

***SCHEME OF EXAMINATION  
RULES & REGULATIONS  
AND  
SYLLABUS  
(Applicable for Academic Session 2019-2021)***

**Master of Science (M.Sc.)  
Microbiology**

**Faculty of Science**



**UNIVERSITY OF KOTA**

**MBS Marg, KOTA (Rajasthan)-324 005**

**INDIA**

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# University of Kota, Kota

## M.Sc. Microbiology

### Semester wise Consolidated Common Scheme of Examinations for the Academic Sessions 2019-2021

Year / Semester	Number, Code or ID and Nomenclature of Paper			Duration of Exam. (in Hrs.)	Teaching Hrs / Week		Distribution of Assessment Marks					
	Number of Paper	Code / ID of Paper	Nomenclature of Paper		Teaching		Continuous or Internal Assessment (30%)		Semester or External Assessment (70%)		Total	
					Th.	Pr.	Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks	Max. Marks	Min. Pass Marks
<b>1st Year I Semester</b>	Paper-1.1	MB-511	General Microbiology	3	4	-	30	12	70	28	100	40
	Paper-1.2	MB-512	Cell Biology and Enzymology	3	4	-	30	12	70	28	100	40
	Paper-1.3	MB-513	Microbial Genetics	3	4	-	30	12	70	28	100	40
	Paper-1.4	MB-514	Biochemistry and Microbial Physiology	3	4	-	30	12	70	28	100	40
	Paper-1.5	MB-515	Lab Course-I	6	-	9	--	--	100	50	100	50
	Paper 1.6	MB-516	Lab Course-II	6	-	9	--	--	100	50	100	50
	<b>Total (I Semester)</b>				<b>24</b>	<b>34</b>		<b>120</b>	<b>48</b>	<b>480</b>	<b>212</b>	<b>600</b>
<b>1st Year II Semester</b>	Paper-2.1	MB-521	Microbial Diversity	3	4	-	30	12	70	28	100	40
	Paper-2.2	MB-522	Molecular Biology	3	4	-	30	12	70	28	100	40
	Paper-2.3	MB-523	Immunology and Immunotechnology	3	4	-	30	12	70	28	100	40
	Paper-2.4	MB-524	Tools and Techniques of Molecular Biology	3	4	-	30	12	70	28	100	40
	Paper-2.5	MB-525	Lab Course-III	6	-	9	--	--	100	50	100	50
	Paper 2.6	MB-526	Lab Course-IV	6	-	9	--	--	100	50	100	50
	<b>Total (II Semester)</b>				<b>24</b>	<b>34</b>		<b>120</b>	<b>48</b>	<b>480</b>	<b>212</b>	<b>600</b>
<b>2nd Year III Semester</b>	Paper-3.1	MB-631	Soil and Agriculture Microbiology	3	4	-	30	12	70	28	100	40
	Paper-3.2	MB-632	Microbial Ecology	3	4	-	30	12	70	28	100	40
	Paper-3.3	MB-633	Environmental Microbiology and Microbiology of Waste	3	4	-	30	12	70	28	100	40
	Paper-3.4	MB-634	Biofuel and Bioenergy	3	4	-	30	12	70	28	100	40
	Paper-3.5	MB-635	Lab Course-V	6	-	9	--	--	100	50	100	50
	Paper-3.6	MB-636	Lab Course-VI	6	-	9	--	--	100	50	100	50
	<b>Total (III Semester)</b>				<b>24</b>	<b>34</b>		<b>120</b>	<b>48</b>	<b>480</b>	<b>212</b>	<b>600</b>
<b>2nd Year IV Semester</b>	Paper-4.1	MB-641	Industrial Microbiology/Medical Microbiology	3	4	-	30	12	70	28	100	40
	Paper-4.2	MB-642	Biostatistics, Bioinformatics and Research Methodology	3	4	-	30	12	70	28	100	40
	Paper-4.3	MB-643	Dissertation	3	-	-	--	--	200	100	100	100
	Paper-4.4	MB-644	Lab Course-VII	6	-	9	-	-	100	50	100	50
	Paper-4.5	MB-645	Comprehensive viva voce	8	-	-	--	--	100	50	100	50
	<b>Total (IV Semester)</b>				<b>16</b>	<b>17</b>		<b>60</b>	<b>24</b>	<b>540</b>	<b>256</b>	<b>600</b>
<b>Grand Total (I + II + III + IV Semester)</b>				<b>88</b>	<b>119</b>		<b>420</b>	<b>168</b>	<b>1980</b>	<b>892</b>	<b>2400</b>	<b>1060</b>

## **Rules & Regulations**

### **Objectives of the Course:**

Microbiology discipline deals the understanding of knowledge from basic to advanced level on the biochemistry, physiology, cell biology, ecology, evolution and clinical aspects of micro-organisms including the host response to these agents. Recent trends from the industry focus on production of totally new eukaryotic compounds like insulin, interferon and other recombinant products using micro-organisms at industrial scale. Many new recombinant vaccines are produced to replace crude vaccines and make them polyvalent to reduce the dosage. The Master of Science in Microbiology programme builds a strong platform on biological education and research. The programme is especially dedicated to the integration and consolidation of deep knowledge in the field of microbiology.

### **Duration of the Course:**

The course for the degree of Master of Science in Microbiology 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 comprise normally 90 working days. The course shall run on the regular basis.

### **Eligibility for Admission in M.Sc. First Semester:**

- ❖ A candidate who has passed any one of the following examination from any University recognized by the UGC shall be permitted to take admission in M.Sc. First Semester to award M.Sc. degree in Microbiology 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: Microbiology, Applied Microbiology, Biotechnology, Biochemistry, Biology, Chemistry, Botany, Zoology, Genetics, Environmental Sciences, Bioinformatics, Pharmaceutical Science, food microbiology or etc.
  - ❖ Bachelor of Science and Education (B.Sc.-B.Ed.) with subject biology, chemistry, botany, zoology.
- ❖ Foreign students who are residing in India and are studying in Indian universities are also eligible to seek admission in this course after due screening.
- ❖ An applicant for the M.Sc. Microbiology examination, prosecuting a regular course of study leading to the Master of Science in Microbiology, shall not be permitted for doing any service or for giving any other regular examination simultaneously to earn a degree.
- ❖ No person shall be admitted to M.Sc. Microbiology if he/she has already passed M.Sc. Microbiology or equivalent examination of any University or statutory body. However, this restriction shall not be applicable to diploma / certificate holders.
- ❖ The candidate who has passed any part of M.Sc. Microbiology programme of any University or statutory body will not be admitted to M.Sc. Microbiology programme of this University on migration 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 papers examinations along 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.

### **Course Structure:**

The Master of Science in Microbiology programme will consist of core and advanced courses of theory as well as practical which are compulsory for the students. Each semester consist of four theory papers, one practical paper and one seminar / personality development / skill development activity. Dissertation(s), project work(s), training(s), field work(s), industrial visit(s), *etc.* (which is/are approved by the concerned Department) may be performed / executed by the students in the government / public / private organization(s), institution(s), industry(ies), firm(s), enterprise(s), *etc.* for advanced learning and more practical exposures.

### **Course Number, Course Code or ID and Nomenclature:**

Number of the course has been given in the Arabic number as Paper-1.1, Paper-1.2, and Paper-1.3 and so on. In the Paper-1.2, 1 represents the semester number and 2 represent the paper number. To give a code to a particular course, following sequence has been adopted:

*“Abbreviation of the programme in upper case + n<sup>th</sup> number of year of study + n<sup>th</sup> number of semester of the programme + course number in Arabic number”*

According to the above sequence, code of paper-IV of the first semester of postgraduate Microbiology programme shall be as “MB-514”. It is noted that the 5 represents here the fifth year of study because it is considered that the student has completed four years of study during his / her undergraduate programme *e.g.* B.Sc. pass course with three or B.Sc. Hons course with three / four years or B.Sc.-B.Ed. / B.Sc.-Tech. / B.Tech. *etc.* with four years. Therefore, the figure 5 represents the fifth year of study.

Nomenclature of the particular course has been given according to the nature or type of contents included in the Unit-I to Unit-V of course of study.

### **Maximum Marks and Credit Points:**

Maximum marks of a theory and practical paper will be decided on the basis of their contact hours per week and subsequently their credit points. One teaching or tutorial hour per week will be equal to 01 credit point and will carry 25 maximum marks. Therefore, 4 teaching hours per week will be equal to 4 credit points and will carry 100 maximum marks for each theory paper / course. For calculating of credit points for practical papers, two contact hours per week for laboratory or practical work will be equal to one contact hour per week of theory paper and will carry 01 credit point. Therefore, 18 contact hours per week for practical work or laboratory work will be equal to 9 contact hours per week of theory paper and will carry 9 credit points. Therefore, 9 credit points per week for practical / laboratory work will carry 225 maximum marks.

### **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.* first internal assessment test or first mid-term test, second internal assessment test or second mid-term test and third internal assessment test) each of 10% weightage of 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) Paper wise consolidated marks for each theory paper and dissertation / seminar (*i.e.* total marks obtained during various modes of internal assessment) obtained by the students (out of the 30% weightage of the maximum marks of the each paper) shall be forwarded (in two copies) by the

Head of the Department to the Controller of Examinations of the University within a week from the date of last internal assessment test for incorporation in the tabulation register.

- (f) The consolidated marks obtained by the students be also made known to them before being communicated by the concerned Head of the Department to the University for final incorporation in the tabulation register. If any discrepancies are discovered or pointed out by the students, the same shall be looked into by the concerned faculty member and corrections made wherever necessary. The decision of the Head of the Department before the communication of marks to the University shall be final. No corrections shall be made in the internal assessment marks after the declaration of the result by the University.
- (g) Consolidated marks of internal assessment obtained out of the 30% weightage of maximum marks of each theory paper which will be communicated to the University shall be in whole number and not in fraction. Marks awarded for the various internal assessments in each paper shall be added up and then round off to the next whole number to avoid any fraction.
- (h) All test copies and other material related to the internal assessment shall also be sent to the Controller of Examinations of the University to keep in record as per the University guidelines.
- (i) The concerned Head of the Department shall be responsible for proper conduct of internal assessment tests and for communication of the consolidated marks to the University within the prescribed time.
- (j) The Head of the Department shall keep a record of the marks and also notify the same to the candidates immediately so that if any candidate is not satisfied with the award in any test or seasonal work, he / she should represent the matter to the higher authority.

**(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 10 marks with one compulsory question comprising ten short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
  - **Section-B** will carry 30 marks with equally divided into five long answer type questions (answer about in 250 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.
  - **Section-C** will carry 30 marks with equally divided into three long answer type questions (answer about in 500 words). Paper setter shall be advised to design total five questions by setting one question from each unit. Students are instructed to attempt any three questions.
- (c) The syllabus of practical paper is divided according to main streams of Microbiology. 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**

**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 any other 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 10 marks with one compulsory question comprising ten short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 30 marks with equally divided into five long answer type questions (answer about in 250 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.
- **Section-C** will carry 30 marks with equally divided into three long answer type questions (answer about in 500 words). Paper setter shall be advised to design total five questions by setting one question from each unit. Students are instructed to attempt any three questions.

**SECTION-A**

**Q. 1.**

**Unit-I**

(i) ..... **1 Mark**

(ii) ..... **1 Mark**

**Unit-II**

(iii) ..... **1 Mark**

(iv) ..... **1 Mark**

**Unit-III**

(v) ..... **1 Mark**

(vi) ..... **1 Mark**

**Unit-IV**

(vii) ..... **1 Mark**

(viii) ..... **1 Mark**

**Unit-V**

(ix) ..... **1 Mark**

(x) ..... **1 Mark**

**SECTION-B**

**Unit-I**

**Q. 2.** ..... **6 Marks**

or

..... **6 Marks**

**Unit-II**

**Q. 3.** ..... **6 Marks**

or

..... **6 Marks**

**Unit-III**

**Q. 4.** ..... **6 Marks**

or

..... **6 Marks**

**Unit-IV**

**Q. 5.** ..... **6 Marks**

or

..... **6 Marks**

**Unit-V**

**Q. 6.** ..... **6 Marks**

or

..... **6 Marks**

**SECTION-C**

**Unit-I**

**Q. 7.** ..... **10 Marks**

**Unit-II**

**Q. 8.** ..... **10 Marks**

**Unit-III**

**Q. 9.** ..... **10 Marks**

<b>Q. 10.</b> .....	<b><u>Unit-IV</u></b>	<b>10 Marks</b>
<b>Q. 11.</b> .....	<b><u>Unit-V</u></b>	<b>10 Marks</b>

**Practical Examinations:**

**Continuous or Internal or Mid Term Assessment:** *Not applicable in practical.*

**External or Semester or End Term Assessment:** **For all Lab Courses.**

**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
<b>Total Marks</b>		<b>100</b>

**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 along with the papers of higher semester examination) in accordance with the following conditions:

- (i) A candidate, for a semester examination, shall be offered all the papers prescribed for that semester examination and besides he/she also shall be offered paper(s) not cleared by him/her at any of the lower semester examination subject to the limitation that the number of un-cleared papers of the lower semester examinations shall not be exceed the total number of the papers prescribed for any one semester.

- (ii) The candidate shall be declared to have passed the examination, if the candidate secures at least 40% marks in each theory paper separately in continuous or internal or mid-term examination & semester or external or end-term examination and also separately 50% marks in each practical / project / dissertation / seminar with 50% aggregate marks of the maximum marks prescribed for each semester examination. There is no minimum pass marks for the practical record / notebook. However, submission of a practical record / notebook is a mandatory during the practical examination. The candidate should compulsorily attend viva-voce / presentation examination to secure pass in practical / project / dissertation / seminar.
- (iii) A candidate, who has been declared as failed/absent in one or more theory paper(s) at any odd semester examination shall be permitted to join the courses of study for the next higher semester *i.e.* permitted to join the course of second semester after first semester examination, permitted to join the course of fourth semester after third semester examination, permitted to join the course of sixth semester after fifth semester examination and so on and eligible to re-appear in that paper(s) as due paper(s) along with next higher semester (next year) examination provided that he/she must have cleared at least 50% of the papers (including practical / project / dissertation / seminar as one paper) collectively prescribed for the first and second semester examinations taken together for promotion to the third semester examination.
- (iv) 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.
- (v) 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.
- (vi) 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.
- (vii) 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.
- (viii) 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.
- (ix) 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.
- (x) 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 semester only 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 along with the papers of his/her own semester.

- (xi) 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.
- (xii) 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.
- (xiii) 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.
- (xiv) 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.
- (xv) 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.
- (xvi) The grace marks scheme shall be applicable as per University norms.

**Classification of Successful Candidates:**

The classification of successful candidates after last semester examination shall be as:

<b>Description of Marks Obtained</b>	<b>Division / Result</b>
• 80% and above marks in a paper.	Distinction in that paper.
• A candidate who has secured aggregate 60% and above marks	First Division
• A candidate who has secured aggregate 50% and above but less than 60% marks	Second Division
• A candidate who has secured aggregate 40% and above but less than 50% marks	Pass

Candidates who pass all the examinations prescribed for the course in the first instance and within a period two academic years in four semesters from the year / semester of admission to the course only are eligible for University Ranking. A candidate is deemed to have secured first rank provided he/she

- (i) Should have passed all the papers in first attempt itself.
- (ii) Should have secured the highest marks in the whole examination of the programme / course, or should have secured the highest cumulative grade point average (CGPA).

..... X ..... X ..... X .....



Culture Media: Natural and Synthetic media, chemically defined media, complex media, selective, differential, indicator, enrichment media.

Isolation Techniques Serial Dilution, Streak, Pour and Spread plate method.

Maintenance and Preservation of pure cultures.

#### **UNIT IV**

**15-18L**

Bacterial Morphology: size, shape and arrangement, glycocalyx, capsule, flagella, fimbriae and pili. Composition and detailed structure of gram positive and gram negative cell walls, spheroplasts, protoplasts, and L-forms. Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids. Endospore: structure, formation, stages of sporulation. Economic importance of Bacteria.

#### **UNIT V**

**15-18L**

Methods of reproduction in bacteria and new cell formation. Microbial Growth curve and its kinetics and growth yield. Determination of cell mass and cell number. Environmental factors affecting growth - temperature, pH, osmotic pressure and nutrient concentration.

Antimicrobial Therapy: Antibiotics their classification and Mechanism, Antibiotic sensitivity test- disc diffusion, Minimum Inhibitory Concentration, Minimum Lethal Concentration.

#### **Text/Reference books:**

1. Prescott, L.M., J.P Harley and D.A Klein, 2007. Microbiology VII Ed. Mc Grow Hill,
2. Davis R.Y. E.A. Adeberg and J.L. Ingram, 1991 General Microbiology
3. Stainer .General Microbiology, V Ed., Printice Hall of India Pvt,Ltd. New Delhi
4. Ronald M. Atlas 1997. Principles of Microbiology. II Ed. Mc Graw Hill Pub.
5. Salle A.J., Fundamental Principles of Bacteriology.
6. Microbiology vol.I & II. Power and Daginawala
7. Microbiology. P.D.Sharma
8. Microbiology: An Introduction. Tortora GJ, Funke BR, and Case CL.
9. Bergey`s manual of systematic bacteriology. George M.Garrity,David R. Boone,Richard W.Castenholz.
10. Brock Biology of Microorganisms, 14thEdition. Michael T. Madigan, John M. Martinko, Paul V. Dunlap and David P. Clark





**UNIT V**

**15-18L**

Isoenzymes and its physiological significance, Ribozymes and Abzymes.

Enzyme engineering: Chemical modification of enzymes: methods of modification of primary structure, catalytic and allosteric properties, use of group specific reagents. Enzyme Immobilization Enzymes in non conventional media, Enzymes sensors, Enzymes as analytical reagents.

**Text/Reference books:**

1. Biochemistry: Lubert Stryer
2. Biochemistry: Lehninger
3. Microbial Physiology: Moat, Foster and Spector
4. Molecular biology of the cell: Bruce Alberts et al.
5. Cell and molecular biology: Gerald Karp.
6. Cell and molecular biology: P.K.Gupta.
7. Molecular cell biology: By Lodish et al.
8. The Cell: Cooper.
9. Enzyme: Copeland.
10. Enzyme Technology: M F Chaplin and D C Bucks.
11. Enzymology and Enzyme Technology: S M Bhatt.

**M.Sc. Microbiology**  
**First Semester Examination**

**Paper1.3: MB-:513- Microbial Genetics**

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 three sections.*

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions(maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 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.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units..

*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 to Molecular Genetics. Cell cycle. DNA structure and types. Superhelicity in DNA. Law of DNA constancy, Cot curve and C value paradox, DNA renaturation kinetics and T<sub>m</sub> value determination and interpretation, Repetitive DNA, Satellite DNA, Selfish DNA, DNA Compaction.

**UNIT-II**

**15-18L**

Recombination: Types of recombination, Models for Homologous recombination, Molecular mechanism of homologous recombination, Homologous recombination in eukaryotes, Molecular mechanism and biological role of site specific recombination. Transposable elements in prokaryotes.

**UNIT-III**

**15-18L**

Conjugation: Conjugation by *E. coli* F factor. (Structure of F factor and regulation of F-factor fertility), F- prime conjugation, Conjugation of fertility inhibited F-like plasmids, Hfr and Lfr conjugation and chromosomal transfer, Non-conjugative, establishment of cell contact.

**UNIT-IV**

**15-18L**

Transformation: Mechanism of natural competence and transformation in *Bacillus subtilis*, *Streptococcus pneumoniae* and *Haemophilus influenzae*. Transformation by artificial competence. Gene linkage and mapping by transformation. Transduction- specialized and generalized transduction and its applications.

**UNIT-V**

**15-18L**

Regulation of gene expression: Operon concept, catabolite repression, instability of bacterial RNA, positive and negative regulation: inducers and co-repressors. Negative regulation in *E. coli* lac operon. Positive regulation in *E. coli* arg operon; regulation by attenuation of his and trp operons.

**Text/Reference books:**

1. Concepts of genetics: Klug and Cummings

2. Genetics: From Genes to Genomes: [Leland Hartwell](#), [Leroy E. Hood](#), [Michael L. Goldberg](#)
3. Genetics: Analysis and Principles (3rd Edition): Brooker
4. Gene cloning : T.A.Brown
5. Cell and molecular Biology : P.K. Gupta.



Biological Nitrogen Fixation: Nitrogen fixing organisms, difference in symbiotic and non symbiotic fixation. Oxygen Protection mechanisms. nif gene organization and regulation

**UNIT V**

**15-18L**

Nucleic acids: structure and properties. Nucleic Acid: Biosynthesis and degradation of Purines and Pyrimidines. Coenzymes and cofactors: Role and mechanisms of action of  $\text{NAD}^+$ / $\text{NADP}^+$ , FAD, lipoic acid, thiamine, Pyrophosphate, Biotin, Pyridoxal Phosphate,  $\text{B}_{12}$  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 Biochemistry and Molecular Biology. Cambridge University Press.
2. Nelson D and Cox MM. (2009). Principles of Biochemistry. W.H. Freeman and Company, New York.
3. Voet D and Voet JG. (2003). Biochemistry. John Wiley and sons New York.
4. Zubay G (2000). Biochemistry. W. C. Brown, New York.
5. Berg J, Tymoczko J, Stryer L (2001). Biochemistry. W. H. Freeman, New York.
6. Moat AG and Foster J W (2003). Microbial Physiology. John Wiley and Sons, New York.
7. Robert K., Murray M.D., Granner D.K., Mayes P.A. and Rodwell V.I. Harper's Biochemistry. McGraw-Hill/Appleton and Lange.
8. Biochemistry U, SatyaNarayan.
9. Biochemistry: Lehninger
10. Fundamental of biochemistry by A.C.Dev.
11. J.L. Jain, Biochemistry.
12. Elements of biochemistry by H.R. Shrivastava.

**M.Sc. Microbiology**  
**First Semester Practical Examination**  
**Paper 1.5 MB- 515 Lab Course-I**

1. Good Microbiology laboratory practices: Laboratory safety (Dos and Don'ts), hazard from chemicals, handling of cultures and chemicals, disposal of chemicals and cultures.
2. Introduction to different Glass wares used in Microbiology Laboratory.
3. To learn handling of different instruments and Equipments used for culture and Sterilization.
4. Techniques of pure culture isolation-pour plate, spread plate, streaking.
5. Preparation of Basic Liquid and Solid media for cultivation of bacteria and fungi.
6. Isolation and Enumeration of microorganisms from Air (plate exposure method), Soil and Water (serial dilution method)
7. To perform different staining methods to study morphological and structural characteristics of bacteria and fungi a. Gram Staining b. Acid fast staining c. Fungal staining (Lacto-phenol cotton blue) d. Spore staining e. Flagella staining f. Capsule staining (Negative staining)
8. To check motility of bacteria by hanging drop and semi solid agar methods
9. To learn culture preservation techniques (Agar slants, stabs and glycerol stocks)
10. Calibration of an ocular micrometer for different objectives of microscope.
11. Measurement of microorganisms by the use of an ocular micrometer.
12. To study microorganisms under and phase contrast microscope.
13. To study activity of disinfectants.
14. Bacterial growth curve-serial dilution, plating and turbidity measurement.
15. Standard qualitative analysis of water (microorganisms).
16. Antibiotics sensitivity test.
17. Study the effect of colchicine on the mitotic division of the Onion root tip .
18. Identification and study of cancer cells by photomicrographs.
19. Study of different stages of mitosis and meiosis.
20. Urease estimation by titrimetric method.
21. Urease estimation by colorimetric method.
22. Acid Phosphatase estimation.
23. Alkaline Phosphatase estimation.
24. Estimation of amylase.
25. Study of enzyme kinetics – calculation of  $V_{max}$ ,  $K_m$ ,  $K_{cat}$  values

**M.Sc. Microbiology**  
**First Semester Practical Examination**  
**Paper 1.6 MB- 516 Lab Course-II**

1. Triple Sugar Iron Test.
2. IMVIC Test
3. Oxidase test
4. Casein hydrolysis.
5. Urease test
6. H<sub>2</sub>S Production
7. Catalase Test.
8. Separation of amino acids by paper chromatography
9. Thin layer chromatography: Amino acids, lipids, mixture of dyes.
10. Qualitative estimation of lipid, carbohydrates & proteins.
11. Reducing sugar estimation by benedict's method.
12. Colorimetry: To determine the association constant of a. given indicator colorimetrically and to prepare the buffer solutions in pH range of 2.2 to 8.0
13. Spectrophotometry: To find out absorption spectrum of given chromophore and /or oxidised and reduced forms (NAD,NADH).
14. Chlorophyll-a concentration measurement with acetone method using spectrophotometer
15. Separation of sub cellular organelles by differential centrifugation.
16. Polyacrylamide gel electrophoresis of proteins.
17. Separation of DNA by gel electrophoresis.
18. To induce mutation by UV radiations and to exhibit DNA repair by photo reactivation.
19. To isolate and produce UV induced auxotrophic mutants by replica plating method.
20. Study of sex linked gene inheritance.
21. Estimating gene frequencies in human population,
22. Recombination in Bacteria.
23. To check purity and quantity of DNA by Spectrophometric method.

**M.Sc. Microbiology**  
**Second Semester Examination**  
**Paper 2.1: MB-521 Microbial Diversity**

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 three sections.*

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions(maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 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.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units..

*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**

Evolution and Origin. Evolutionary tree of microorganisms.

Classification of microorganisms – Haeckel’s three kingdom concept, Whittaker’s five kingdom concept, Three domain concept of Carl Woese, Classification systems-artificial or phonetic, natural and phylogenetic, Classification and salient features of bacteria according to the Bergey’s manual of determinative bacteriology.

**UNIT II**

**15-18L**

Fungi: Recent Trends in fungal systematics (Alexopolus & Mims), General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultrastructure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, Life cycle (major group of Fungi), heterokaryosis Parasexuality and Heterothallism. Economic Importance (Agriculture, Environment, Industry, Medicine, Food, Biodeterioration, Mycotoxins).

**UNIT III**

**15-18L**

Algae: Definition, occurrence, Classification upto class level, Ultra-structure, Reproduction and Life cycle. Economic importance (Agriculture, Industry, Environment and Food)

Protozoa: General Characteristics – Definition, Occurrence, Ultrastructure, Reproduction, Economic importance.

Virus: General characteristics – Definition, Structure, Reproduction and Ultrastructure, Capsids. Virus related agents–Viroids, Prions.

Bacteriophages: Structure, Life cycle –Lytic & Lysogenic

**UNIT IV**

**15-18L**

Characteristics of important genera and physiology of: Chemoautotrophic and Methophilic eubacteria, Gram negative aerobic eubacteria, Gilding bacteria (Myxobacteria), Enteric group and related eubacteria, Gram negative anaerobic eubacteria, Gram negative eubacteria- Rickettsia, Chlamydia and Spirochaetes.

Gram positive eubacteria- Unicellular endospore forming eubacteria, Actinomycetes.



**UNIT V**

**15-18L**

General Characters, Classification, Adaptations and Physiology of Archaeobacteria: methanogens, Acidophiles, Halophiles, Thermoacidophiles.

Cyanobacteria: General characters , Ultra structure, Reproduction and Economic importance. Photosynthetic eubacteria : Anoxygenic and oxygenic photosynthesis, Sulfur or NonSulfur Bacteria (purple and green), Mollicutes. Gram positive fermentative eubacteria.

Bdellovibrio and its interperiplasmic growth cycle.

**Text/Reference books:**

1. Michael T. Madigan, John M. Martinko, Paul V. Dunlap and David P. Clark, Brock Biology of Microorganisms, 13thEdition, Pearson Education, Limited, 2011.
2. Pelczar, M.J., ChanE.C.S. and Krieg, N.R., Microbiology –Application based approach, 5th edition, Mc Graw Hill, 2009.
3. Tortora,G. Microbiology: An Introduction-Benjamin Cummings, 10thEdition, 2009.
4. Willey J, Sherwood and Woolwerton C, Prescott, Harley and Klein's, Microbiology, 8thEdition, McGraw Hill International, 2010.
5. Singh, Pandey, Jain. A text Book of Botany, 2016

**M.Sc. Microbiology**  
**Second Semester Examination**  
**Paper 2.2 MB-522- 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 three sections.*

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions(maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 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.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units..

*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 nature of Genetic material: The structure of DNA and RNA. Organization of Microbial Genomes, Organization of Eukaryotic Genomes, Chromatin arrangement, nucleosome and solenoid structure of DNA. Mutations : Types of Mutations and mutagens. Molecular mechanisms of induced mutation ,DNA damages and it repair pathways.

**UNIT II**

**15-18L**

DNA Replication: Central dogma. DNA replication in prokaryotes and eukaryotes- Initiation , elongation and termination. Enzymology of replication. Proofreading of DNA with reference to specific enzymes and co-factors. Regulation of replication. Genetic code.

**UNIT III**

**15-18L**

Transcription: Transcription machinery of prokaryotes and eukaryotes -initiation, elongation and termination, various transcription enzymes and cofactors. Transcription eukaryotes -initiation, elongation and termination Types of RNA polymerase. Promoters, enhancers, silencers, activators. Regulation of transcription.

**UNIT IV**

**15-18L**

Translation: Mechanisms of translation in prokaryotes and eukaryotes- initiation, elongation and termination. RNA processing: splicing, capping and polyadenylation, rRNA and tRNA, processing, RNA Editing, RNAi : :miRNAs and siRNA, Post-transcriptional gene regulation. Ribozymes.

**UNIT V**

**15-18L**

Genetic Engineering: Principle and basic tools. Gene cloning vectors: Plasmids, phage vector- Ti and Ri plasmid, Phagemids, Cosmids, shuttle vectors, Artificial chromosomes (BAC, YAC, HAC), DNA sequencing methods, DNA markers, Application of genetic engineering, GMO's ,Transgenic technology.

**Text/Reference books:**

1. Molecular Biology: D. Freifelder
2. Molecular biotechnology: Glick.

3. Genetics: From Genes to Genomes by Leland Hartwell, Leroy E. Hood, Michael L. Goldberg
4. Molecular Cell Biology: J.Darnell, H.Lodhis & D.Baltimore
5. Genetics: Analysis and Principles (3rd Edition) : Brooker
6. Gene cloning : T.A.Brown
7. Genetic Engineering : Nicoll
8. Molecular Biology and Genetic Engineering: P.K.Gupta

**M.Sc. Microbiology**  
**Second Semester Examination**

**Paper 2.3-MB-523 Immunology and Immunotechnology**

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 three sections.*

- **Section-A** will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.
- **Section-B** will carry 25 marks with equally divided into five long answer type questions (answer about in 250 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.
- **Section-C** will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of remaining four questions. Paper setter shall be advised to design question paper covering from all five units..

*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**

Structure, composition and types of cells and organs involved in immune system, Innate and acquired immunity. Immunization – Modern methods of producing vaccines. Humoral and cell mediated immune responses. Vaccines: Active and passive immunization, vaccine schedule, whole organism vaccine, subunit vaccine, vaccine, DNA vaccine, recombinant vaccine, subunit vaccines and anti-idiotypic vaccine.

**UNIT-II**

**15-18L**

Antigens: Structure and properties, Types– Iso and allo – haptens, adjuvants, antigen specificity, Immunoglobulins-structure, heterogeneity, types and subtypes, physico- chemical and biological properties. Molecular mechanism of antibody diversity and class switching. Cytokines: types, structure and functions.

Complement system: components, activation pathways, regulation of activation pathways and Its role in immune response.

**UNIT-III**

**15-18L**

Antibody: Mediated – type I. Anaphylaxis; Type II. Antibody dependent cell cytotoxicity; Type III immune complex mediated reactions; Type IV Cell mediated hypersensitivity reactions. Autoimmunity – mechanism and diseases. Immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies.

**UNIT-IV**

**15-18L**

Major histocompatibility complex: organization of MHC genes, types and function of MHC molecules, antigen presentation, MHC polymorphism, MHC related diseases. Transplantation immunology: immunologic basis of graft rejection, clinical manifestation of graft rejection and clinical transplantation.

**UNIT-V**

**15-18L**

Antigen- Antibody interaction -*In vitro* methods - Agglutination, Precipitation, Immunofluorescence, ELISA, Radioimmunoassays; Immuno blotting. *In vivo* methods: Skin tests and immune complex tissue demonstrations and their

applications in diagnosis of microbial diseases. Hybridoma Technology: Monoclonal antibodies production. Antibody engineering: Chimeric and Humanized monoclonal antibodies.

**Text/Reference books:**

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



detectors), GC-MS, MALDI-TOF. Fluorescent spectroscopy. Applications of different Spectroscopic techniques in Biology. GM counter, Scintillation counter, Flow cytometry. RIA, ELISA, DNA Fingerprinting.

**Text/Reference books:**

1. Wilson K. and Walker J. (2008). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
2. Nelson D and Cox MM. (2009). Principles of Biochemistry. W.H. Freeman and Company, New York.
3. Voet D and Voet JG. (2003). Biochemistry. John Wiley and sons New York.
4. Zubay G (2000). Biochemistry. W. C. Brown, New York.
5. Berg J, Tymoczko J, Stryer L (2001). Biochemistry. W. H. Freeman, New York.
6. Nuclear Magnetic Resonance: Williams
7. A Biologist Guide to Principle and Techniques: Willson K. and Gounding K.H.
8. Biochemical Techniques theory and practice: White R.
9. Molecular biotechnology- Glick
10. An Introduction to Practical Biochemistry: Plummer D. T.
11. Life Science in tools and Techniques: P. S. Bisen and Shruti Mathur.

**M.Sc. Microbiology**  
**Second Semester Practical Examination**  
**Paper 2.5 MB- 525 Lab Course III**

1. Isolation cultivation and morphological studies of Actinomycetes.
2. Isolation cultivation and morphological studies of fungi.
3. Study of *Rhizopus*, *Penicillium*, *Aspergillus*, *Saccharomyces* using temporary mounts.
4. Study of *Spirogyra* and *Chlamydomonas*, *Volvox* using temporary mounts
5. Study of the following protozoans using permanent mounts/photographs: *Amoeba*, *Entamoeba*, *Paramecium* and *Plasmodium*.
6. Isolation and enumeration of bacteriophages (PFU) from water/sewage sample.
7. To isolate genomic DNA from bacteria.
8. DNA: a) Isolation of DNA (nuclear and Mt)
  - i. Agarose gel electrophoresis
  - ii. Demonstration of DNA modifications
  - iii. Restriction endonuclease digestions and separation of fragments by gel chromatography
9. Isolation of total cellular RNA from suitable organisms (yeast, plant, animal cells)
10. Isolation of total m RNA from suitable organisms.
11. To isolate total RNA and mRNA from bacteria.
12. Thermal melting of DNA
13. To perform SDS-PAGE for separation of proteins in given sample.
14. Blotting Techniques.
15. Fragment separation by restriction endonuclease enzyme.
16. Isolation of plasmid DNA - i) minipreparation ii) large scale isolation.
17. DNA ligation, transformation of *E.coli*.
18. Culture of *E.coli* cells & plasmid isolation
19. Preparation of competent cells.
20. Calcium chloride mediated transformation.



**M.Sc. Microbiology**  
**Second Semester Practical Examination**  
**Paper 2.6 MB- 526 Lab Course IV**

1. To prepare soluble antigen by different methods.
2. To demonstrate various routes of immunization in mice.
3. To prepare serum and plasma from blood.
4. To precipitate immunoglobulins by ammonium sulphate and to determine total protein contents.
5. To determine Blood group and Rh factor by slide agglutination test
6. Estimation of haemoglobin content.
7. To determine Total Leukocyte Count (TLC) for given blood sample
8. To determine Differential Leukocyte Count (DLC) for given blood sample using Leishmans stain.
9. To perform Widal agglutination test (slide and tube) for diagnosis of typhoid.
10. To perform Ouchterlony double diffusion test for detection of antigen and antibody reaction and to demonstrate relationship between antigens.
11. To perform Radial immuno-diffusion test for detection of antigen and antibody reaction and for quantification of antigens.
12. To perform immuno-electrophoresis for separation of antigens and for detection of antigen and antibody reaction
13. To perform Rocket immuno-electrophoresis for detection of antigen and antibody reaction
14. To perform ELISA for assay of antibodies in serum sample against given antigen.
15. To perform DOT ELISA.
16. Study of Laboratory Instruments
17. Ion exchange and gel filtration chromatography .
18. Separation of subcellular organelles by differential centrifugation .
19. Separation of blood cells by density gradient centrifugation.
20. Polyacrylamide gel electrophoresis of proteins.
21. To perform PCR for amplification of target DNA segment (or gene).
22. Electrophoretic separation of DNA in agarose gel.
23. SDS PAGE for protein separation.
24. Southern Blotting Techniques.
25. Restriction Digestion.
26. Demonstration of DNA fingerprinting,
27. Gel documentation of DNA, RNA and protein

