NEP-2020 BASED CURRICULA AND EXAMINATION SCHEME,
UNIVERSITY OF KOTA,KOTA 2023

M.Sc. Biotechnology programme

CBCS pattern (with effect from 2023-2024)

DEPARTMENT OF BIOTECHNOLOGY

UNIVERSITY OF KOTA
MBS Marg, KOTA (Rajasthan)-324 005
INDIA

Course Code: MBT 12350P

Type of the Course:Professional

Title of the Course: M.Sc Biotechnology

Level of the Course: PG level

Credit of the Course :100

Delivery subtype of the Course:Practical

Pre requisities and co requisities of the Course

- A candidate who has passed any one of the following examinationfrom any University recognized by the UGC shall be permitted to take admission in M.Sc. First Semester to award M.Sc. degree in Biotechnology from this University after completion of a course of study of two academic years divided in the four semester scheme of examination:
- B.Sc. (Pass / Hons)under biological science stream with subjects: Biotechnology, Microbiology, Biochemistry, Biology, Chemistry, Botany, Zoology, Genetics, Environmental Sciences, Bioinformatics, Pharmaceutical Science, etc. or
- Bachelor of Science and Education (B.Sc.-B.Ed.) with subject biology, chemistry, botany, zoology.
- B.Tech. Biotechnology

University of Kota, Kota

M.Sc. Biotechnology

Semester wise Consolidated Common Scheme of Examinations for the Academic Sessions 2023-2024

Year / Semester	Number, Code or ID and Nomenclature of Paper				Duration of Exam. (in Hrs.)	Distribution of Assessment Marks Teaching Hrs / Week& Credit points			Continuous or Internal Assessment (30%)		Semester or External Assessment (70%)		Total	
	Number of Paper	Code / ID of Paper		Nomenclature of Paper		Teaching Th.	Pr.	Credit Points	Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks
1st Year I Semester	Paper-1.1	MBT-5101	DCC	Cell Biology and Enzyme Technology	3	4	-	4	30	12	70	28	100	40
	Paper-1.2	MBT-5102	DCC	General Microbiology	3	4	-	4	30	12	70	28	100	40
	Paper-1.3	MBT-5103	DCC	Bio-Instrumentation	3	4	-	4	30	12	70	28	100	40
	Paper-1.4	MBT-5104	DCC	Fundaments of Biochemistry	3	4	-	4	30	12	70	28	100	40
	Paper-1.5	MBT-5105	DCC	Lab Course-I	6	-	8	4	--	--	100	50	100	50
	Paper-1.6	MBT-5106	DCC	Lab Course-II	6		8	4			100	50	100	50
	Total (I Semester)				**24**	**32**		**24**	**120**	**48**	**480**	**212**	**600**	**260**
1st Year II Semester	Paper-2.1	MBT-5201	DCC	Fundamentals of Molecular Biology	3	4	-	4	30	12	70	28	100	40
	Paper-2.2	MBT-5202	DCC	Basic Plant and Animal Tissue Culture	3	4	-	4	30	12	70	28	100	40
	Paper-2.3	MBT-5203	DCC	Immunology and Immunotechnology	3	4	-	4	30	12	70	28	100	40
	Paper-2.4	MBT-5204	DCC	Genetic Engineering and its Applications	3	4	-	4	30	12	70	28	100	40
	Paper-2.5	MBT-5205	DCC	Lab Course-III	6		8	4			100	50	100	50
	Paper-2.6	MBT-5206	DCC	Lab Course-IV	6		8	4			100	50	100	50
	Total (II Semester)				**24**	**32**		**24**	**120**	**48**	**480**	**212**	**600**	**260**
2nd Year III Semester	Paper-3.1	MBT-6301	SEC	Applied Plant and Animal Biotechnology	3	4	-	4	30	12	70	28	100	40
	Paper-3.2	MBT-6302	DSE	Fermentation Technology, Biosafety and IPR	3	4	-	4	30	12	70	28	100	40
	Paper-3.3	MBT-6303	DSE	ELECTIVE **I** 1.Environmental Biotechnology 2. Stem cells and Healthcare	3	4	-	4	30	12	70	28	100	40
	Paper-3.4	MBT-6304	DSE	ELECTIVE II 1.Medical Biotechnology 2.Genomics and Proteomics	3	4		4	30	12	70	28	100	40
	Paper-3.5	MBT-6305	DCC	Lab Course-V	6	-	8	4	--	--	100	50	100	50
	Paper-3.6	MBT-6306	DCC	Lab Course-VI	6		8	4			100	50	100	50
	Total (III Semester)				**24**	**32**		**24**	**120**	**48**	**480**	**212**	**600**	**260**
2nd Year IV Semester	Paper-4.1	MBT-6401	DSE	Industrial Bioprocess Technology	3	4	-	4	30	12	70	28	100	40
	Paper-4.2	MBT-6402	DSE	Biostatistics, Bioinformatics and Research Methodology	3	4	-	4	30	12	70	28	100	40
	Paper-4.3	MBT-6403	DCC	Lab Course VII	6	-	8	4	-	-	200	100	200	100
	Paper-4.4	MBT-6404	SEM	Comprehensive Viva Voce	3	-	-	4	-	-	100	50	100	50
	Paper-4.5	MBT-6405	DPR	Dissertation	3	-	-	8	--	--	100	50	100	50
	Total (IV Semester)				**18**	**16**		**24**	**60**	**24**	**540**	**256**	**600**	**280**
GrandTotal (I + II + III + IV Semester)					**90**	**112**		**96**	**420**	**168**	**1980**	**892**	**2400**	**1060**

Salient features are as follows:

- Discipline Centric Core (DSC) Core Courses in Biotechnology as Major.
- Discipline Specific Electives (DSE) or Elective Courses in the Core Subject or Discipline.
- Open Electives (OE) are Elective Courses offered to students from non-core Subjects across disciplines.
- Skill Enhancement Courses (SEC) that are domain-specific or generic.
- Dissertation/Project/ course (DPR) or Elective course in the core subject
- Seminar/Viva course (SEM) or Elective course in the core subject

Objectives of the Course: Biotechnology is the broad area of biology involving living systems and organisms to develop or make products, or "any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use".

- Students will gain necessary knowledge and develop specialized skills in the different areas ofBiotechnology.
- Students will think critically and creatively about the use of biotechnology to address local and globalproblems.
- Students will be able to implement the scientific skills for development of industrial applications andentrepreneurship

Hyperlinks of suggested e resources onUniversity website and on web

https://link.springer.com/
https://www.tandfonline.com/
https://onlinelibrary.wiley.com/

NPTEL and UGC epathsala, SWAYAM,MH Education,GeoGebra and MS Excel toolbox
https://ghr.nlm.nih.gov/resources#inheritance
https://opentextbc.ca/biology/chapter/10-1-cloning-and-geneticengineering/
http://www.hoajonline.com/molbiolgeneteng
https://www.yourgenome.org/facts/what-is-genetic-engineering
https://www.immunology.org/
https://onlinelearning.hms.harvard.edu/hmx/courses/hmximmunology
https://www.rcsb.org/
http://jgi.doe.gov/our-science/
https://www.genengnews.com/
http://biosafety.icgeb.org/in
https://iop.vast.ac.vn/theor/conferences/smp/1st/kaminuma/SWISSPROT/ index.html
http://www.ipindia.nic.in/
http://www.wipo.int
http://www.wto.org

http://www.nbaindia.org
http://www.envfor.nic.in/ divisions/csurv/geac/annex-5.pdf
Springer® Journal author tutorials now with interactive courses
Elsevier® Researcher Academy
https://www.hhs.gov/vaccines/about/resources/smart-vaccinetool/index.html
https://www.cdc.gov/vaccines/pubs/pinkbook/index.html
https://www.embl.org/
https://www.cathdb.info/
Environmental biotechnology latest research and news
Biotechnology news, Science Daily , Nature News, Science News
Nature Biotechnology, Journal of Applied Biology & Biotechnology

Course learning outcome

Upon completion of the M.Sc. Biotechnology programme, the candidate should be able to**:**

- Demonstrate knowledge for in-depth analytical and critical thinking to identify, formulate and solve the issues related to Biotechnology Industry, Pharma industry, Medical or hospital related organizations, Regulatory Agencies & Academia.
- Demonstrate skills to use modern analytical tools/ software/ equipment to design & develop experiments and analyze and solve problems in various courses of biotechnology.
- Appreciate and execute their professional roles in society as biotechnology professionals,employers and employees in variousindustries, regulators, researchers, educators andmanagers
- Acquire basic and advance skills in in various fields of biotechnology for self- employment and entrepreneurship

Duration of the Course:

The course for the degree of Master of Science in Biotechnology shall consist of two academic years / sessions divided in to four equal semesters. The first academic year / session will comprise first and second semesters. The second academic year / session will comprise of the third and fourth semesters. Each semester shall comprisenormally 90 working days. The course shall run on the regular basis.

Minimum Marks required in Qualifying Examination:

❖ Qualifying examination passed from any recognised University which is situated in Rajasthan State:

- General Category = 55%.
- SC / ST / OBC / SBC or MBC = Min. Pass Marks

❖ Qualifying examination passed from any recognised University which is situated at outside the Rajasthan State:

- All Categories = 60%.

❖ Eligibility for Admission in M.Sc. Third Semester:

A candidate may be promoted in the next academic session (in odd semester *i.e.* III semester) if he/she has cleared collectively at least 50% of the papers of both semesters (*i.e.*semester I & II) of previous academic session with 50% of the aggregate marks. The candidate who does

not fulfill the above condition will remain as an ex-student and will re-appear in the due papersexaminationsalong with next odd/even semester examinations.

A candidate who has passed B.Ed. examination as a regular course of study after completing first and second semester examinations from this University shall also be eligible to take admission in third semester examination as a regular candidate.

Open elective:
This course is open to students of other Department of the University. The student of the M.Sc. BiotechnologyProgramme can also take up an open elective being offered by any of the other Department of the University of Kota or from Government online portal like SWAYAM, MOOC etc.

Attendance:

Every teaching faculty, handling a course, shall be responsible for the maintenance of Attendance Register for candidates who have registered for the course. The teacher of the course must intimate the Head of the Department at least seven calendar days before the last instruction day in the semester about the attendance particulars of all students. Each student should earn 75% attendance in the courses of the particular semester failing which he or she will not be permitted to sit in the end semester examinations. However, it shall be open to the authorities to grant exemption to a candidate who has failed to obtain the prescribed 75% attendance for valid reasons and such exemptions should not under any circumstance be granted for attendance below 65%.

Teaching Methodologies:

The classroom teaching would be through conventional lectures or use of OHP or power point presentations (PPT). The lecture would be such that the student should participate actively in the discussion. Student seminars would be conducted and scientific discussions would be arranged to improve their communicative skill. In the laboratory, instruction would be given for the experiments followed by demonstration and finally the students have to do the experiments individually. For the students of slow learners, special attention would be given.

Assessment Pattern:

The assessment of the students shall be divided into two parts in which first part is continuous assessment or internal assessment or mid-term assessment (30% weightage of the maximum marks) and second part is semester assessment or external assessment or end-term assessment (70% weightage of the maximum marks). Assessment pattern and distribution of maximum marks is summarized as given below:

(i) Continuous or Internal or Mid Term Assessment:

(a) The continuous or internal or mid-term assessment (30% weightage of the maximum marks) for each theory paper shall be taken by the faculty members of the respective Departments during each semester. There will be three internal assessment tests (*i.e.*firstinternal assessment test or first mid-term test and second internal assessment test or second mid-term test and third internal assessment test) each of 10% weightageof maximum marks of each theory paper. Each internal assessment shall be of one hour duration for theory paper and shall be taken according to academic calendar which will be notified by the Department / University.

(b) For practical papers, there will be no continuous or internal or mid-term assessment. There will be only one external or semester or end-term assessment (100% weightage of maximum marks).

(c) A student who remains absent (defaulter) or fails or wants to improve the marks in the internal assessment may be permitted to appear in the desired paper(s) (only one time) in the same semester with the permission of the concern Head of the Department. A defaulter / improvement fee of Rupees 250/- per paper shall be taken from such candidates. Duly forwarded application of such candidates by the teacher concerned shall be submitted to Head of the Department who may permit the candidate to appear in the internal assessment after production of satisfactory evidence about the reason of his/her absence in the test(s) and deposition of the defaulter / improvement fee. A record of such candidates shall be kept in the Department.

(d) Regular attendance of the student shall be considered in the internal assessment. Some marks for regularity shall be given to the student(s) who is/are taken classes regularly from the 5% weightage of the maximum marks. The 5% weightage of the maximum marks of regularity shall be taken from the weightage given for second internal assessment (10% weightage of maximum marks). After excluding the 5% weightage of regularity, the second internal assessment shall be of 10% weightage of maximum marks.If the attendance / regularity factor is similar for all the students, then it may be merged with the weightage of second internal assessment test (class test, home assignment, quiz, seminar, *etc.*) and then second internal assessment test shall be of 15% weightage of maximum marks.

(e) 'Student should qualify both internal & external assessment separately to pass the paper i.e., if candidate passes in external & fails in internal, the candidate has to reappear in internal & external exam of that paper. But if candidate passes in the internal & fails in the external, the candidate has to reappear in external exam of the paper and in internal examination he has option either to forward the obtained internal marks of that paper in the previous attempt (on the basis of the application submitted by the candidate and approval of Head of Department for the same) or can reappear in the internal examination if he wants to improve his marks in that paper.'

(ii) Semester or External or End Term Assessment:

(a) The semester or external or end-term assessment (70% weightage of the maximum marks) shall be three hours duration to each theory paper and twelve hours duration (spread over two days with 6 hours per day) for each practical paper and shall be taken by the University at the end of each semester.

(b) The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

Section-A *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*

Section-B *will carry 50 marks with equally divided into five long answer type questions . Paper setter shall be advised to set two questions from each unit and*

students are instructed to attempt five questions by selecting one question from each unit.

(c) The syllabus of practical paper is divided according to main streams of Biotechnology. Marks shall be awarded on the basis of major & minor experiments,spotting, viva-voce, practical record, regularity factor, lab skills, maintain cleanness of workplace, *etc*.

Question Paper Pattern:

(A) Continuous or Internal or Mid Term Assessment:

30% weightage of Maximum Marks (30 Marks out of 100 Maximum Marks).

(i) First Continuous or Internal or Mid Term Assessment:

Format

Department of .....
College / University .....
Address.....

First Internal Assessment Test 20… - 20….

Class	**:**	**Max. Marks**	**: 10 Marks**
Semester	**:**	**Duration of Exam.**	**:**
Subject	**:**	**Date of Examination**	**:**
Paper	**:**	**Name of Teacher**	**:**

Note: All questions are compulsory and marks are given at the end of the each question. Two or three sub-divisions may be given in the question.

Q. No. 1. ……..
or
…….
4 Marks
Q. No. 2. ……..
or
…….
3 Marks
Q. No. 3. ……..
or
…….
3 Marks

(ii) Second Continuous or Internal or Mid Term Assessment:

(a) Attendance:

Marks shall be given by the faculty member in each paper according to its weightage.

5% weightage of Maximum Marks

Note:

If the attendance / regularity factor is similar for all the students, then it may be merged with the weightage of second internal assessment test (class test, assignment, quiz, etc.).

(b) Seminar / Presentation/Projects
5% or 10% weightage of Maximum Marks

Format

Department of .....
College / University .....
Address.....
Second Internal Assessment Test 20… - 20….

Class	**:**	**Max. Marks**	**: 10 Marks**
Semester	**:**	**Duration of Exam.**	**:**
Subject	**:**	**Date of Examination**	**:**
Topic/Paper	**:**	**Name of Teacher**	**:**

Seminar /Presentation
(Based on Curriculum)

Format

Department of .....
College / University .....
Address.....
Third Internal Assessment Test 20… - 20….

Class	**:**	**Max. Marks**	**: 10 Marks**
Semester	**:**	**Duration of Exam.**	**:**
Subject	**:**	**Date of Examination**	**:**
Topic/Paper	**:**	**Name of Teacher**	**:**

(a) Assignment:

(May be divided in parts or questions or may not be. It will be depending on the nature of assignment).

10% weightage of Maximum Marks
or

(b) Quiz:

(May be divided in parts or questions or may not be. It will be depending on the nature of quiz).

10% weightage of Maximum Marks
Or

(c) Excursion or Industrial visit or Anyother tool may be adopted for internal Assessment
10% weightage of Maximum Marks

(B) Semester or External or End Term Assessment:
70% weightage of Max Marks (*i.e.*70 Marks out of 100 Max Marks).

Duration of Examination: 3 Hours **Max. Marks: 70**

Note*: The syllabus is divided into five independent units and question paper will be divided into three sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of one mark.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions . Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

SECTION-A

Q. 1.

Unit-I

(i) …… **2 Mark**
(ii) …… **2 Mark**

Unit-II

(iii) …… **2 Mark**
(iv) …… **2 Mark**

Unit-II

(v) …… **2 Mark**
(vi) …… **2 Mark**

Unit-IV

(vii) …… **2 Mark**
(viii) ..…… **2 Mark**

Unit-V

(ix) …… **2 Mark**
(x) …… **2 Mark**

SECTION-B

Unit-I

Q. 2. ……..…… **10 Marks**

or

…….....…… **10Marks**

Unit-II

Q. 3. ……...…… **10 Marks**

or

……..…..…… **10 Marks**

Unit-III

Q. 4. ……...…… **10 Marks**

or

……..…..…… **10 Marks**

Unit-IV

Q. 5. . ……..…..…… **10 Marks**

or

……..……..… **10Marks**

Unit-V

Q. 6. ……....…… **10Marks**

or

…… **10 Marks**

Practical Examinations: For All Lab Courses

Continuous or Internal or Mid Term Assessment: *Not applicable in practical.*
External or Semester or End Term Assessment:
Duration of Exam : 6 Hours
Maximum Marks : 100 Marks*

Distribution of Maximum Marks:

S. No.	Name of Exercise	Marks
1.	Exercise No. 1 : Major Experiment	20
2.	Exercise No. 2 : Major Experiment	20
3.	Exercise No. 3 : Minor Experiment	10
4.	Exercise No. 4 : Minor Experiment	10
5.	Exercise No. 5 : Spotting Experiment(5 spots)	15
6.	Laboratory Skills, Regularity, *etc.*	10
7.	Practical Record	5
8.	Viva-voce	10
Total Marks		**100**

Seminar:

The students shall compulsorily have to deliver an oral presentation on for continuous or internal or mid-term assessment in each semester. There will not be semester or external or end-term assessment for seminar.

Dissertation :

A dissertation shall be initiated at the end of the Semester III and continued during Semester IV.A dissertation may be undertaken in any research laboratories/industries/university department. The students shall compulsorily submit the certificate of completion and report to the Department during the practical examination.The marks will be awarded by the external examiner on the day of the practical examination on the basis of the experimental,presentation and viva-voce.

Minimum Pass Marks and Rules regarding Determination of Results:

Each semester shall be regarded as a unit for working out the result of the candidates. The result of each semester examination shall be worked out separately (even if the candidate has appeared at the paper(s) of the lower semester examination alongwith the papers of higher semester examination) in accordance with the following conditions:

a) The candidate shall be declared as pass in a semester examination, if he/she secures at least 40% marks in each theory paper separately in external & internal examinations and 50% marks in each practical paper and at least 50% marks in project/ dissertation with 50% aggregate marks in that semester.

b) A candidate declared as fail/absent in one or more papers at any odd semester examination shall be permitted to take admission in the next higher semester (even semester) of the same academic session.

c) A candidate may be promoted in the next academic session (odd semester) if he/she cleared collectively at least 50% of the papers of both semester of previous academic session with 50% of the aggregate marks. The candidate who does not fulfil the above condition will remain as an ex-student and will appear S in the due papers with next odd/even semester exams.

d) If any student who is provisionally admitted in higher odd semester but not secure prescribed minimum marks in previous semesters will be treated as ex-student and his/her admission fee will be carry forward to the next odd semester of forthcoming academic session.

(i) A candidate may be promoted in the next semester (odd semester) if he/she has cleared collectively at least 50% of the papers of both semesters of previous academic session with 50% of the aggregate marks. The candidate who does not fulfill this condition will remain in the same semester as an ex-student and will re-appear in the due papers examination along with next odd/even semester examinations.

(ii) If any student who is provisionally admitted in higher odd semester but could not secure prescribed minimum marks in previous semesters will be treated as ex-student and his/her admission fee will be carry forwarded to the next odd semester of forthcoming academic session.

(iii) A candidate declared as failed in that particular paper he/she can re-appear for that paper in the next year examination as a due paper. However, the internal marks shall be carried forward for the total marks of the due examination. A candidate will not be allowed to re-appear in the practical examination.

(iv) A candidate may be given only two additional chances for passing the semester thus maximum tenure for completing the two years' postgraduate course will be limited to four years, for three years postgraduate programme up to five years and so on.

(v) If the number of papers prescribed at the first and second or third and fourth semester examination is an odd number, it shall be increased by one for the purpose of reckoning 50% of the papers.

(vi) A candidate who passes in 50% or more papers of the first and second semester examination, and thereby becomes eligible for admission to the third semester examination, but chooses not to do so and desires to appear in the remaining papers of first and second semester examination only or to re-appear in all the prescribed papers and practical/dissertation/seminar of the M.Sc. first and second semester examination will be permitted to do so on the condition that in the latter case his previous performance will be treated as cancelled.

(vii) If a candidate, who has been promoted to the next semester and wishes to improve his / her performance in the theory paper(s) of previous semester,can be permitted to do so in case of the theory papers only, not in practical / project / dissertation / seminar, belonging to the immediately preceding semesteronly for one time in these papers in next odd/even semester examinations. In such a case, he/she shall have to appear in these papers alongwith the papers of his/her own semester.

(viii) A candidate shall be declared as passed after the result of the fourth semester examination, if he/she cleared all papers of the all the four semesters and secure minimum 40% of the aggregate marks of the maximum marks in theory papers and 50% of the aggregate marks of the maximum marks for practical / dissertation / presentation / seminar prescribed for four semesters Master's programme.

(ix) In the case of an ex-student, the marks secured by him/her at his/her last examination as a regular candidate shall be taken into account except in cases where a candidate is re-appearing at the examination as a regular student and in that event he/she shall have to repeat the internal assessment test which will be finally accounted for working out his result.

(x) A candidate who has failed at the M.Sc. third and fourth semester examination but has passed in at least 50% of the papers prescribed for the examination shall be exempted from re-appearing in a subsequent year in the papers in which he/she has passed.

(xi) If a candidate clears any paper(s) prescribed at the first and second semester (previous) and/or third and fourth semester (final) examination after a continuous period of three years, then for the purpose of working out his/her division, only the minimum pass marks shall be taken into account in respect of such paper(s) as are cleared after the aforesaid period provided that in case where a candidate requires more than 40% marks in order to reach the requisite minimum aggregate, as many marks out of those secured by him/her will be taken in to account as would enable him/her to make up the deficiency in the requisite minimum aggregate.

(xii) In case the candidate is not able to clear his/her due paper(s) in the stipulated period as mentioned above (continuous period of three years), he/she may be given last one mercy attempt to clear due paper(s) subjected to approval of the Vice Chancellor or Board of Management.

(xiii) The grace marks scheme shall be applicable as per University norms.

M.Sc. Biotechnology

First Semester Examination

Paper 1.1: MBT-5101T Cell Biology and Enzyme Technology

Contact Hours / Week	: 4 Hours	Maximum Marks	: 100 Marks
Duration of Examination	: 3 Hours	Continuous/Internal/Assessment	: 30 Marks
		Semester Assessment	: 70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions (answer about in 400 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

Note: *Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc.*

UNIT-I **15-18L**

The cell theory, Modern concepts of cell, pre-cellular evolution, Endosymbiont theory, overview of prokaryotic and eukaryotic cell types.

Plasma Membrane: various models of biological membrane, Membrane structure and composition: lipid bilayer, membrane carbohydrates, membrane proteins, channel proteins, carrier proteins and pumps. Study of the GERL Complex: Golgi complex, Endoplasmic reticulum and Lysosomes. Peroxisomes and Ribosome.

UNIT-II **15-18L**

Structure of Nucleus and Chromosome.

Transport across member as active facilitated and passive transport.

Mitochondrial and chloroplast energy transformation: ultra structure of mitochondria and chloroplasts, structure and role of ATP synthetase, oxidative and photophosphorylation. Proton gradient and chemiosmotic coupling.

UNIT-III **15-18L**

Cell cycle, Cell Cycle Regulators- Cyclin and CDKs, Mechanism of cell division: Mitosis and Meiosis. Programmed Cell Death: intrinsic and extrinsic pathways. Cancer cells and factors involved in oncogenesis.

Overview of extracellular signaling, modes of signaling, ligands and receptor molecules. G-protein coupled receptors, Secondary messengers (cAMP), Tyrosine kinase linked receptors.

UNIT- IV **15-18L**

Introduction to enzyme and enzyme technology: Enzymes:General properties, Classification and Nomenclature. Mechanism of enzyme action and regulation.

Steady state kinetics: Methods of estimation of rate of enzyme catalyzed reaction with special reference to Michaelis-menton kinetics. Feedback inhibition. Isozymes, ribozymes, abzymes, zymogens, multi-enzymes complexes and multifunctionalenzymes.

UNIT- V **15-18L**Enzyme and cell immobilization.

Mechanism of enzyme function and reactions in process techniques; enzymatic bioconversions e.g., starch and sugar conversion processesand various other enzyme catalytic action in food processing.

Enzymes biosensor: Principle,components and applications.

Advancement in enzyme technology. Diagnostic importance of enzymes.

Reference Books:

1. The World of the Cell:Becker ,Kleinsmith and Hardin.
2. Cell and molecular biology: GeraldKarp.
3. Cell and molecular biology: P.K.Gupta.
4. Molecular cell biology: By Lodish.
5. The Cell: Cooper.
6. Molecular biology of the cell: Bruce Alberts.
7. Enzymology and Enzyme Technology: S M Bhatt.
8. Enzyme Technology- M F Chaplin and D CBucks
9. Industrial Enzymology- Godfrey and West
10. Enzyme –Copeland
11. Enzyme in Industry – W.Gerhartz
12. Principles of Biochemistry. Ed Lehninger, Nelson and Cox. CBS publishersanddistributors.
13. Biochemistry. Ed Donald Voet and Judith G. Voet. John Wiley &sons,Inc.

M.Sc. Biotechnology

First Semester Examination

Paper-1.2 MBT-5102T General Microbiology

Contact Hours / Week	: 4 Hours	Maximum Marks	: 100 Marks
Duration of Examination	: 3 Hours	Continuous/Internal/Assessment	: 30 Marks
		Semester Assessment	: 70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
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Note: *Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc.*

UNIT I **15-18L**

Introduction History and Basic Principles of Microbiology. Contribution of Antony Von Leeuwenhoek, Louis Pasture, Robert Koch.

Classification of microorganisms – Haeckel's three kingdom concept, Whittaker's five kingdom concept, Classification and salient features of bacteria according to the Bergey's manual of determinative bacteriology. Classification of microbes on the basis of phenotypic and genotypic characters. Molecular methods in assessing microbial diversity; 16S rDNA sequencing and Ribosomal Database Project.

UNIT II **15-18L**

Staining techniques: Stains and Dyes, Simple, Gram, Negative, Capsule, Endospore, Acid fast.

Sterilization and Disinfection (Physical and Chemical methods): Heat, Temperature, Filtration Pasteurization, Dehydration, Radiation, Alcohol, Surface active agents, Aldehyde, Halogen, Gases.

Isolation Techniques.Culture Media: Types of Media.

UNIT III **15-18L**

General account of classification, ultrastructure, nutrition, reproduction, biology and economic importance of Archaebacteria, Eubacteria, Cyanobacteria, Actinomycetes and Fungi. General account of L- forms, Mycoplasma, Phytoplasma, Spiroplasma, Ureoplasma&Rickettsiae.

Study of Viruses: General structure and properties of viruses, taxonomy, reproduction, cultivation, purification and assay.

UNIT IV **15-18L**

Bacteriophage: Structure and life cycle. Prions,Viroids and retro viruses.

Bacterial morphology, Bacterial Growth: Growth curve and its kinetics and growth yield, growth synchronization. Determination of biomass, Environmental factors affecting growth.

Microbial metabolism: Phototrophy, chemolithotrophy, anaerobic respiration, fermentation, methanogens, biological nitrogen fixation.

UNIT V **15-18L**

Microbial diseases: Food and water borne disease, Anthrax, Tuberculosis,Covid-19, AIDS, Influenza, cutaneous and systemic mycoses, Malaria.

Antimicrobial drugs: General Characteristics, Antibacterial (Classification and mode of action), antifungal and antiviral.

Text/Reference books:

1. Microbes: Concepts & Applications- P.S. Bisen, Mousumi Debnath, Godavarthi B.K.S. Prasad, John Wiley & Sons Publication 2012
2. Microbiology: An Introduction. Tortora GJ, Funke BR, and Case CL.
3. Bergey`s manual of systematic bacteriology. George M.Garrity,David R.Boone,RichardW.Castenholz.
4. Brock Biologyof Microorganisms, 14th Edition. Michael T. Madigan, John M. Martinko, Paul V. Dunlap and David P. Clark.
5. Prescott, L.M., J.P Harley and D.AKlein, 2007. Microbiology VII Ed.McGrowHill,
6. Davis R.Y. E.A. Adeberg and J.L. Ingram,1991 General Microbiology
7. Stainer.General Microbiology, V Ed., Printice Hall of India Pvt,Ltd. NewDelhi
8. Ronald M. Atlas 1997. Principles of Microbiology. II Ed. Mc Graw HillPub.
9. Salle A.J., Fundamental Principles ofBacteriology.
10. Microbiology Vol.I& II. Power and Daginawala
11. Microbiology. P.D.Sharma

M.Sc. Biotechnology

First Semester Examination
Paper-1.3 MBT-5103 Bio-Instrumentation

Contact Hours / Week	: 4 Hours	Maximum Marks	: 100 Marks
Duration of Examination	: 3 Hours	Continuous/Internal/Assessment	: 30 Marks
		Semester Assessment	: 70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

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Note: *Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc.*

UNIT-I15-18L

Microscopy: Microscopes types, use of techniques of preparing specimens, resolving power, optical microscope-Basic idea of light microscopy, Types- bright field, dark field, ultra-violet, fluorescence and phase-contrast microscopes, confocal microscopy Electron microscope: TEM, SEM.

Microtomy and sample preparation for microscopy.

UNIT – II **15-18L**

Centrifugation techniques: - Differential, gradient, zonal or band and isopycnic density gradient centrifugation.

Chromatography: principle and procedure of absorption, column, thin layer (TLC), partition, and gas-liquid, ion-exchange chromatography.

UNIT – III **15-18L**

Electrophoresis: Principle, equipment and procedure of various types:Pulse field GE, Denaturing gradient GE, Temperature gradient GE, SDS-PAGE electrophoresis, Iso- electric focusing and 2D gel electrophoresis.

Nucleic acid hybridizations Technique: colony, plaque, dot blot, southern, northern and western blotting.*Insitu*hybridization,Microarray technology.

UNIT- IV **15-18L**

DNA sequencing techniques: Sanger-Coulson method, Maxam Gilbert method and next generation sequencing.

Polymerized Chain Reaction: PCR -steps, Types of PCR and its applications.

Spectroscopy: Laws of absorption, Principles, instrumentation and applications of colorimetry, UV-visible spectroscopy.

UNIT- V **15-18L**

Principles, instrumentation and applications: Infrared Spectroscopy,fluorescence Spectroscopy, NMR, ESR., Mass Spectroscopy (types of ion source, analyzers and detectors), GC-MS,

MALDI-TOF. X Ray Microanalysis, Techniques with radioisotopes: GM counter, Scintillation counter, Autoradiography, RIA.

Text/Reference

1. Introduction to Instrumentation in Life Science. P.S. Bisen & Anjana Sharma. 2013. CRC Press. Tylor & Francis group.
2. Wilson K. And Walker J. (2008). Principal and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
3. Molecular Diagnostics: Promises & Possibilities 2010. MousuniDabnath, G.B.K.S. Prasad P.S. Bisen.
4. Nelson D and Cox MM(2009). Principal of Biochemistry. W.H. Freeman and Company, New York.
5. Voet D and Voet JG. (2003). Biochemistry. Jhon Wiley and sons New York.
6. Zubay G (2003). Biochemistry. W.C. Brown, New York.
7. Life Science in tools and Techniques: P.S Bisen and Shruti Mathur, S Chand Publication
8. Berg J, Tymoczko J, Stryer L(2001). Biochemistry W.H. Freeman, New York.
9. Nuclear Magnetic Resonance: Williams.
10. A Biologist Guide to Principal and techniques: Williams K. and Gounding K.H.
11. Biochemical Techniques theory and practice: White R.
12. Molecular biotechnology- Glick.
13. An Introduction to practical Biochemistry. Plummer D.T.
14. Bioinstrumentation by Merit,Vivaladi and Deen.

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First Semester Examination

Paper-1.4 MBT-5104 Fundamentals of Biochemistry

Contact Hours / Week	: 4 Hours	Maximum Marks	: 100 Marks
Duration of Examination	: 3 Hours	Continuous/Internal/Assessment	: 30 Marks
		Semester Assessment	: 70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

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- ***Section-B*** *will carry 50 marks with equally divided into five long answer type.. Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

Note: *Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc.*

UNIT- I **15-18L**

Covalent, Non-Covalent, hydrophilic and hydrophobic interaction and their influence on structure of biomolecules. Acid, bases, pH, pk, and ionization of water. Buffers.

High energy phosphate compounds: Introduction, Phosphate group transfer free energy of hydrolysis of ATP and sugar phosphate. Henderson Hasselbalch equation, concepts of bioenergetics. First and second law of thermodynamics. Gibb's free energy.

UNIT-II **15-18L**

Carbohydrates: Classification, characteristics and functions. Reactions of carbohydrates, Isomerism of carbohydrates, Fischer projections, Haworth structures. Structure and functions of homo and heteropolysaccharides, glycoconjugates,

Carbohydrate Metabolism: Introduction, Aerobic and anaerobic pathways: Glycogenolysis, Gluconeogenesis, Glycolysis.TCA cycle, Electron Transport chain, Oxidative phosphorylation, Chemiosmotic theory of ATP Synthesis Reductive TCA cycle, Glyoxylate cycle, amphibolic &anaplerotic reactions. Pentose phosphate pathway (HMP Shunt), Glycogen metabolism.

UNIT-III15-18L

Lipids-Introduction, Sources, Nomenclature,Classification. Properties and Functions. Steroids: Structure of steroid nucleus, biological role of cholesterol.

Lipid Metabolism- Biodegradation of fatty acids, beta – oxidations of fatty acids. Ketone bodies production during starving and diabetes.

Biosynthesis of fatty acids – Acetyl-CoA carboxylase reaction, Fatty acid synthase complex, biosynthesis of palmitate. Biosynthesis of triacylglycerols, Biosynthesis of cholesterol, Prostaglandins.

UNIT- IV **15-18L**

Amino Acid Metabolism- Overview of amino acid metabolism, Biodegradation of amino acids – deamination, transamination, decarboxylation, glutamine and glutamic acid

pathway, urea cycle, uric acid biosynthesis. Protein structure (primary, secondary, tertiary and quaternary). Ramachandran plot. Protein degradation and Targeting.

UNIT- V **15-18L**

Nucleic Acid: Biosynthesis and degradation of Purines and Pyrimidines. Coenzymes and cofactors: Role and mechanisms of action of NAD^+/$NADP^+$, FAD, lipoic acid, thiamine, Pyrophosphate, Biotin, Pyridoxal Phosphate, B_{12} co-enzymes and Metal ions with specific examples. Water and Fat soluble Vitamins; Structure, distribution, interaction and functions.

Text/Reference books:

1. Wilson K. and Walker J. (2008). Principles and Techniques of Biochemistryand Molecular Biology. Cambridge UniversityPress.
2. Nelson D and Cox MM. (2009). Principles of Biochemistry. W.H. Freemanand Company, NewYork.
3. Voet D and Voet JG. (2003). Biochemistry. John Wiley and Sons NewYork.
4. Zubay G (2000). Biochemistry. W. C. Brown, NewYork.
5. Berg J, Tymoczko J, Stryer L (2001). Biochemistry. W. H. Freeman, NewYork.
6. Robert K., Murray M.D., Granner D.K., Mayes P.A.and Rodwell V.I.Harper's Biochemistry. McGraw-Hill/Appleton andLange.
7. Biochemistry:-Pankaja Nayak.
8. Biochemistry:-Lehninger
9. Fundamental of Biochemistry:-A.C.Dev.
10. Biochemistry: - J.L. Jain.
11. Elements of Biochemistry :- H.R.Shrivastava.
12. Essentials of Biochemistry:- Pankaja Naik
13. Instrument method of Analysis :- Dean John A

M.Sc. Biotechnology

First Semester Examination
Paper 1.5 MBT 5105 PLab Course-I

Practical Exercises

1. Mitosis in onion root tip cells.
2. Meiosis in anther.
3. Study of mitosis and meiosis from permanents slides.
4. Study of cell biology techniques.
5. Urease estimation by titrimetric method.
6. Urease estimation by colorimetric method.
7. Acid Phosphatase estimation.
8. Alkaline Phosphatase estimation.
9. Estimation of amylase.
10. Study of enzyme kinetics – calculation of *V*max, Km, Kcat values.
11. Applications of enzymes.
12. Immobilization of *Saccharomycescerevisiae*.
13. Microscopy: simple, compound, Dark Field, phase contrast.
14. Micrometry: Calibration of stage and Occularmicrometer and measurement of the given biologicalsample
15. Cleanliness, media preparation, sterilization, culture methods, dilution techniquesin microbiology.
16. Staining techniques in microbiology i) Flagella staining ii) Negativestaining iii) Spore staining iv) Capsule staining. (v) Lactophenol blue.
17. Isolation of pure culture- Serial Dilution, Pour, Spread,Streak.
18. To learn culture preservation techniques (Agar slants, stabs and glycerol stocks).
19. Identification of unknown bacteria by biochemicaltests-IMVIC, Catalase test, starch hydrolysis.
20. Bacterial growth curve-serial dilution, plating and turbiditymeasurement.
21. Antibiotics Sensitivitytest.
22. Standard qualitative analysis of water(microorganisms).

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First Semester Examination
Paper 1.6 MBT 5106 Lab Course-II

Practical Exercises

1. Ion exchange and gel filtration chromatography.
2. Separation of subcellular organelles by differential centrifugation.
3. Separation of blood cells by density gradient centrifugation.
4. Polyacrylamide gel electrophoresis of proteins.
5. To perform PCR for amplification of target DNA segment (or gene).
6. Electrophoretic separation of DNA in agarose gel.
7. SDS PAGE for protein separation.
8. Southern BlottingTechniques.
9. Restriction Digestion.
10. Demonstration of DNA fingerprinting.
11. Preparation of reagents, buffers and solutions.pH meter: Buffering capacity of a buffer, indicators. To determine the pKavalueand hence the dissociation constant of a given acid by using pHmeter.
12. Estimation of protein: Lowry, Biuret and Bradford methods, standard curveslinear regression and assessment of ranges and reliability.
13. Estimation of reducing sugar by DNS method.
14. Protein purification: Ammonium sulphate, acetone, TCA pptn. Dialysis concentration.
15. Thin layer chromatography: amino acids lipids, mixture ofdyes.
16. Chlorophyll-a concentration measurement with acetone method using spectrophotometer.
17. Spectrophotometry: To find out absorption spectrum of given chromophore and/or oxidised and reduced forms (NAD andNADH).
18. Colorimetry: To determine the association constant of given indicator colorimetrically and to prepare the buffer solutions in pH range of 2.2 to 8.0.
19. To estimate total hardness of water
20. To estimate Calcium hardness of water
21. To estimate the total solids (Ts), total dissolved solids (TDS) and suspended solids (SS) in the given water sample

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Second Semester Examination

Paper-2.1: MBT-5201 Fundamentals of Molecular Biology

Contact Hours / Week	: 4 Hours	Maximum Marks	: 100 Marks
Duration of Examination	: 3 Hours	Continuous/Internal/Assessment	: 30 Marks
		Semester Assessment	: 70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

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Note: *Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc.*

UNIT- I **15-18L**

Genetic Material: Structure, chemical composition and organization. Central Dogma Difference between euchromatin and heterochromatin. DNA super coiling, Different forms of DNA. Repetitive DNA and satellite DNA. Experimental proof of DNA as genetic material. Mutation- Types and various mutagens.

UNIT- II **15-18L**

DNA replication in prokaryotes and eukaryotes-Initiation, elongation, termination, fidelity of replication, enzymology of replication. Regulation at replication level. Chromosome walking, extrachromosomal replicons, DNA repair- enzymes; Photoreactivation; Nucleotide excision repair; Mismatch correction; SOS repair; Non-homologous end joining; Recombination: Homologous.

UNIT- III **15-18L**

Transcription: transcription in prokaryotes and eukaryotes- Initiation, elongation and termination. Transcription factors and machinery, transcription activator and repressor. RNA processing-capping, splicing and polyadenylation, RNA editing Structure and function of different types of RNA, RNA transport. Ribozymes

UNIT- IV **15-18L**

Translation machinery; Ribosomes; Features of genetic code. Proteins Synthesis: Mechanism of translation in Prokaryotes and Eukaryotes–initiation, elongation, termination. Transposons – Transposable Elements, Classification of Transposons, Types.

UNIT- V **15-18L**

Gene Regulation: Prokaryotic Gene Regulatory Mechanism; Operon concept: Lac and Trp operons. Gene Regulation in Eukaryotes – Attenuation control, Regulation by DNA Methylation, Transcription Factors, Enhancer Element.

Text/Reference books:

1. Molecular Biology of the Gene:Watson-Baker-Bell-Gann- Levine-

Losick,PearsonEducation
2. Molecular Biology: D. Freifelder, Narosa Publishing House, NewDelhi
3. Genome: T.A. Brown, John Wiley &Sons
4. Microbial Genetics: Freifelder, Narosa Publishing House, NewDelhi
5. Gene VII: Lewin Benjamin(Oxford)
6. Molecular Cell Biology: J.Darnell, H.Lodhis&D.Baltimore (W.H.Freeman&Co.)
7. DNA Repair and Mutagenesis: E.C.Friedberg, G.C.Walker and W. Seide (ASMPublisher)
8. Molecular Biotechnology: S.B.Primrose
9. Molecular Biotechnology:Glick

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Second Semester Examination

Paper-2.2 MBT-5202 Basic Plant and Animal Tissue Culture

Contact Hours / Week	: 4 Hours	Maximum Marks	: 100 Marks
Duration of Examination	: 3 Hours	Continuous/Internal/Assessment	: 30 Marks
		Semester Assessment	: 70 Marks

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Note: *Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc.*

UNIT-I **15-18L**

Plant Tissue Culture: General Introduction; Concept of Totipotency, Historical Background; Concept of asepsis and methods of sterilization. Laboratory planning and design. Basic tools and techniques of *in vitro* culture, Explant selection and surface sterilization, Composition and preparation of tissue culture media.

UNIT-II15-18L

Micropropagation: Pathways (Axillary bud proliferation, adventitious shoot bud differentiation, callus organogenesis and somatic embryogenesis), meristem tip culture and production of virus - free plants. Thermotherapy, chemotherapy, virus indexing, Applications and limitations. Anther, pollen and ovule culture for haploid production, in vitro fertilization and ovary culture; Somaclonal Variations-Isolation of somaclonal variants, molecular basis, Applications and Limitations.

UNIT-III **15-18L**

Germplasm conservation and cryopreservation: Importance, methods of conservation: In situ and ex situ conservation; In vitro conservation, cryopreservation technique – importance of cryopreservation, pretreatment,freezing methods, cryoprotectants,vitrification.Protoplast Culture: Isolation, purification and regeneration of protoplast; Testing of viability of isolated protoplast; Somatic hybridization and methods of protoplast fusion; Selection of hybrids.

UNIT-IV **15-18L**

Structure and organization of animal cell. Animal cell culture- Equipment and facilities for animal cell culture. Cell culture media, sterilization techniques. Media and its preparation, pH and pH maintenance in culture media, role of carbon dioxide, serum and- serum free media, artificial media.

UNIT-V **15-18L**

Types of animal cell culture- primary and secondary cell culture, development of cell lines or established cultures. Biology and characterization of the cultured cells, measuring parameters of growth. Basic techniques of mammalian cell culture in vitro; culture, maintenance of cell culture; cell separation. Disaggregation of tissue and primary culture, maintenance of cell culture.Basic techniques of mammalian cell culture, methods of sub culturing.

Reference Books

1. Plant tissue culture and its biotechnological applications by W. Barz, E. Reinhard, M.H. Zenk
2. Purohit, SD 2013, Introduction to Plant Cell, Tissue and Organ Culture, PHI Learning Private Limited, Delhi.
3. Plant tissue culture: theory and practice by S.S. Bhojwani and A. Razdan
4. Plant cell, tissue and organ culture, applied and fundamental aspects by Y.P.S. Bajaj and A. Reinhard.
5. Plant Tissue Culture by MK Razdan & SS Bhojwani (1996) Elsevier
6. Plant Biotechnology by H.S.Chawla.
7. Plant Tissue Culture Concepts and Laboratory Exercises, Second Edition, Robert N Trigiano,Dennis J Gray, CRC Press November 1999
8. Animal Cell Culture John R.W. Masters Oxford University Press
9. R.Ian Freshney, Culture of Animal Cells, 5th Edition, Wiley-Liss, 2005
10. Modern Concepts of Biotechnology H.D. Kumar Vikas Publishing House Pvt. Ltd., New Delhi.
11. Butler. M 2014, Animal Cell Biotechnology-Methods & Protocol (Portner, R ed.) Springer.

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Second Semester Examination

Paper -2.3: MBT-5203 Immunology and Immuno-technology

Contact Hours / Week	: 4 Hours	Maximum Marks	: 100 Marks
Duration of Examination	: 3 Hours	Continuous/Internal/Assessment	: 30 Marks
		Semester Assessment	: 70 Marks

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Note: *Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc.*

UNIT-I **15-18L**

Cells and organs of immune system,Immunity - Innate and adaptive, Humoral and cell-mediated, Clonal selection theory, Hematopoiesis, Cells of Immune System, Lymphoid organs.Immunoprophylaxis –Active and passive immunization, Vaccines: Types and toxoids.
Antigens: Structure and properties, Types, haptens, adjuvants, antigen specificity, antigenic determinants, super antigens.

UNIT-II **15-18L**

Immunoglobulins-basic structure, classes and subclasses of immunoglobulins, Multigene organization of immunoglobulin genes, Generation of antibody diversity.ClassswitchingAntigen processing and presentation.
Complement system: Structure, complement pathways and biological consequence of complement activation.
Hybridoma Technology: Monoclonal antibodies production. Antibody engineering: Chimeric and Humanized monoclonal antibodies.

UNIT-III **15-18L**

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance.
Hypersensitivity reactions- Type I- Anaphylaxis. Type II- Antibody dependent cell cytotoxicity. Type III- Immune complex mediated reactions. Type IV-Cell mediated hypersensitivity reactions.

UNIT-IV **15-18L**

Major Histocompatibility Complex: Structure and functions of MHC. HLA and tissue transplantation. Graft versus host reaction and rejection. Tissue typing methods for organ and tissue transplantations in humans.Cytokines: Structure and function.

Tumor Immunology:Tumor specific antigens. Immune response to tumors. Immuno-diagnosis of tumors. Cancer Immunology.Immune response to SARS-CoV-2.

UNIT-V **15-18L**

Antigen- Antibody interaction - Agglutination, Precipitation, Immunofluorescence, ELISA, Radioimmunoassays; Immunoblotting,Immunofluorescence, Flow cytometry, Protein microarrays, *In vivo* methods: skin test and their applications.Epitopemapping,Detection of immune complex. Cell cytotoxic assay.

Autoimmune diseases- Addison's disease, Grave's disease, Hashimoto's thyroiditis,goodpasture's disease, rheumatoid arthristis. Systemic Lupus erythematosus, Multiple Sclerosis.Immune deficiencies- Primary and secondary.

Text/Reference books:

1. Essentials of Immunology, Author- Roitt, I.M., ELBS. Blackwell Scientific Publishers, London.
2. Immunology II Edition, Author- Kuby, J. WH., Freemanand Company, NewYork.
3. Immunology. Author- Klaus D. Elgert,Wiley-Liss. NY.
4. Text Book on Principles of Bacteriology, Virology and Immunology, IX Edition (5 volumes). Authors- Topley and Wilson's, Edward Arnold,London.
5. The Experimental Foundations of Modern Immunology. Authors- Clark, V.R., John Willey andSons,Incl.
6. Fundamental Immunology. Author – W.E. Paul, Raven Press, NewYork.
7. Fundamentals of Immunology. Authors – R.M. Coleman, M.F. Lombord and R.E. Sicard 2nded. C. Brownpublishers.
8. Immunology. Authors – D.M. Weir and J. Steward 7thEd. (1993).
9. Immunology : Shailendra Sharma.
10. Immunology: C.V.Rao.

M.Sc. Biotechnology

Second Semester Examination
Paper 2.4 MBT-5204 Genetic Engineering and its Application

Contact Hours / Week	: 4 Hours	Maximum Marks	: 100 Marks
Duration of Examination	: 3 Hours	Continuous/Internal/Assessment	: 30 Marks
		Semester Assessment	: 70 Marks

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Note: *Contents of each unit may be completed into 15-18 lectures or contact hours which also include revisions, seminars, internal assessments, etc.*

UNIT- I **15-18L**

Genetic engineering tools and their applications: Restriction-modification system & different enzymes, Gene Cloning Vectors- Plasmids, bacteriophages, phagemids, cosmids. Artificial chromosome vectors (YAC, BAC, HAC, PAC, MAC), virus derived vectors- SV40, M13, retroviral vectors.

UNIT- II **15-18L**

Gene manipulation: cDNA Synthesis and its Cloning; mRNA enrichment, DNA primers, linkers and adaptors, Library (cDNA and Genomic) construction and screening. Alternative Strategies of Gene Cloning- Two and three hybrid systems, cloning of genes in expression vectors and regulation. Microarray Technology.

UNIT-III **15-18L**

Protein Engineering and Processing of Recombinant proteins - Directed Mutagenesis- Oligo- nucleotide with M13 DNA,PCR,RTPCR, PCR amplified oligo-nucleotide and Random mutagenesis. Protein Engineering: adding disulfide bonds, reducing number of free sulfhydryl residues, changing amino-acids, increasing and modifying enzymatic activity.

UNIT- IV **15-18L**

Processing of Recombinant proteins: Purification and refolding. Characterization of recombinant proteins, stabilization of proteins. Protein markers. DNA markers Molecular marker: RAPD, RFLP, AFLP, ISR, SNP.Omics Technology: Genomics, transcriptomics, proteomics, metabolomics. Biochips.

UNIT- V **15-18L**

Genome analysis: Introduction, DNA typing, human genome project.
Genetically modified organisms: Introduction, Transgenic animals, Transgenic Plants. Transgenic Technology. Antisense technology.
Nanotechnology:Introduction and Biological materials.DNA nanotechnology.
Stem cell technology.

Text/Reference books:

1. Molecular Biology of the Gene: Watson-Baker-Bell-Gann-Levine-Losick, 5thEdn., Pearsoneducation
2. Molecular Biology: D. Freifelder, Narosa Publishing House, NewDelhi
3. Genome: T.A. Brown, John Wiley &Sons
4. Microbial Genetics: D. Freifelder, Narosa Publishing House, NewDelhi
5. Gene VII: Lewin Benjamin(Oxford)
6. Molecular Cell Biology: J.Darnell, H.Lodhis&D.Baltimore (W.H.Freeman&Co.)
7. DNA Repair & Mutagenesis: E.C.Friedberg, G.C.Walker and W. Seide (ASMPublisher)

M.Sc. Biotechnology

Second Semester Examination
Paper 2.5MBT 5205 Lab Course-III
Practical Exercises

1. Isolation of total DNA.
2. Isolation of plasmid and its quantification.
3. Preparation of competent cells
4. To induce mutation by UV radiations and to exhibit DNA repair by photo reactivation.
5. To isolate and produce UV induced auxotrophic mutants by replica plating method.
6. To perform Ames test for detecting carcinogen or mutagen.
7. Quantification of DNA by DPA method.
8. Quantification of RNA by Orsinol method
9. To check purity and quantity of DNA by Spectrophotometric method.
10. Preparation of competent cells.
11. Sterilization techniques: Washing of glassware, dry and steam sterilization.
12. Preparation of culture Media. Stock solutions for MS media.
13. Micro propagation techniques. Hardening and transfer of plants to soil
14. Surface sterilization and Organ culture. Ovary culture
15. Study of somatic embryogenesis.
16. Anther culture, production of Haploids.
17. Demonstration of protoplast fusion employing PEG
18. To study the development and maintenance of animal cell line.
19. Studying cell death and cytotoxicity by staining methods
20. Differentiation of the viable and nonviable cell by staining methods.
21. Introduction to culture environment, medium and culture vessels for animal cell culture.
22. Preparation of culture media and concept of sterilization in animal cell culture.
23. Demonstration of establishment of primary cell culture by trypsinization
24. Identification of cell types by maceration method.
25. Preparation of metaphase chromosome from cultured cells.

M.Sc. Biotechnology

Second Semester Examination
Paper 2.6 MBT 5206Lab Course-IV

Practical Exercises

1. Antibody titre by ELISA method.
2. Double diffusion, Immuno-electrophoresis and Radial Immuno-diffusion.
3. Immunoblotting, Dot Elisa assays
4. Blood smear identification of leucocytes by Giemsa stain.
5. Separation of leucocytes.
6. Blood group typing.
7. Blood film preparation and identification of cells.
8. MIC assay – Kirby Bauer method.
9. Isolation of serum from whole blood.
10. Bacterial culture and antibiotic selection media.
11. Isolation of plasmid DNA.
12. Isolation of phage DNA.
13. Restriction mapping of Plasmid DNA.
14. Cloning in Vectors.
15. PCR.
16. To study the production of transgenic crops for disease resistance.
17. To study the genetically modified crop plants production &theirusefulness.
18. Restriction endonuclease digestions and separation of fragments.
19. RFLP analysis
20. Biosynthesis of nanoparticles.
21. Use to nanobiotechnology in various fields.