research methods, data analysis to match the industrial demands.

PEO 4: The aim of this class is to offer detailed knowledge of techniques applied in biological research and industries.

PEO 5: Understanding biotechniques is essential to strengthen the knowledge of the candidate desired to operate in the area of biotechnological research, development and fabrication.

PEO 6: Learning biotechniques is important for students of all fields of life sciences.

PROGRAMME OUTCOMES (PO)

PO1: Possess the modern molecular Biological and Technical knowledge needed to support Biotechnology research activities.

PO 2: Demonstrate their ability to function effectively in teams.

PO3: Study the use of living organisms and Bioprocess in genetic engineering, Medicine, Agriculture and results in all kinds of Bio products from GMO food to carry out Gene therapy to Auto Immune Disease.

PO 4: They also explore Bioinformatics in the discipline of Molecular Biology.

PO 5: Bioinformatics methods are widely used for Gene Mapping, DNA analysis and Protein Samples. Biotechnology and Bioinformatics do a great favour to evolutionary biology and offer new vistas for Drug design and discovery.

PO 6: Students gain sound professional Ethics, Leadership and consensus building skills relevant to Biotechnology aspects of business endeavor.

PO 7: Students become an excellent researcher or Scientist or Teacher in Biotechnology field to discover unique products for societal needs with proper Ethical statute.

PO 8: Apply knowledge and science in the conception and development of solutions for problems relevant to advanced biology to provide the needs of biotech industries.

PO 9: Become professionally trained in the field of molecular biology, recombinant DNA engineering, microbial technology, animal and plant tissue culture, Bioinformatics etc.

PO 10: Excel in the research related to biotechnology and quality control of biologicals.

PO 11: Demonstrate highest standards of critical, interpersonal and communication skills as easily as a dedication to lifelong learning.

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO1: Demonstrate their ability to apply Biotechnological research strategies to solve the Global Environmental Problems like Climate change, Ozone Depletion, Acid Rain, Industrial waste etc.

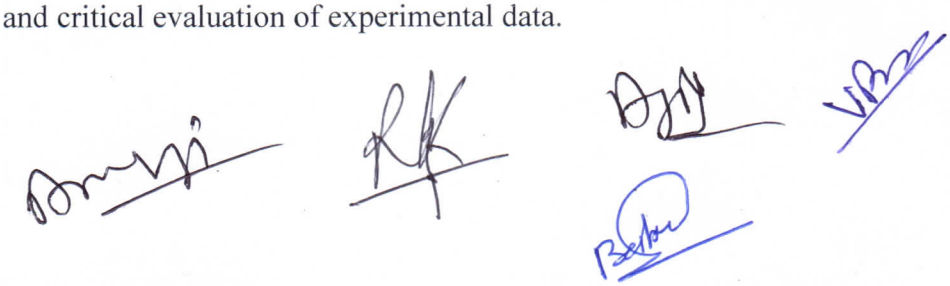
PSO 2: Exhibit their knowledge on Industrial regulations and Environmental safety principles in biotechnology industries.

PSO 3: Work collaboratively on projects involving typical business timeline.

PSO 4: Integrate the basic principles of analytical techniques for the implementation of such technique to facilitate the development of Bio Pharma products viz. Drugs, Antibiotics, Hormones, Vaccines.

PSO 5: Familiar with the principles underlying the relevant compounds and their clinical relevance.

PSO 6: Expert in using online database understanding, creation and testing of scientific hypothesis and critical evaluation of experimental data.



[Approved by Academic Council in its meeting dated / / 2014 and by Executive Council in its meeting dated / /2014]

RAMA UNIVERSITY

Ordinances for

Master of Science in Biotechnology

RAMA UNIVERSITY, KANPUR

Ordinances for

Master of Science in Biotechnology

[Approved by Academic Council in its meeting dated / /2014 and by

Executive Council in its meeting dated / /2014]

1. Admission

1.1. Admission to M.Sc. Biotechnology First year in Ist semester will be made as per the rules prescribed by the Academic Council of the Rama University, Kanpur.

1.2. Admission on migration of a candidate from any other University to the University is permitted.

2. Eligibility for Admissions:

2.1. Admission to M.Sc. Biotechnology First Year:

Candidates who have passed B.Sc. Biotechnology/Biosciences/Agricultural are eligible for admission to first year of 2 year M.Sc. Biotechnology. Courses offered by Faculty Sciences affiliated to Rama University, Kanpur.

3. Attendance

3.1 Every student is required to attend all the lectures, tutorials, practicals and other prescribed curricular and co-curricular activities. The attendance can be condoned up to 25% on medical grounds or for other genuine reasons beyond the control of students.

3.2 A further relaxation of attendance up to 15% for a student can be given by Dean provided that he/she has been absent with prior permission of the Head of Department for the reasons acceptable to him.

3.3 No student will be allowed to appear in the end semester examination if he / she do not satisfy the overall average attendance requirements of Clause Nos. 3.1, and 3.2. and such candidate(s) shall be treated as having failed and will be further governed by clause no. 4.1 & 4.2.

3.4 The attendance shall be counted from the date of admission in the college or start of academic session whichever is later.

4. Duration of Courses

4.1 Total duration of the M.Sc. Biotechnology Course shall be 2 years, each year comprising of four semesters. Each semester shall normally have teaching for the 90 working days or as prescribed by UGC from time to time.

4.2 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 further subject to clause 9.

5. Curriculum:

5.1 The 2 years curriculum has been divided into 4 semesters and shall include lectures, tutorials, practicals, 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.

5.2 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.

6. Examination:

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

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

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

6.4 The minimum pass marks in each theory subject (including sessional marks) shall be 40% with a minimum of 30% marks in each theory paper in the end semester examination. If there is no provision of sessional marks in any subject, the minimum pass marks in that subject shall be 30% in the end semester examination.

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

6.6 A candidate, in order to pass, must secure 50% marks in the aggregate in a particular academic year inclusive of both semesters of the academic year subjected to conditions as clause 8.2(a).

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

7. Promotion:

7.1 A candidate satisfying all the requirements under clause 7 shall be promoted to the next academic year of study.

7.2. (a) A candidate shall be eligible for provisional promotion to the next academic year of study provided :

(i) He/she fails to satisfy the requirements of clause 6.4, 6.5 and 6.7 in not more than 6 theory subject and 2 practical/ project subjects on the basis of combined result of both semester examinations of a particular academic year.

(ii) He/she fails to satisfy the requirements of clause 6.4, 6.5 and 6.7 (theory and/or practical/ project subjects) in not more than 5 theory subjects and 2 practical/project subjects in addition he/she fails to satisfy requirement of clause 6.6 (aggregate marks) in the combined result of both semester examinations of a particular academic year. In such a case aggregate marks shall be treated as one theory subject.

(b) If a candidate satisfies the requirement of clauses 6.4, 6.5 & 6.7 but fails to satisfy the requirement of clause 6.6, he/she shall be eligible for provisional promotion with carry over. He/she may choose up to a maximum of any four theory papers of that particular academic year as per his/her choice to pass the examination of that year.

7.3 A candidate shall not be promoted to third year unless he/she passes all the subjects of first year. Similarly, a candidate shall not be promoted to fourth year unless he/she passes all the examinations of second year.

7.4 All other candidates who do not satisfy conditions laid down in clause 7 shall be declared fail and shall be required to repeat the whole academic year after taking re- admission. This facility is, however, subject to the time limits stipulated in clause-4.

8. Carryover System:

8.1(a) A candidate who satisfies the requirements of clause 7.2 (a) will be required to appear in those theory papers / practicals 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.

(b) A candidate satisfying clause 7.2 (b) shall be required to exercise his/her choice up to a maximum of five theory papers in which he/she desires to appear in the examination to fulfill the requirements of clause 6.6. He/she shall inform the college about his/her choice within 15 days after the start of new session.

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

9. Ex-studentship:

9.1A 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.

9.2A candidate opting for ex-studentship shall be required to apply to the faculty of Sciences by paying only examination fee within 15 days from the start of new session.

10. Re-admission:

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

10.1 A candidate is declared fail.

10.2 A candidate did not appear in a semester examination / or he/she was not granted permission to appear in the examination.

10.3 A candidate has been detained by the department and subsequently has been permitted to take re-admission.

10.4 A candidate as an ex-student passed the examination of the academic year or qualified for carryover system.

10.5 A candidate promoted with carry over subjects and he/she opted for re- admission.

11. Results:

11.1The result of a candidate shall be declared on the basis of performance of both semesters of the same academic year. However, a final year student, who is not permitted in any one of the final year semester examinations due to shortage of attendance, will be permitted in that particular semester of the next academic session to study as a regular student and appear at that semester examination.

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

12.1 Calculation of Grade Point and Grade Point Average

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

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

In order to arrive at alphabet grades, the total marks in a particular course for all the students pursuing the course are tabulated in the descending order (equivalently a histogram).

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

12.2 Calculation System of Semester Grade Point Average:

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

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

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

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

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

- Percentage conversion of CPI :

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

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

≥8 CPI	**Ist division with honours**
≥6 CPI	**Ist division**
≥5 CPI	**IInd division**
<5 CPI	**Fail**

12.3 If a candidate passes all examinations in first attempt without grace and secures 8CPI or more marks, he/she shall be placed in FIRST DIVISION WITH HONOURS and the candidates at first two top positions amongst First Div. with Honours only will be awarded medals viz. Gold and Silver respectively in order of merit.

13. Award of Rank:

On the basis of final year result, the top ten candidates in each branch shall be awarded rank according to their merit provided they pass all the examinations in first attempt.

14. Grace Marks:

14.1 A candidate may be awarded grace marks up to a maximum of total 10 marks, in maximum three subjects but not more than four marks in any subject including theory papers, practicals, project, seminar, industrial training and/ or aggregate marks in each academic year provided he/she can be declared to have passed the academic year by the award of these marks.

14.2 The grace marks shall not be added to the aggregate marks.

15. Scrutiny and Revaluation:

15.1Scrutiny shall be allowed in three theory papers.

15.2Revaluation of theory/practical papers is not permitted.

16. 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.

17. Award of Sessional Marks:

Sessional marks for theory subjects, practicals and project shall be awarded as will be prescribed and at present the break-up of sessional marks shall be as follows:

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks
Conduct / Perform/Execution /Practical File/ Viva-Voice

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

Make-up test may be held only for those students who could not appear in any one of mid-term class tests due to genuine reasons for which the prior permission from the Head of Department was taken. Make up test shall ordinarily be held about two weeks before the semester examination. The syllabus for the make-up test shall be the whole syllabus covered by the subject teacher upto that time.

18. Award of Seminar, Industrial Training, Educational Tour Marks at Department level:

18.1The marks of Seminar, Major project shall be awarded on the following basis:

Criteria	Internal	External	Total
Project Report	200	50	250
Viva Voce	100	50	150
Total	**300**	**100**	**400**

18.2 The marks in Seminar, Industrial Training and Educational Tour shall be awarded by a committee consisting of following members:

(i) Head of the Department or his/her nominee.

(ii) Concerned Officer – Incharge.

(iii) Senior Faculty Member of the department nominated by the Head of Department.

19. 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 4.2

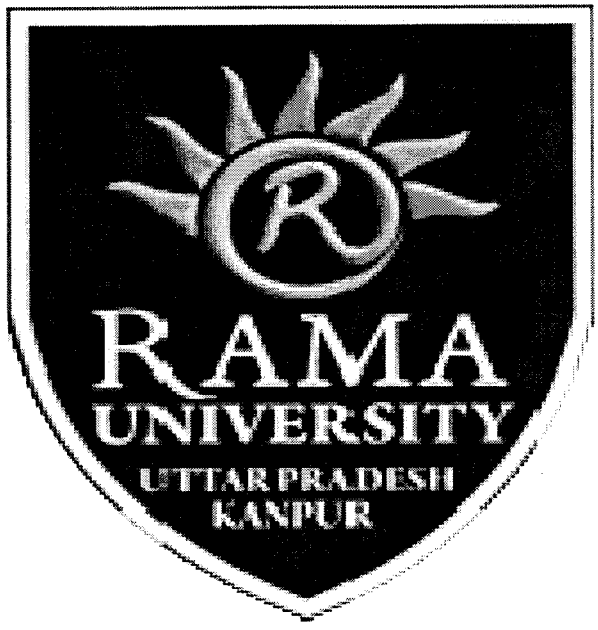
or

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

20. 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.

Rama University Uttar Pradesh, Kanpur

Faculty of Sciences



EVALUATION SCHEME

[Effective from the Session 2014-15]

M.Sc. Biotechnology

1st & 2nd Year

Rama University Uttar Pradesh, Kanpur

Faculty of Sciences

COURSE DETAIL & EVALUATION SCHEME

M.Sc. Biotechnology

(Effective from the Session 2014-15)

FIRST YEAR (SEMESTER-I)

S.N.	Subject Code	Subject Name	Period			Evaluation Scheme			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory subjects										
1	MBT-101	Biomolecules	3	1	0	20	20	60	100	4
2	MBT-102	Microbiology	3	1	0	20	20	60	100	4
3	MBT-103	Molecular Cell Biology	3	1	0	20	20	60	100	4
4	MBT-104	Biophysical Tools and Techniques	3	1	0	20	20	60	100	4
Practicals / Project										
5	MBT-151	Cell & Microbiology Lab	0	0	2	30	20	50	100	2
6	MBT-152	Biophysical Tech Lab	0	0	2	30	20	50	100	2
Total			**12**	**4**	**4**	**140**	**120**	**340**	**600**	**20**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

1. Attendance: 5 Marks
2. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks

b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

Rama University Uttar Pradesh, Kanpur

Faculty of Sciences

For Continuous Evaluation (CE) is such as: 30 Marks

Conduct / Perform/Execution /Practical File/ Viva-Voice

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

(Convener)

(Chairperson)

Signature.....

Name : Ajit P. Singh Yadav

Date:

Internal Members

Signature 1.....

Name : Mr. Anjani kumar Srivastava

Date:

Signature 2.....

Name : Mr. Vachaspati Rao

Date:

External Members

Signature 1.....

Name : Prof. (Dr.) R.K. Mishra

Date:

Signature 2.....

Name : Dr. G. Sunil Babu

Date:

Rama University Uttar Pradesh, Kanpur

Faculty of Sciences

COURSE DETAIL & EVALUATION SCHEME

M.Sc. Biotechnology

(Effective from the Session 2014-15)

FIRST YEAR (SEMESTER-II)

S.N.	Subject Code	Subject Name	Period			EVALUATION SCHEME			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory subjects										
1	MBT-201	MOLECULAR BIOLOGY	3	1	0	20	20	60	100	4
2	MBT-202	ENZYMOLOGY	3	1	0	20	20	60	100	4
3	MBT-203	INTERMEDIARY METABOLISM	3	1	0	20	20	60	100	4
4	MBT-204	BIOSTATISTICS & BIOINFORMATICS	3	1	0	20	20	60	100	4
Practicals / Project										
5	MBT-251	BIOCHEMISTRY & MOLECULAR BIOLOGY LAB	0	0	2	30	20	50	100	2
6	MBT-252	BIOSTATISTICS AND BIOINFORMATICS LAB	0	0	2	30	20	50	100	2
Total			**12**	**4**	**4**	**140**	**120**	**340**	**600**	**20**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

3. Attendance: 5 Marks
4. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks

b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks

Conduct / Perform/Execution /Practical File/ Viva-Voice

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

(Convener)

Signature.....

Name : Ajit P. Singh Yadav

Date:

Internal Members

Signature 1.....

Name : Mr. Anjani kumar Srivastava

Date:

Signature 2.....

Name : Mr. Vachaspati Rao

Date:

External Members

Signature 1.....

Name : Prof. (Dr.) R. K. Mishra

Date:

Signature 2.....

Name : Dr. G. Sunil Babu

Date:

COURSE DETAIL & EVALUATION SCHEME

M.Sc. Biotechnology

(Effective from the Session 2014-15)

SECOND YEAR (SEMESTER-III)

S.N.	Subject Code	Subject Name	Period			EVALUATION SCHEME			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory Subjects										
1	MBT-301	IMMUNOLOGY	3	1	0	20	20	60	100	4
2	MBT-302	PLANT BIOTECHNOLOGY	3	1	0	20	20	60	100	4
3	MBT-303	ANIMAL CELL SCIENCE & TECHNOLOGY	3	1	0	20	20	60	100	4
4	MBT-304	BIOPROCESS ENGG. & FERMENTATION TECHNOLOGY	3	1	0	20	20	60	100	4
PRACTICALS / PROJECT										
5	MBT-351	TISSUE CULTURE LAB	0	0	2	30	20	50	100	2
6	MBT-352	IMMUNOLOGY LAB	0	0	2	30	20	50	100	2
Total			**12**	**4**	**4**	**140**	**120**	**340**	**600**	**20**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

5. Attendance: 5 Marks
6. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 30 Marks

Conduct / Perform/Execution /Practical File/ Viva-Voice

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 50 Marks

(Convener)

Signature.....

Name : Ajit P. Singh Yadav

Date:

Internal Members

Signature 1.....

Name : Mr. Anjani kumar Srivastava

Date:

Signature 2.....

Name : Mr. Vachaspati Rao

Date:

External Members

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Name : Prof. (Dr.) R. K. Mishra

Date:

Signature 2.....

Name : Dr. G. Sunil Babu

Date:

Rama University Uttar Pradesh, Kanpur

Faculty of Sciences

COURSE DETAIL & EVALUATION SCHEME

M.Sc. Biotechnology

(Effective from the Session 2014-15)

SECOND YEAR (SEMESTER-IV)

S.N.	Subject Code	Subject Name	Period			EVALUATION SCHEME			Subject Total	Credit
			L	T	P	CE	MTE	ETE		
Theory Subjects										
1	MBT-401	GENETIC ENGINEERING	3	1	0	20	20	60	100	4
2	MBT-402	ENVIRONMENTAL BIOTECHNOLOGY	3	1	0	20	20	60	100	4
Practicals / Project										
5	MBT-451	PROJECT WORK & PRESENTATION	0	0	12	300	-	100	400	12
Total			**6**	**2**	**12**	**340**	**40**	**220**	**600**	**20**

L-Lecture, T-Tutorial, P- Practical, CE- Continuous Evaluation, MTE-Mid Term Examination, ETE-End Term Examination

Evaluation Scheme:

- **Course without practical components**

For Continuous Evaluation (CE) is such as: 20 Marks

7. Attendance: 5 Marks
8. Assignments/Quiz / Seminar/Term paper /Project :15Marks

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks

b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 60 Marks

- **Course with practical components only**

For Continuous Evaluation (CE) is such as: 300 Marks

Major Project/Conduct / Perform/Execution /Practical File/ Viva-Voice/Project Work & Presentation

MTE - Mid Term Examination: 20 Marks

a. First Mid Term Examination: 10 marks
b. Second Mid Term Examination: 10 marks

ETE - End Term Examination: 100 Marks

(Convener)

Signature.....

Name : Ajit P. Singh Yadav

Date:

Internal Members

Signature 1.....

Name : Mr. Anjani kumar Srivastava

Date:

Signature 2.....

Name : Mr. Vachaspati Rao

Date:

External Members

Signature 1.....

Name : Prof. (Dr.) R. K. Mishra

Date:

Signature 2.....

Name : Dr. G. Sunil Babu

Date:

Rama University Uttar Pradesh, Kanpur

Faculty of Sciences

First Year- 1st Semester

MBT-101- BIOMOLECULES

L T P **Credit-4**

3 1 0

OBJECTIVES:

The course aims to provide students with a basic understanding of:

1. demonstrate knowledge and understanding of the principles that govern the structures of macromolecules and their participation in molecular recognition
2. the principles of bioenergetics and enzyme catalysis
3. the chemical nature of biological macromolecules, their three-dimensional construction, and the principles of molecular recognition

OUTCOME:

Students will learn about:

1. How chemical and molecular processes take place in and between cells. Your understanding of these processes will sufficient depth to enable you to describe and explain both the processes and their effect on the properties of living organisms.
2. The most important molecular or mesoscopic methods used today to expand our biological and medical knowledge, or to increase our understanding of biomaterials.

CONTENTS:

Unit I: **8 Hours**

Classification and physico-chemical properties of amino acids and proteins. Isolation, purification and criteria of purity of proteins. Definition, structural and functional features, and determination of primary, secondary, tertiary and quaternary structures of proteins. protein sequencing.

Unit II: **8 Hours**

Classification & properties of mono-, di-, oligo and poly- saccharides. Structural features and compositional analysis of polysaccharides. Biological importance of glucose, fructose, maltose, sucrose, lactose, starch, glycogen, lignin, kitin, cellulose, peptidoglycan and glycoproteins.

Unit III: **8 Hours**

Introduction to Vitamins, hormones, Phytohormones and their role. Classification, structure, properties and functions of lipids. Biological importance of choline, lecithine, lipoproteins, chylomicrons , VLDL, LDL, HDL.

Unit IV: **8 Hours**

Structure, properties and functions of nucleic acids. Sequencing of DNA, RNA Polymorphism, Tm and its relation to GC content, Cot value.

Unit V: **8 Hours**

Classification and properties of porphyrins, metalloproteins. Nature, synthesis and physiological significance of bile pigments.

Books Recommended:

1 Christopher K. Mathews, K.E. van Holde and Kevlin G. Ahern, *Biochemistry*, Pearson Education (Singapore) Pte. Ltd. Indian Branch, 482 F.I.E. Patparganj, Delhi.

2 Lubert Stryer, *Biochemistry*, W.H. Freeman and Company, New York .

3. D.L. Nelson, M.M. Cox, *Lehninger's Principles of Biochemistry*, Macmillan Worth Pub. Inc. New York

4. Geoffery Zubey, Biochemistry, Macmillon Publishing Company, New York

5. Donald Voet and Judith Voet, *Biochemistry*, John Wiley & Sons, New York

MBT-102: MICROBIOLOGY

L T P **Credit-4**

3 1 0

OBJECTIVES:

Our curriculum is designed to educate our majors in a variety of important microbiological disciplines, as well as to promote and develop skills and competencies that have enduring value beyond the classroom.

OUTCOME:

Students will be able to:

1. define/explain within multiple microbiology disciplines the core theories and practices;
2. describe/explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host populations;
3. demonstrate practical skills in the use of tools, technologies and methods common to microbiology, and apply the scientific method and hypothesis testing in the design and execution of experiments.

CONTENTS:

Unit I: **8 Hours**

History, development and scope of microbiology: Doctrine of spontaneous generation; controversy over spontaneous generation; contribution of Antony Van Leeuwenhoek, Lazzaro Spallanzani, John Tyndall, Louis Pasteur, Joseph Lister, Iwanowsky, Robert Koch in the development of microbiology, Microbiology in the 20th century.

Unit II: **8 Hours**

Structural and functional relation of prokaryotes. Cell wall, cell membrane, capsule, flagella, pili, Tactic movements, storage granules, metabolism of volutin (polyphosphates), glycogen, polyb-hydroxy alkanoates, endospore structure and process of sporulation. Microbial genetics (transformation, conjugation, transduction and transposition) Plasmids: F plasmids, R plasmids, Col plasmids etc.

Unit III: **8 Hours**

Different types of culture media, Isolation identification of microbes, culture techniques, preservation of cultures.

Nutrition: Photoautotrophs, photoheterotrophs, chemoautotrophs, chemoheterotrophs.

Growth: Microbial definition measurement of growth, generation time, arithmetic and exponential growth growth, Batch growth curve, continuous and synchronous culture, factors affecting microbial growth. P^h, Temp, Oxygen etc.

Unit IV: **8 Hours**

Microbial control: Methods and dynamics of sterilization, mechanisms of control (physical, chemical, and radiation etc), biocontrol. Concept of chemotherapy: chemotherapeutic agents (antibiotics, drugs, medicines etc), mechanisms of action. Drug resistance: Multi Drug Resistance, assessment and management of drug resistance.

Unit V: **8 Hours**

Application of microbiology: Microbial decomposition of organic matter cellulose, hemicelluloses, and lignin. Degradation of pesticides: Xenobiotics, Plastics, biodegradable plastics, and biopesticides. Microbiology of water, algal bloom, waste water treatment, biogas generation. Host-microbe interaction: rhizosphere, phyllosphere, mycorrhiza, PGPR, sidrophores in relation to rhizobacteria

Books Recommended:

1. Pelczar et al , *Microbiology* , Tata Mac Graw Hill , New Delhi
2. Pressscott, Harley, Klein, *Microbiology*-, WCB Mc Graw Hill, New York.
3. Madigan, Martinko, Parker , *Brock's Biology of Microorganisms* , Prentice Hall, New Delhi.
4. J Black , *Microbiology: Principles and Explorations* , John Wiley & Sons, New York.
5. Cappuccino Sherman , *Microbiology- A Laboratory manual*, Benjamin Cummings.
6. R Y Stanier et al , General Microbiology, Mc Millan Press Ltd., New Delhi

MBT-103: MOLECULAR CELL BIOLOGY

L T P **Credit-4**

3 1 0

OBJECTIVES:

Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles

OUTCOME:

At the end of this course students should be able to

1. Exhibit a knowledge base in genetics, cell and molecular biology, and anatomy and physiology
2. Demonstrate the knowledge of common and advanced laboratory practices in cell and molecular biology

CONTENTS:

Unit I: **8 Hours**

Origin of biomolecules, the ancient reducing environment of earth, origin of oxygen, origin of prokaryotes and eukaryotes, origin of mitochondria and chloroplast, Miller-Urey experiment, cell theory.

Unit II: **8 Hours**

The structural and Functional relation of cellular organelles: Plasma membrane, cell wall, cytoskeleton their structural organization and extra cellular matrix. Mitochondria, chloroplast, endoplasmic reticulum, golgi bodies, ribosome, lysosomes, oil and carbohydrate containing bodies, nucleus, and other organelles and their organization.

Unit III: **8 Hours**

Biological membranes- Physicochemical properties of cell membranes and their structural constitution. Transport of nutrients across the membranes –simple, passive, facilitated diffusion, Protein targeting and sorting- Post transitional import of proteins to mitochondria lysosomes, nucleus, secretary vesicles, chloroplast and peroxisomes.

Unit IV: **8 Hours**

Cellular responses (various types of chemicals) in bacteria, plants and animals, Mechanism of signal transduction. Cell cycle (mitosis and meiosis) molecular events and, cell cycle control, mechanism of aging with reference of mitochondrial gene action and their involvement.

Unit V: **8 Hours**

Cellular basis of differentiation and development – cell division, gametogenesis and fertilization, differential developmental pattern in vertebrates, differential gene activity and cell differentiation, clevage, morulla, blastula, gastrullation and neurulation etc. morphogenetic determinants in egg cytoplasm, genetic regulation of early, embryonic development in Drosophilla, homeotic genes.

Books Recommended:

1. H Lodish, D Baltimore, A Berk, SL Zipursky, P Matsudaira, J Darnell, *Molecular Cell Biology*, W.H.Freeman, USA.
2. Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, *Essential Cell Biology*, Garland, USA.
3. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, *Molecular Biology of the Cell,* Garland, USA.
4. Lubert Stryer, Jeremy Berg, John Tymoczko, *Biochemistry* , W.H.Freeman, USA.
5. David L. Nelson, Michael M. Cox ,*Lehninger: Principles of Biochemistry,* W.H.Freeman, USA.

6. Gerald Karp, *Karp: Cell and Molecular Biology: Concepts and Experiments,* Wiley (Asia Pvt Ltd)

MBT-104: BIOPHYSICAL TOOLS AND TECHNIQUES

L T P **Credit-4**

3 1 0

OBJECTIVES:

Biophysical Techniques explains in a readily accessible way the basics of the various methods available including those used to study molecular structure, cell structure, and dynamic interactions so that students can understand the principles behind the different methods used.

OUTCOME:

1. A Master's degree will give you a broad foundation in biophysics with particular focus on radiation physics. In particular, this includes learning about the structure and function of important biomolecules and cellular systems.
2. Students will also learn about methods for measuring the effects of radiation on these models. Students will learn fundamental scientific working methods, how to work independently on a large-scale project, and you will gain experience in producing a clear, well-structured, critical written presentation.

CONTENTS:

Unit I: **8Hours**

Microscopic techniques for observing cell structure: Principles and applications of light, phase, contrast, fluorescence, scanning and transmission electron microscopy, electron cryomicroscopy, scanning tunneling microscopy, cytophotometry and flow cytometry.

Unit II: **8Hours**

Chromatographic Techniques: TLC and Paper chromatography; Chromatographic methods for macromolecule separation - Gel permeation, Ion exchange, Hydrophobic, Reverse-phase and Affinity chromatography; HPLC and FPLC; Criteria of protein purity.

Electrophoretic techniques: Theory and application of Polyacrylamide gel electrophoresis and Agarose gel electrophoresis; Capillary electrophoresis; 2D Electrophoresis; Disc gel electrophoresis; Gradient electrophoresis; Pulsed field gel electrophoresis, SDS PAGE.

Unit III: **8Hours**

Centrifugation: Basic principles; Mathematics & theory (RCF, Sedimentation coefficient etc); Types of centrifuge - Microcentrifuge, High speed & Ultracentrifuges; Preparative centrifugation; Differential & density gradient centrifugation; Applications (Isolation of cell components); Analytical centrifugation; Determination of molecular weight by sedimentation velocity & sedimentation equilibrium methods.

Unit IV: **8Hours**

Spectroscopic Techniques:

NMR: basic principles; chemical shift; Use of NMR in studying protein structure and X-ray diffraction. Measurement of stable isotopes: Falling drop method and Mass spectrometry. UV, Visible and Raman Spectroscopy; Theory and application of Circular Dichroism, Fluorescence, ESR and Plasma Emission spectroscopy, MALDI-TOF, Mass spectrometry.

Radioisotope techniques: Application of radioisotopes in biology; autoradiography and radiation dosimetry. Nanotechnology- Nanoparticles; their application in medicine and biology.

Unit V: **8Hours**

Radioactivity: Radioactive & stable isotopes, Pattern and rate of radioactive decay, Units of radioactivity. Measurement of radioactivity: Geiger-Muller counter, Solid & Liquid scintillation counters (Basic principle, instrumentation & technique), Brief idea of radiation dosimetry, Cerenkov radiation, autoradiography. Applications of isotopes in biochemistry, Principles of tracer techniques, Its advantages and limitations, Clinical application. Radioimmunoassay.

Books recommended:

1. Biophysical Chemistry vol. I, II & III (1997) Cantor and Schimmel **Pub**: W.H. Freeman & Com.
2. Molecular Biology of the gene (5th Edtion), – J.D. Wastson, T.A. Baker, S.P. Bell, A. Gann, M. Levine, R. Losick, **Pub:** Pearson Education (Singapore) Pvt. Ltd. Delhi
3. Biochemistry (3rd Edition) – G. Zubay., **Pub**: Wm. C. Brown Pub
4. Biochemistry (2nd Edition) – D. Voet and J.G. Voet **Pub:** John Willy & Sons.
5. Physical Biochemistry (2nd Edition) D. Friefelder **Pub:** W.H. Freeman & Com.
6. Biochemistry (5th Edition) – Lubert Stryer. **Pub:** W.H. Freeman & Com., NY.
7. Principles of Biochemistry (4th Edition)–Lehninger, Nelson & Cox. **Pub**: Macmillan Pub.
8. Molecular Cell Biology, (5th Edition) H. Lodish, A. Berk P. Matsudaira Chris A. Kaiser, M.Krieger.
9. Practical Biochemistry (5thEdition)–K.Wilson & J.Walker.**Pub**:Cambridge Univ.Press, (U.K.)

MBT-151: CELL & MICROBIOLOGY LAB

L(0) / T(0) / P(2) **Credit-1**

Cell Biology Lab

1. Mitotic metaphase chromosome preparation from bone marrow of mouse/rat.
2. Cell motility and flagellar staining.
3. Microscopic studies of cell organelles.
4. Isolation of neutrophils and demonstration of phagocytosis.
5. Determination of osmotic fragility of RBC membrane.
6. Vital Staining of Mitochondria with Janus green B.
7. Demonstration of diversity of cell types (Muscle, Neuron)
8. Study of mitosis (smear and squash method, root tip of onion).
9. Study of meiosis (pollen grain), Maize, Rat testis.
10. Determination of activity of sodium/potassium ATPase of plasma membrane.

Microbiology Lab

1. Instruments/equipments commonly used in Microbiology.
2. Washing and Sterilization of Lab wares.
3. Media preparation for growing (i) Bacteria (ii) Moulds (iii) Yeast.
4. Culturing of Microorganisms – (i) Slant preparation (ii) Suspension culture (iii) Streaking (iv) Plating.
5. Simple and Gram staining
6. Isolation of soil organisms, plate streaking method.
7. Counting of microorganisms using Haemocytometer in given sample (serial dilution)
8. Size measurement of microorganisms using stage and ocular micrometer.
9. Growth measurement by optical density/plating method.

MBT-152: BIOPHYSICAL TOOLS AND TECHNIQUES LAB

L(0) / T(0) / P(2) **Credit-1**

pH meter :

1- List uses of pH meter, measurement, detailed diagram of pH electrode and reference electrode (combined electrode also), find pH of a solution giving detailed account of pH meter operation, trouble shouting.

2- Preparation of solution using pH meter.

3- Demonstration of the effect of the solution

Spectroscopy :

To determine maximum absorption spectra of mixtures (potassium dichromate and potassium permanganate) solution.

Centrifugation :

1. Measure components and working of centrifuges, solving g and RPM of centrifuge with respect to various heads. rotors

2. Isolation of cellular organelles by differential centrifugation

Chromatography :

1- Solvent-solvent extraction of plant pigments,

2- Use of paper chromatography for separation of plant pigments

3- Use of thin-layer chromatography for amino acid (TLC)

4- Demonstration of Ion-exchange chromatography

5- Demonstration of Gel-exclusion chromatography

Electrophoresis:

1- Electrophoresis of protein by SDS-PAGE

2- Electrophoresis of DNA by agarose gel

First Year- 2nd Semester

MBT-201 MOLECULAR BIOLOGY

L	T	P	Credit-4
3	1	0	

OBJECTIVES:

This course will emphasize the molecular mechanisms of DNA replication, repair, protein synthesis etc. and also to demonstrate knowledge and understanding of the molecular machinery of living cells

OUTCOME:

At the end of this course students should be able to demonstrate a clear understanding of the facts and basic concepts of molecular biology which are covered in lectures, including:

1. To provide with the core principles of molecular biology.

2. To gain higher level thinking skills that is necessary for scientists.

3. This course should excite about basic science and its applications

CONTENTS:

Unit I **8Hours**

DNA as a genetic material: Griffiths and Hershey-Chase experiment, central dogma of Molecular biology, Genomic organization of prokaryotes & eukaryotes, Polytene and Lampbrush chromosomes. Chromatin –histone and non-histone proteins, chromatin remodeling. DNA- supercoiling, structure of gene, introns and exons. mutation, types of mutation, Transposons.

Unit II **8Hours**

Nucleosomes model, DNA replication, modes of replication, replisomes, DNA polymerases the DNA replicating enzymes, mechanism and regulation of DNA replication in prokaryotes and eukaryotes. DNA repair.

Unit III **8Hours**

Transcription, transcription unit, substrate for transcription, transcription apparatus, RNA polymerases, prokaryotic transcription, eukaryotic transcription, transcription factors, promoters and enhancers, various RNA species and their properties, processing of pre-mRNA to mature mRNA, RNA splicing, lariat Formation. Ribozymes.

Unit IV **8Hours**

Translation: Prokaryotic & Eukaryotic and translation, the translational machinery, mechanisms of initiation elongation and termination, translation factors, regulation of translation .Protein localization and targeting: Synthesis of secretary and membrane proteins, import into nucleus, mitochondria, chloroplast and peroxisomes, receptor mediated endocytosis.

Unit V **8Hours**

The genetic code, properties of genetic code, wobble hypothesis, mechanism and regulation of translation in Prokaryotes and Eukaryotes, molecular chaperones, DNA-binding motifs, operon, negative and positive control, *lac* operon, *trp* operon, attenuation. Stringent response in bacteria.

Books Recommended:

1. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, *Molecular Biology of Genes,* The Benjamin/ Cummings Publishing Company, New York.

2. T. A. Brown, *Genomes,* Wiley Publishers (Asia Pvt Ltd).
3. Lubert Stryer, Jeremy Berg, John Tymoczko *Biochemistry*, W.H.Freeman, USA.
4. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, *Molecular Biology of the Cell*, Garland, USA.
5. David L. Nelson, Michael M. Cox, *Lehninger: Principles of Biochemistry*, W.H.Freeman, USA.
6. Hartl and Jones, *Genetics*, Jones and Bartlett publishers, USA.
7. H.K.Das, *Textbook of Biotechnology*, Wiley Dreamtech India Pvt. Ltd.
8. Voet and Voet, *Biochemistry*, John Wiley and sons (Asia Pvt Ltd).
9. Benjamin Lewin, *Gene VIII*, Oxford University press, U.K.

MBT-202 ENZYMOLOGY

L T P **Credit-4**

3 1 0

OBJECTIVES:

The objective of the course is to provide a deeper insight into the fundamentals of enzyme structure and function and kinetics of soluble and immobilized enzymes. Also it deals with current applications and future potential of enzymes. process. The student will be able to perform immobilization of enzymes.

OUTCOME:

1. At the end of this course students should be able to define enzyme structure, define differences between enzymes and normal catalytic substances, recognize the catalytic substances
2. Explain chemical structure of enzymes, recognize the enzymes chemical structure, explain cofactor and coenzymes chemical structure
3. Recognize chemical structures of biological cofactor and coenzymes and express Important coenzymes and the groups they transfer.

CONTENTS:

Unit I **8Hours**

classification and nomenclature of enzymes. Introduction to enzymes: Holoenzyme, apoenzyme, prosthetic group. Interaction between enzyme and substrate- lock and key model, induced fit model. Features of active site, activation energy, Enzyme denaturation and renaturation, enzyme specificity and types.

Unit II **8Hours**

Kinetics of single substrate reactions; Derivation of Michaelis -Menten equation, turnover number; determination of Km and Vmax (LB plot, ED plot), Importance of Km & Vmax; Multi-Substrate reaction mechanisms. Enzyme inhibition: irreversible; reversible (competitive, uncompetitive and non competitive inhibition); Substrate and Product inhibition, Ribozymes, Abzymes, allostearic enzyme, regulation of allostearic enzymes, concerted & sequential model; Deactivation Kinetics. Factors affecting the velocity of enzyme catalyzed reaction- enzyme concentration, temperature, pH, substrate concentration, inhibitors and activators.

Unit III **8Hours**

Extraction of crude enzyme from plant, animal and microbial source; some case study. Purification of enzymes by the help of different methods(chromatographic techniques). Methods of characterization of enzymes; criteria of purity. Unit of enzyme activity - definition and importance. Development of enzyme assays.

Unit IV **8Hours**

Enzyme Immobilization: Adsorption, Matrix entrapment, Encapsulation, Cross linking, Covalent binding and their examples; Advantages and disadvantages of different immobilization techniques. Structure & stability of immobilized enzymes, kinetic properties of immobilized enzymes- partition effect, diffusion effect. Overview of applications of immobilized enzyme systems.

Unit V **8Hours**

Enzyme Biosensors: elements of biosensors, three generations of biosensors, Types of biosensors: calorimetric, potentiometric, amperometric, optical and piezoelectric. Design of enzyme electrodes and their applications as biosensors in industry, health care and environment. Design of Immobilized Enzyme

Reactors- Stirred tank reactors(STR), Continuous Flow Stirred Tank Reactors (CSTR), Packed- bed reactors (PBR), Fluidized-bed Reactors (FBR); Membrane reactors.

Books Recommended:

1. Fundamentals of enzymology by Nicolas C. price and Lewis stevens . Oxford University Press
2. Enzymes by Trevor palmer, East west Press
3. Enzyme Technology by Messing
4. Enzymes: Dixon and Webb. (IRL Press)
5. Enzyme technology by Chaplin and Bucke. Cambridge Univerity Press
6. Biochemical engineering fundamentals, second edition. James E Bailey, David F., Ollis, McGraw Hill Intl. Edition

MBT-203 INTERMEDIARY METABOLISM

L T P **Credit-4**

3 1 0

OBJECTIVES:

A step-by-step guided discovery approach to the learning of the chemical steps in gluconeogenesis and the citric acid cycle is described. Metabolic pathways, and their study, oftentimes in great depth, are a staple of biochemistry.

OUTCOME:

1. Students will be able to define the major pathways of intermediary metabolism of biomolecules, and discuss their bioenergetics, physiological adaptation, metabolic and main hormonal regulation, localization and cellular compartmentalization.
2. Correlate the metabolic activity of tissues and organs with their function. Discuss how disruptions in intermediary metabolism may lead to disease, and illustrate with selected examples.

CONTENTS:

Unit I **8Hours**

Energy, energy flow cycle, energy conversion; Structure and properties of ATP; High energy compounds, Thermodynamic considerations, Role of water as solvent , P^H, P^{Ka} , Henderson Hasselbalch equation

Unit II **8Hours**

Metabolism of carbohydrates & its regulation- Gluconeogenesis, Glycolysis and Feeder pathways, secondary pathways of glucose oxidation – PPP & glucuronic acid pathway & TCA, Glyoxylate cycle. Regulatory mechanism of glycolysis, TCA, and ETS system.

Unit III

8Hours

Metabolism of fatty acids- beta -oxidation of saturated, unsaturated (mono & poly), odd and even chains fatty acids, alpha and gamma oxidation. Metabolism of sterols, phytanes, porphyrins, Impaired metabolism and lipid disorders

Unit IV **8Hours**

Biosynthesis of amino acids Oxidation of amino acids and urea cycle, Nucleotide biosynthesis (De-novo and Salvage pathway, purines and pyrimidines), metabolic disorders of amino acids. Nitrogen metabolism, Nitrogenase complex, Role of nif gene and oxygen toxicity(role of leghaemoglobin).

Unit V **8Hours**

Photo synthetic apparatus in plants and bacteria, photo pigments, Light dependent and independent reaction, Oxidative phosphorylation and photophosphorylation and photorespiration, Photosynthesis-(C3 cycle, C4 cycle, and CAM pathway).

Introduction and metabolism of secondary metabolic products- alkaloids, terpenoids, flavonoids, steroids and pigments.

Books Recommended:

1. Harper's Illustrated Biochemistry, (26th Edition) – R.K. Murray, D.K. Garner, P.A. Mayers & V.W. Rockwell,

Pub: McGraw Hill International Edition.

2. Principles of Biochemistry (4th Edition) – Lehninger, Nelson & Cox. **Pub**: Macmillan

3. Biochemistry (3rd Edition) – G. Zubay., **Pub**: Wm. C. Brown Pub.

4. General Biochemistry (5th Edition, 1996) – Weil, **Pub**: New Age Intl. Ltd.

5. Biochemistry (5th Edition) – Lubert Stryer. **Pub:** W.H. Freeman & Com., NY.

6. Biochemistry – D. Voet and J.G. Voet **Pub:** John Willy & Sons

7. Biochemistry (4th Edition, 1974) – West & Todd **Pub**: Oxford IBH,

8. Biochemistry (9th Edition) – Debjyoti Das.–**Pub:** Academic Publishers Kollkata

9. Practical Biochemistry (3rd Edition) – David Plummer. **Pub**: Tata McGraw Hill

10. Practical Biochemistry (5th Edition) – K. Wilson and J. Walker. **Pub**: Cambridge Univ. Press, (U.K.)

MBT-204 BIOSTATISTICS &BIOINFORMATICS

L T P **Credit-4**

3 1 0

OBJECTIVES:

Demonstrate an understanding of the central concepts of modern statistical theory and their probabilistic foundation and read and learn new statistical procedures independently

OBJECTIVE:

1. Recognize the importance of data collection and its role in determining scope of inference.
2. Demonstrate a solid understanding of interval estimation and hypothesis testing.
3. Choose and apply appropriate statistical methods for analyzing one or two variables.
4. Use technology to perform descriptive and inferential data analysis for one or two variables.
5. Interpret statistical results correctly, effectively, and in context.

CONTENTS:

Unit I **8 Hours**

Scope of biostatistics, Variables in biology, Collection, classification, tabulations and diagrammatic presentation of

statistical data, Concepts of statistical population and sample, Measures of central tendencies and Dispersion, Simple measure of Skewness and kurtosis.

Unit II **8 Hours**

Probability – Definition, simple theorems of probability and simple application of probability.

Unit III **8Hours**

Correlation, correlation coefficient, standard error of estimate and regression, linear regressions, least square method of fitting, Basic idea of significance, testing level of significance, random variations, Chi-square test, ANOVA.

BIOINFORMATICS

Unit IV **8 Hours**

Introduction, classification and generation of computers, components of a computer system, input and output devices. Biological Data Base: Primary, Secondary and Composite database ,Nucleotide sequence databases, Protein sequence databases.

Unit V **8 Hours**

Structural sequence databases, Sequence analysis; Sequence alignment: Types and methods, Primer designing, Role of Bioinformatics in drug discovery and development.

Books Recommended:

1. Biostatistics – Garret
2. Encyclopedia of Biostatistics – Peter Armitage & Theodore Colton
3. Statistics – Schaum's Series Publication.
4. Statistical analysis – A computer oriented approach IInd Ed. Academic Press New York
5. Fundamentals of statistics – D.N. Elhance
6. Statistical methods for research workers – Central publisher Ludhiana.
7. Bioinformatics: A practical guide to the analysis of genes & Proteins – Ed. Andreas,
8. Computer – Schaum Series Publication.
9. David W Mount : Bioinformatics : Sequence and Genome analysis , CSHL Press, New York
10. Lesk, Arthur M: Introduction to Bioinformatics: Oxford University press, Oxford

MBT-251: BIOCHEMISTRY & MOLECULAR BIOLOGY LAB

L(0) / T(0) / P(2) **Credit-1**

Biochemistry Lab

1. Preparation of buffers.
2. Standardization of pH meter, preparation of emulsions.
3. Spectroscopy: determination of absorption maxima of a given solution.
4. Quantitative estimation of carbohydrates
5. Distinguish reducing and non-reducing sugars
6. Quantitative and qualitative estimation of proteins
7. Separation of sugars, fatty acids and amino acids by paper chromatography
8. Extraction of lipids from plant material
9. Thin layer chromatography
10. Gel electrophoresis

Molecular Biology Lab

1. Estimation of DNA content in the given sample by diphenylamine method. (Nitrogen cylinders, -200C fridge, grinders, cooling centrifuges, etc.)
2. Estimation of RNA content by the Orcinol method.
3. Determination of Tm of DNA and RNA.
4. Isolation of Plasmid DNA.
5. Isolation of bacterial/fungal genomic DNA.
6. Isolation of plant DNA.

MBT-252: BIOSTATISTICS AND BIOINFORMATICS LAB

L(0) / T(0) / P(2) **Credit-1**

(Sec. A) Biostatistics Lab

1. Measure of central tendencies and dispersion
2. Measure of skewness and kurtosis
3. Probability
4. Binomial and poisson distribution.
5. Correlation and regression

(Sec. B) Bioinformatics Lab

1. Construction of database for specific class of proteins/enzymes, genes/ ORF/ EST/Promoter sequences

   DNA motifs or protein motifs using oracle.
2. Access and use of different online protein and gene alignment softwares.
3. Gene finding related search for a given nucleotide sequence in order to predict the gene.
4. ORF prediction for different proteins out of some given nucleotide sequences.
5. Exon identification using available softwares for a given nucleotide sequences
6. Secondary structure prediction for amino acid sequences of a given protein.

(Convener)

Signature.....

Name : Ajit P. Singh Yadav

Date:

Rama University Uttar Pradesh, Kanpur

Faculty of Sciences

Internal Members

Signature 1.....

Name : Mr. Anjani kumar Srivastava

Date:

Signature 2.....

Name : Mr. Vachaspati Rao

Date:

External Members

Signature 1.....

Name : Prof. (Dr.) R. K. Mishra

Date:

Signature 2.....

Name : Dr. G. Sunil Babu

Date:

Rama University Uttar Pradesh, Kanpur

Faculty of Sciences

Second Year- 3rd Semester

MBT-301: IMMUNOLOGY

L T P **Credit-4**

3 1 0

OBJECTIVE:

To provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology

OUTCOME:

1. The students will be able to identify the cellular and molecular basis of immune responsiveness.
2. The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease.
3. The students will be able to describe immunological response and how it is triggered and regulated.
4. The students will be able to demonstrate a capacity for problem-solving about immune responsiveness.
5. The students will be able to transfer knowledge of immunology into clinical decision-making through case studies presented in class.

CONTENTS:

Unit I **8 Hours**

History & phylogeny of Immune system. Types of immunity. Cells & organs of the immune system. Structure and function of immunoglobulins. Nature of antigens, antigenicity and immunogenecity. Lymphocyte traffic.

Unit II **8 Hours**

BCR & TCR and generation of immunological diversity. Activation of B and T cell lymphocytes. Antigen antibody interactions, cross reactivity, precipitation reactions – their principles and applications serological techniques – ELISA, RIA and western blotting

Unit III **8 Hours**

Immunological tolerance. Induction of tolerance; T- cell energy; immunologically privileged sites. MHC structure and function; MHC –polymorphism; disease susceptibility, MHC restriction. Antigen processing and presentation: generation of MHC class-I and class-II peptides and their association with antigenic peptides. Generation of immunological response and its genetic control. Transplantation immunology: Immunological basis of graft rejection; immunosuppressive therapy. Complement system: Consequences of complement activation and regulation.

Unit IV **8 Hours**

Hypersensitivity reactions: Types of hypersensitive reactions: immunoprophylactic interventions. Autoimmunity– systemic and localized autoimmunity and probable mechanisms to develop autoimmunity. Immunodeficiency; primary, secondary immunodeficiency; SCID and AIDS. Tumor immunology –tumor antigens, immunological factors influencing the incidence of cancer, effecter mechanisms in cancer immunity.

Unit V **8Hours**

Vaccines: Historical perspective; bacterial, viral vaccines and vaccines against cancer and birth control vaccines. Antibody engineering: monoclonal and polyclonal sera their role in clinical diagnosis; production of monoclonal antibodies; immunotoxins and their therapeutic uses; humanized and chimeric antibody.

Books Recommended:

1. Richard A Goldsby,Thomas J Kindt, Barbara S Osborne : Kuby's Immunology. 5th Edition , W.H.Freeman & Coy , New York

2. Abbas , Basic Immunology: Functions& disorders of the immune system , WB Sanders Co. Philadelphia.
3. William Paul : Fundamental Immunology , Lippincot Raven, Philadelphia
4. Roitt : Essential Immunology :9th Edition, Blackwell Science ltd. London.
5. DP Stites, AL Terr, TG Parslow : Medical Immunology, 10th Edition, Appleton and Lange , New York
6. David Male, Jonathan Brostoff, David Roth & Ivan Roitt: Immunology: 7th Edition:Mosbey Title: Philadelphia
7. EP Diamandsis and Theodore K Christopoulos: Immunoassay , Academic press, Sandiego, USA
8. Ronald W Ellis : Vaccines- new approaches to immunological problems , Butterworth Henimann, Boston, USA
9. Hay, Frank C: Practical immunology: Blackwell ScienceLtd. London

MBT-302 PLANT BIOTECHNOLOGY

L T P **Credit-4**

3 1 0

OBJECTIVES:

The main objective of the study programme is to prepare motivated, able to think creatively plant biotechnology specialists familiar with plant biotechnological processes and equipped with the knowledge and skills allowing to understand the interaction of all elements of the technological process.

OUTCOME:

Students will be able to :

1. explain the basics of the physiological and molecular processes that occur during plant growth and development during environmental adaptation.
2. understand how biotechnology has been used to develop knowledge of complex processes that occur in the plants
3. use basic biotechnological techniques to explore molecular biology of plants
4. understand the processes involved in the planning, conduct and execution of plant biotechnology experiments
5. explain how biotechnology is used for plant improvement and discuss the ethical implications of that use

CONTENTS:

Unit I **8 Hours**

Conventional plant breeding (introductory), Introduction to cell and Tissue culture. Tissue culture as a technique to produce novel plants and hybrids. Tissue culture media (composition and preparation)

Callus and suspension cultures: initiation and maintenance of callus and suspension cultures; single cell clones. Organogenesis. Embryogenesis; transfer and establishment of whole plants in soil.

Unit II **8 Hours**

Shoot tip culture: rapid clonal propagation and production of virus free plants.Embryo culture and embryo rescue. Hybrid plants: protoplast isolation, culture and fusion, selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrid. Production of haploid plants: anther, pollen and ovary cultures for production of haploid plants and homozygous lines. Germplasm conservation: cryopreservation, slow growth cultures and DNA banking for germplasm conservation.

Unit III **8 Hours**

Applications of plant transformation for productivity and performance

Herbicide resistance, phosphoinothricine glyphosate, sulfonyl urea, atrazin, insect resistance, Bt genes, non- Bt-like protease inhibitor, virus resistance, coat protein mediated nucleocapsid gene, disease resistance, chitinase, 1-3 beta glucanase, RIP, antifungal proteins, thionins, PR proteins, nematode resistance, abiotic stress, post harvest losses, long shelf life of fruits and flowers, use of ACC synthase, polygalacturanase, ACC oxidase, male sterile lines, bar and barnase systems, carbohydrate composition and storage, ADP glucose pyrophosphatase.

Unit IV **8 Hours**

Basic Techniques of Plant transformation technology: basis tumor formation, hairy root, features of Ti and Ri plasmids, mechanisms of DNA transfer role of virulence genes, use of Ti and Ri as Vectors, binary vectors, genetic markers, Reporter genes, reporter gene, methods of transformation, viral vectors and their applications, multiple gene transfers, Vector less or direct DNA transfer, particle bombardment,

electroporation, microinjection, transformation of monocots. Transgene stability and Gene silencing.

Unit V **8 Hours**

Plant metabolic engineering and industrial products: plant secondary metabolites, control mechanisms and manipulation of phenylpropanoid pathway, shikimate pathway, alkaloids, industrial enzymes, biodegradable plastics, polyhydroxybutyrate, therapeutic proteins, lysosomal enzymes, antibodies, edible vaccines, purification strategies, oleosin partitioning technology. Molecular marker aided breeding: RFLP maps, linkage analysis, RAPD markers, STS, microsatellite, SCAR (sequence characterized amplified regions), SSCP (single strand conformational polymorphism).

Books Recommended:

1. Adrian Slater, Mark Fowler, Nigel Scott, *Plant Biotechnology: The genetic Manipulation of Plants* , , Oxford University Press, USA.
2. B.D.singh *Biotechnology: expanding horizons,* Kalyani Publishers, New Delhi.
3. S. B. Primrose, Richard M. Twyman, R. W. Old, *Principles of Gene Manipulation and Genomics*, Blackwell Science (Asia Pvt Ltd).
4. Richard J.Reece, *Analysis of gene and genome*, John Wiley and sons (Asia Pvt Ltd).
5. Rana P. Singh and Pawan K. Jaiwal, *Plant genetic engineering* (Vol 1-7), Studium Press LLC, USA.
6. Bob Buchanan, Wilhelm Gruissem, Russell L. Jones, *Biochemistry and molecular biology of plants*, John Wiley & sons (Asia pvt Ltd.) for American Society of Plant Biotechnology (ASPB) publication, USA.
7. H.S.Chawala, *Biotechnology in Crop Improvemen,* International book Depot, India.
8. Bhojwani and Razdan, *Tissue Culture*, Elsevier, Amsterdam.
9. Bernard R. R. Glick, Jack J. Pasternak, Jack J. Pasternak, Jack J. Pasternak, *Molecular Biotechnology: Principles and Applications of recombinant DNA,* ASM Press, U.S.A.

MBT-303 Animal Cell Science and Technology

L T P **Credit-4**

3 1 0

OBJECTIVES:

Studying animal genomics and its varied applications.DNA forensics, molecular diagnostics, cloning, wildlife conservation, stem cell research and bio - processing technologies are other import areas of animal biotechnology.

OUTCOMES:

Upon successful completion of this subject, students should:

1. Be able to describe the structure of animal genes and genomes.
2. Be able to describe how genes are expressed and what regulatory mechanisms contribute to control of gene expression.
3. Be able to describe basic principles and techniques in genetic manipulation and genetic engineering.
4. Be able to describe gene transfer technologies for animals and animal cell lines.
5. Be able to describe techniques and problems both technical and ethical in animal cloning.

CONTENTS:

Unit I **8 Hours**

Introduction to cell culture, Basic techniques of mammalian cell culture: Primary and established cell line cultures, disaggregation of tissue and primary culture .Measurement of viability and cytotoxicity. Measurement of growth; culture medium and role of serum.

Biology and characterization of the cultured cells and maintenance of cell culture. Cell separation, Scaling –up of animal cell culture.

Unit II **8 Hours**

Cell cloning, micromanipulation, synchronization and transformation .Stem cell cultures, embryonic stem cells and their applications. Organ culture-Totipotency, Nuclear transfer experiments. Molecular events during fertilization and early development. Role of maternal gene contribution in early embryonic development.

Unit III **8 Hours**

Biology of Cancer: Oncogenes. Chemical carcinogenesis. Tumor suppressor genes from humans, structure, function and mechanism of action of pRB and p53 tumor suppressor proteins. Apoptosis-morphologic and biochemical features of apoptosis, role of apoptosis in regulating lymphocyte development.

Unit IV **8 Hours**

Gene therapy and transgenic animals: Vector engineering, somatic and germ line manipulations, strategies of gene delivery, targeted gene replacement /augmentation, gene correction, gene editing and gene silencing. Genetic disorders; Construction of transgenic animals /gene knockouts. Ethical and biosafety considerations.

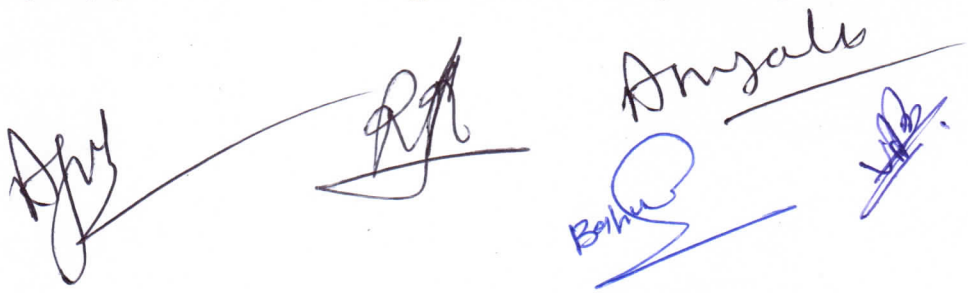
Unit V **8 Hours**

Molecular markers linked to human disorders/ diseases infections and disease resistance genes. Application of RFLP in forensic, disease prognosis, genetic counseling, pedigree varietal etc. Animal trafficking and poaching.

Books Recommended:

1. Edi. Jhon R.W. Masters : Animal cell culture- practical approach , Oxford University press, Oxford
2. Ed. R.Basega : Cell growth and division : A practical approach , IRL press,Oxford University press, Oxford

3. Ed. Martin Clynes : Animal cell culture techniques , Springer- Verlag, New York,
4. F.Grasveld, George V. Kallias: Transgenic Animals, Academic press, Sandiego, USA
5. Asok Mukhopadhyay: Animal cell technology, IK International publishing House, New Delhi.



Second Year- 4th Semester

MBT-401 GENETIC ENGINEERING

L T P

3 1 0

Credit-4

OBJECTIVES:

Genetic Engineering, in simple words, is a laboratory technique used by scientists to change the DNA of living organisms. This wonderful branch of engineering or science enables the human minds to interfere in and modify the processes of life, birth death and even offers escape from certain congenital diseases.

OUTCOMES:

Students will be able to:

1. Describe the importance of being able to locate the position of genes on chromosomes.
2. Describe the techniques involved in Genetic Engineering and show how this technology can be used to combine genetic material from two different species.
3. Explain how genes can be removed from chromosomes and inserted into different chromosomes.
4. Explain why bacterial cells are used in genetic engineering.

CONTENTS:

Unit I **8 Hours**

Introduction and need of genetic engineering, Type of Restriction enzymes, Restriction modification, enzymes used in recombinant DNA technology endonucleases, ligases and other enzymes useful in gene cloning, PCR technology for gene/DNA detection, cDNA, Use of *Agrobacterium* for genetic engineering in plants; Gene libraries; Use of marker genes. Cloning of foreign genes: DNA delivery

methods -physical methods and biological methods, Genetic transformation of prokaryotes: Transferring DNA into E. coli –Chemical induction and Electroporation.

Unit II **8 Hours**

Gene cloning -concept and basic steps; application of bacteria and viruses in genetic engineering; Molecular biology of E. coli and bacteriophages in the context of their use in genetic engineering, Cloning vectors: Plasmid cloning vector PBR322, Vectors for cloning large piece of DNA– Bacteriophage-λ and other phage vectors; Cosmids, Phagemids; YAC and BAC vectors, Model vectors for eukaryotes – Viruses.

Unit III **8 Hours**

Gene library: Construction cDNA library and genomic library, Screening of gene libraries screening by DNA hybridization, immunological assay and protein activity, Marker genes: Selectable markers and Scorable markers, non antibiotic markers.

Unit IV **8 Hours**

Gene expression in prokaryotes: Tissue specific promoter, wound inducible promoters, Strong and regulatable promoters; increasing protein production; Fusion proteins; Translation expression vectors.

Unit V **8 Hours**

Origins of organismal cloning in developmental biology research on frogs; nuclear transfer procedures and the cloning of sheep (Dolly) & other mammals; applications in conservation; therapeutic vs. reproductive cloning; ethical issues and the prospects for human cloning; Two vector expression system; two-gene expression vector, Directed mutagenesis; transposon mutagenesis, Gene targeting, Site specific recombination.

Books Recommended:

1. J Sambrook & EF Fritsch, Molecular Cloning: A laboratory manual, Cold Spring Harbor Laboratory press, U.S.A.
2. S.B Primerose, R M Twyman, Principles of Gene Manipulation and Genomics, Blackwell Science (Asia Pvt Ltd).
3. Richard J.Reece, Analysis of gene and genome, John Wiley and sons (Asia Pvt Ltd).
4. H.K.Das,Textbook of Biotechnology, Wiley Dreamtech India Pvt. Ltd.
5. T.A.Brown, Principles of Gene Manipulation and Genomics, Wiley Blackwell Publishers (Asia Pvt Ltd)
6. Bernard R. R. Glick, Jack J. Pasternak, Jack J. Pasternak, Jack J. Pasternak, Molecular Biotechnology: Principles and Applications of recombinant DNA, ASM Press, U.S.A.

MBT-402 ENVIRONMENTAL BIOTECHNOLOGY

L T P

3 1 0

Credit-4

OBJECTIVE:

One of the main objectives of environmental biotechnology is the conservation of resources via the recycling of waste materials Reclaiming organically polluted water, application of microbes to degrade recalcitrant compounds, use of animal waste as fertilizer, recycling of microbial protein as an animal feed and removal of heavy metals found in sewage sledges, are examples of this type of technology.

OUTCOME:

By the end of the course, the student should be able to

1. Outline the principles of methods for quantification of organic carbon in wastewater and calculate the theoretical oxygen demand (ThOD) for simple organic compounds.
2. Explain the microbial processes and growth requirements undelaying the activated sludge process, nitrification, denitrification, enhanced phosphorus removal, and anaerobic digestion
3. Describe the most commonly applied disinfection methods, and the steps typically involved in drinking water treatment process
4. Evaluate the potential for biodegradation of organic pollutants, taking microbial and physical/chemical environments, as well as the chemical structure of the compound itself, into consideration

CONTENT:

Unit I **8Hours**

Introduction of biotechnology in environment: basic concept and issues. Environmental pollution: types of pollution, methods for the measurement of pollution; methodology of environmental management the problem solving approach, its limitations.

Unit II **8Hours**

Air pollution and its control through biotechnology .Water pollution and its control: water as a scarce natural resources, need for water management, measurement of water pollution, sources of water pollution, waste water treatment –physical, chemical and biological treatment processes.

Unit III

8Hours

Microbiology of waste water treatments, aerobic process: activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. Anaerobic processes: anaerobic digestion, anaerobic filters, upflow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic Industries. Solid wastes: sources and management (Composting, vermiculture and methane production).

Unit IV **8 Hours**

Microbiology of degradation of xenobiotics in environment ecological considerations, decay behaviour & xenobiotics degradative plasmids; hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Biopesticides in integrated pest management. Bioremediation of contaminated soils and wasteland.

Unit V **8Hours**

Global environmental problems: environmental issues related to BT cotton, BT brinjal, and GM foods and crops in Indian scenario, ozone depletion, UV-B, green house effect and acid rain, their impact and biotechnological approaches for management.

Books Recommended:

1. Metcall and Eddy, *Waste Water Engineering-Treatment, Disposal and Reuse*, McGraw Hill, New York.
2. I S Thakur, Environmental Biotechnology, I.K. International Pvt. Ltd, New Delhi.

MBT-451 Project work and Presentation

A student has to make a latest technology based project in their respective stream. It may be hardware or software based.

(Convener)

Signature.....

Name : Ajit P. Singh Yadav

Date:

Internal Members

Signature 1.....

Name : Mr. Anjani kumar Srivastava

Date:

Signature 2.....

Name : Mr. Vachaspati Rao

Date:

External Members

Signature 1.....

Name : Prof. (Dr.) R. K. Mishra

Date:

Signature 2.....

Name : Dr. G. Sunil Babu

Date: