



Estd. 1962  
"A++" Accredited by  
NAAC (2021)  
With CGPA 3.52

**SHIVAJI UNIVERSITY, KOLHAPUR - 416004,  
MAHARASHTRA**

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**शिवाजी विद्यापीठ, कोल्हापूर - ४१६००४, महाराष्ट्र**

दूरध्वनी-ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१-२६०९०९४

०२३१-२६०९४८७



**SU/BOS/Science/09**

**Date: 02/01/2024**

**To,**

The Principal,  
All Concerned Affiliated Colleges/Institutions  
Shivaji University, Kolhapur

The Head/Co-ordinator/Director  
All Concerned Department (Science)  
Shivaji University, Kolhapur.

**Subject:** Regarding syllabi of M.Sc. Part-II (Sem. III & IV) as per NEP-2020 (1.0) degree programme under the Faculty of Science and Technology.

**Sir/Madam,**

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of M.Sc. Part-II (Sem. III & IV) as per NEP-2020 (1.0) degree programme under the Faculty of Science and Technology.

<b>M.Sc.-II (Sem. III &amp; IV) as per NEP-2020 (1.0)</b>			
1.	Mathematics	9.	Gen Microbiology
2.	Mathematics (Distance Mode)	10.	Pharmaceutical Microbiology (HM)
3.	Mathematics (Online Mode)	11.	Alcohol Technology
4.	MSc.(Mathematics With Computer Application)	12.	Sugar Technology
5.	Statistics	13.	Geology
6.	Applied Statistics and Informatics	14.	AGPM
7.	Electronics	15.	Geoinformatics
8.	Microbiology (HM)	16.	Physics

This syllabus, nature of question and equivalence shall be implemented from the academic year 2024-2025 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website [www.unishivaji.ac.in](http://www.unishivaji.ac.in), NEP-2020 (Online Syllabus).

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2024 & March/April 2025. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

**Dy Registrar  
Dr. S. M. Kubal**

**Copy to:**

1	The Dean, Faculty of Science & Technology	4	P.G Admission / Eligibility Section
2	The Chairman, Respective Board of Studies	5	Computer Centre/ Eligibility Section
3	B.Sc. Exam/ Appointment Section	6	Affiliation Section (U.G.) (P.G.)

# **SHIVAJI UNIVERSITY, KOLHAPUR**



**Established: 1962**

**A<sup>++</sup> Accredited by NAAC (2021) with CGPA 3.52**

**Structure and Syllabus in Accordance with**

**National Education Policy - 2020**

**with Multiple Entry and Multiple Exit**

**Master of Science (General Microbiology)**

**Sem. III & IV**

**under**

**Faculty of Science and Technology**

**(To Be Implemented From Academic Year 2024-25)**

## Programme Structure

**Structure in Accordance with National Education Policy - 2020**

**With Multiple Entry and Multiple Exit Options**

**M.Sc. (General Microbiology) Part – II (Level-6.5)**

	Course Code	Teaching Scheme			Examination Scheme					
		Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
		Lectures + Tutorial (Per week)	Hours (Per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
Semester-III										
Major Mandatory	MMT-301	4	4	4	80	32	3	20	8	1
	MMT -302	4	4	4	80	32	3	20	8	1
Major Elective	MME -303	4	4	4	80	32	3	20	8	1
Practical Course	MMPR -304	4	4	4	80	32	3	20	8	1
	MEPR-305	2	2	2	40	14	2	10	4	0.5
Research Project	RP-306			4	80	32	3	20	8	1
Total of Sem III				22	440			110		
Semester-IV										
Major Mandatory	MMT-401	4	--	4	80	32	3	20	8	1
	MMT -402	4	--	4	80	32	3	20	8	1
Major Elective	MME - 403	4	--	4	80	32	3	20	8	1
Practical Course	MMPR -404	2	2	2	40	14	2	10	4	0.5
	MEPR-405	2	2	2	40	14	2	10	4	0.5
Research Project	RP-406			6	100	40	3	50	17	2
Total of Sem IV				22	420			130		
Total (Sem III + Sem IV)				44	860			240		

<ul style="list-style-type: none"> <li>• MMT–MajorMandatory Theory</li> <li>• MMPR–MajorMandatoryPractical</li> <li>• MET–MajorElective Theory</li> <li>• MEPR–MajorElective Practical</li> <li>• RP- Research Project</li> </ul>	<ul style="list-style-type: none"> <li>• Total Marks for M.Sc.-II : <b>1100</b></li> </ul>
	<ul style="list-style-type: none"> <li>• Total Credits for M.Sc.-II (Semester III &amp; IV) : 44</li> </ul>
	<ul style="list-style-type: none"> <li>• <i>Separate passing is mandatory for University and Internal Examinations</i></li> </ul>
# Evaluation scheme for Research Project shall be decided by concerned BOS	
## Evaluation scheme for Research Project shall be decided by concerned BOS	
<ul style="list-style-type: none"> <li>• <b>Requirement for Exit after Level 6.5:</b> Students can exit after completion of Level 6.5 with Post Graduate in General Microbiology</li> </ul>	

**SHIVAJI UNIVERSITY KOLHAPUR**  
**M.Sc. GENERAL MICROBIOLOGY**  
**(For Affiliated Colleges)**  
**CURRICULAM FRAMEWORK BASED ON**  
**‘NATIONAL EDUCATION POLICY 2020**

**SEM III**

Y E A R  I I	LE V EL  6.5	Code	Title of the paper	Credits	Hrs/ week	Total Lecturs	Maximum Marks		
							Internal Assessment	Universi ty Examin ation	Total
		Major Mandatory Papers							
		MMT 301	Quantitative Biology	04	04	60	20	80	100
		MMT 302	Medical Microbiology and Virology	04	04	60	20	80	100
		Major Elective Papers (CHOOSE ANY ONE)							
		MET 303-A	Bioethics, Biosafety, Quality control in Microbiology	04	04	60	20	80	100
		MET 303-B	Bioinformatics, Biostatistics and Bionanotechnology	04	04	60	20	80	100
		MET 303-C	Agricultural Microbiology	04	04	60	20	80	100
		Minor RP (Compulsory paper)							
		RP- 306	Research Project	04	04	60	20	80	100
		PRACTICAL COURSES							
		MMP R-304	Practical course 1	04		60	20	80	100
		MEP R-305	Practical course 2	02		30	10	40	50

## SEM IV

Y E A R  I I	LE V EL  6.5	Code	Title of the paper	Credits	Hrs/ week	Total Lecturs	Maximum Marks		
							Internal Assessment	Univer sity Examin ation	Total
		Major Mandatory Papers							
		MMT 401	Food and Dairy Microbiology	04	04	60	20	80	100
		MMT 402	Molecular Biology Tools and Applications	04	04	60	20	80	100
		Major Elective Papers (CHOOSE ANY ONE)							
		MET 403-A	Industrial Waste Management	04	04	60	20	80	100
		MET 403-B	Enzymology and Enzyme Technology	04	04	60	20	80	100
		MET 403-C	Clinical Microbiology	04	04	60	20	80	100
		Minor RP (Compulsory paper)							
RP- 406	Research Project	06	06	90	50	100	150		
MEP R - 404	Practical course 1	02	02	30	10	40	50		
MEP R- 405	Practical course 2	02	02	30	10	40	50		
	Total of Sem. IV				130	420	550		
	Total of M.Sc. Course						2200		

### **Assessment for Research Project 306:**

#### **Internal (institutional) assessment of the project RP-306:**

Internal assessment of the project will be carried out in the Department where the candidate is registered for post graduate degree. This will be carried out as follow:

<b>Item</b>	<b>Marks</b>	<b>Note</b>
Presentation of the plan of work	10	Should be carried out as open defense. Any suggestions if are should be communicated to the guide.
Submission of completed work in the form of CD ROM of dissertation copy along with 2 certified bound copies	10	CD ROM should be submitted to the University where the University may take appropriate decision for forwarding it to Shodhganga.  Note: Any work having conflicts of interest with respect to intellectual properties should not be published without permission of respective guide.
<b>Total marks:</b>		<b>20</b>

#### **University Evaluation:**

University evaluation will be carried out for 80 marks. This will be conducted as open defense presentation. For the purpose candidate is allowed to present the work through LCD Projector or any other alternative as available in the institute. In case of national emergencies, online presentation is allowed. For the purpose the candidate is allowed to use online meeting apps as allowed by the central government. For the purpose of the evaluation, external examiners appointed by university at the time of practical exam. One examiner will be external having adequate research experience and minimum qualification as Ph.D. For the purpose any senior academician / senior scientist working in institutes of national and international reputes / senior person working in industry / Entrepreneur with minimum qualification of Ph.D. in Microbiology may be appointed. Another examiner will be appointed from the institute where, the candidate has registered for his/her post graduate degree. Minimum qualification of the internal examiner should be Ph.D. in Microbiology.

### **Evaluation by External examiner:**

Internal examiner as appointed above will evaluate the dissertation of the candidate for 80 marks. Following criteria should be used for evaluation purpose by internal examiner.

<b>Sr. No.</b>	<b>Criteria</b>	<b>Maximum Marks</b>	<b>Obtained Marks</b>
<b>1.</b>	Understanding the basic concept of dissertation	<b>10</b>	
<b>2.</b>	Fulfillment of Aims and objectives	<b>10</b>	
<b>3.</b>	Results, discussion and conclusion	<b>10</b>	
<b>4.</b>	Regularity and punctuality	<b>10</b>	
<b>5.</b>	Literature Review	<b>10</b>	
<b>6.</b>	Fulfillment of Plagiarism norms as per attached certificate	<b>10</b>	
<b>7.</b>	Publication of work	<b>10</b>	
<b>8.</b>	Potential Applications of the work /Social relevance	<b>10</b>	
<b>Total out of 80</b>			

**Thus, project will be assessed for 100 marks.**

### **Alternative to Internship / Research Project in case of national emergencies like Covid pandemics:**

In case of national emergencies like Covid pandemics, following alternative should be followed vide cited references:

#### **References:**

1. Letter no. UNI/2020/Baithak/vishi 1/4131A dt. 8<sup>th</sup> May 2020, Pg. no. 6, clause no. 5
2. UGC Guidelines on Examinations and Academic Calendar for the Universities in View of COVID-19 Pandemic and Subsequent Lockdown dt. April 2020, pg. no. 6 and 7, clause no 10.

#### **Alternative No. 1:**

**Review article**

#### **Alternative No. 2:**

**Field work/Online Surveys related to needs of society having subject relevance/Book review**

**Note:** Here, in case of national emergencies or lockdown period students are allowed to work from home and the work done under above titles will be considered for evaluation and grading purposes.



**Explanation:****1. Review Article:**

The criteria for awarding the marks are as follow:

Sr. No.	Criteria
1.	Selection of the topic considering social relevance
2.	Well organized abstract/ introduction
3.	Survey of the topic selected as evidenced through references
4.	Discussion of current developments in a selected field/ topic
5.	Summarizing significant findings of the present study
6.	Literature Review and the use of software like Mendeley to keep flexibility for publication and referencing style.
7.	Fulfillment of Plagiarism norms as per attached certificate
8.	Publication of work

**2. Field work (Data Collection)/ online surveys: having subject relevance**

Sr. No.	Criteria
1.	Selection of the topic considering social relevance
2.	Method followed for data collection
3.	Statistical analysis of the data
4.	Well organized abstract/ introduction
5.	Reference work
6.	Discussion of current developments in a selected field/ topic
7.	Summarizing significant findings of the present study
8.	Fulfillment of Plagiarism norms as per attached certificate
9.	Publication of work

OR

**3. Book review: having subject relevance**

Sr. No.	Criteria
1.	Name of the author and book with relevant details of publisher and publication
2.	Relevant information about the author like who the author is and where he/she stands in the genre or the field of enquiry.
3.	Context of the book
4.	Brief discussion about the theme of book
5.	Strengths and weaknesses of the book
6.	Highlighting parts of the book by selecting particular chapter/ theme for the justification of review
7.	Concluding remarks about books overall perspective, argument and purpose
8.	Plagiarism check report

**Evaluation:**

Internal evaluation for the alternative that is, submitting review article and field work /survey / book review will be carried out as follow:

<b>Online presentations through central government approved apps</b>
Presentation based on review article (1)
Presentation based on field work/ survey / book reviews (2 presentations each of 20 marks)
Total marks

**IMP Note:** The candidate has to submit the project report before the deadlines notified by the department. The candidate who fails to submit the project report may re-submit the same in a subsequent semester examination for evaluation purpose. The project work activities must be duly supported by documentary evidences and those should be endorsed by the HOD or the guide. All forthcoming UGC notifications regarding promotion of academic integrity and prevention of plagiarism in higher education institutions will be binding to the students **SEE ANNEXURE I (DECLARATION BY THE CANDIDATE)**. Submitted thesis by the students will be evaluated by, ‘Departmental Academic Integrity Panel (DAIP)’ and will be certified to be eligible for further evaluation as mentioned above. **SEE ANNEXURE II (DAIP CERTIFICATE)**

Award of the Grade will be based on the following criteria.

### **Guidelines for conducting RP- 406 Research Project in Sem IV of the curriculum**

1. RP – 406 research project should be completed minimum of 90 hours.
2. The research project may be completed in research laboratories, industries, National Incubation Centers, research institutes, public testing laboratories, diagnostic laboratories, etc. The candidates who are not getting an opportunity in cited categories may complete their research in the department of their parent institute.

### **Assessment for Research Project :**

The project shall carry 150 marks. The assessment for the said courses should be carried out as follows;

**a. Assessment by Research Guide: The entire project will be assessed by research guide for 50 marks. Criteria used for the assessment are as follow:**

**(Confidential and to be sent through with signed sealed envelope by research guide)  
SEE ANNEXURE III (CERTIFICATE OF GUIDE)**

<b>Sr. No.</b>	<b>Criteria</b>	<b>Maximum Marks</b>	<b>Obtained Marks</b>
<b>1.</b>	Understanding the basic concept of dissertation	<b>05</b>	
<b>2.</b>	Fulfillment of Aims and objectives	<b>05</b>	
<b>3.</b>	Results, discussion and conclusion	<b>10</b>	
<b>4.</b>	Regularity and punctuality	<b>10</b>	
<b>5.</b>	Literature Review	<b>05</b>	
<b>6.</b>	Fulfillment of Plagiarism norms as per attached certificate	<b>05</b>	
<b>7.</b>	Publication of work	<b>05</b>	
<b>8.</b>	Potential Applications of the work /Social relevance	<b>05</b>	
<b>Total out of 50</b>			

**Note: Respective research guide should submit weekly progress report to the head of the department through official mail. Signed print copies of the progress report are also accepted.**

**Evaluation by external examiner:**

External examiner as appointed above will evaluate the dissertation of the candidate for 100 marks. Following criteria should be used for evaluation purpose by external examiner.

<b>Sr. No.</b>	<b>Criteria</b>	<b>Maximum Marks</b>	<b>Obtained Marks</b>
<b>1.</b>	Understanding the basic concept of dissertation	<b>10</b>	
<b>2.</b>	Fulfillment of Aims and objectives	<b>10</b>	
<b>3.</b>	Results, discussion and conclusion	<b>10</b>	
<b>4.</b>	Regularity and punctuality	<b>10</b>	
<b>5.</b>	Literature Review	<b>10</b>	
<b>6.</b>	Fulfillment of Plagiarism norms as per attached certificate	<b>10</b>	
<b>7.</b>	Publication of work (Conference presentation / Research Paper in Journal)	<b>20</b>	
<b>8.</b>	Potential Applications of the work /Social relevance	<b>20</b>	
<b>Total out of 100</b>			

	Semester III	
Credits	<b>MMT-301: Quantitative Biology</b> Core Compulsory Theory Paper <b>Total: 4 Credits; Workload: -15 hrs /credit</b> <b>(Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)</b> <b>Course outcome:</b> At the end of this course the students will be able to: <ol style="list-style-type: none"> <li>1. Understand role of statistics in biological field especially in research.</li> <li>2. Understand application of different statistical parameters.</li> <li>3. Understand the use of computer softwares for analysis of biological data.</li> <li>4. Understand role of different statistical test for validation of experimental data</li> <li>5. Understand quantitative methods used in pharmaceutical and food industry</li> </ol>	Lectures (Hours)
I	<ol style="list-style-type: none"> <li>1. <b>Basic concepts:</b> definitions – statistics and biostatistics, population, sample, variable and the various types, statistic and parameter.</li> <li>2. <b>Collection and presentation of data:</b> primary and secondary data, collection of data – enumeration and measurement, significant digits, rounding of data, accuracy and precision, recording of data. Tabular and diagrammatic presentation – arrays, frequency distribution, bar diagrams, histograms and frequency polygons.</li> <li>3. <b>Descriptive statistics:</b> measures of central tendency, dispersion, skewness and kurtosis</li> <li>4. <b>Probability:</b> definition, elementary properties, types, rules, applications to biological problems, distributions – Binomial, Poisson, Normal, chi-square (<math>\chi^2</math>) distribution and test.</li> <li>5. <b>Sampling methods:</b> principles of sampling, necessity – merits and demerits, random sampling – lottery, geographical arrangement random number; deliberate or non-random sampling, stratified sampling, cluster sampling</li> </ol>	15
II	<ol style="list-style-type: none"> <li>1. <b>Inference about populations:</b> sample size, sampling distribution, standard error, estimation of population mean - confidence interval, Student's <i>t</i>- distribution and its applications (<i>t</i>- test).</li> <li>2. <b>Hypothesis testing:</b> definition of hypothesis, hypotheses - null and alternate hypotheses, general procedure, decision about H<sub>0</sub>: – one-tailed and two-tailed tests, type I and type II errors</li> <li>3. <b>Analysis of Variance (ANOVA):</b> basic concepts, experimental designs – CRD, RBD, factorial experiment, repeated measures, other designs, general method, F – test, multiple comparison tests.</li> <li>4. <b>Correlation:</b> introduction, types, methods of study – scatter diagram, correlation graph, Karl Pearson's coefficient of correlation and its interpretation, test of significance.</li> </ol>	15

	5. <b>Regression:</b> introduction, simple linear regression - model, equation, least-squares line, evaluating and using the equation, multiple regression – model, obtaining, evaluating and using the multiple regression equation.	
III	<b>Bioinformatics</b> 1. <b>Basic concepts of Bioinformatics:</b> Definition, Role of bioinformatics in life science, Importance, Analytical approach, and Applications 2. <b>Biological Sequence Databases:</b> Sequence database, Nucleotide sequence database, Protein Sequence Database, Medical Databases, Genbank, Swiss port, structure database and motif database. 3. <b>Bioinformatics tools and applications:</b> a. <b>Tools in Bioinformatics:</b> Pairwise alignment, Scoring Matrices, PAM Matrices, Blosum Matrices, Nucleotide Scoring Matrices, Gaps and Gap Penalties, Alignment algorithm (BLAST and FASTA) and EMBOSS. b. <b>Protein Structure Prediction:</b> Secondary structure prediction, tertiary structure prediction, comparative modeling, RASMOL, and protein function prediction 4. <b>Emerging areas in Bioinformatics:</b> DNA microarrays, Metabolomics, Pharmacogenomics, and Human genome project	15
IV	<b>Quantitative methods in pharmaceutical and food</b> 1. <b>Bioburden determination: Introduction;</b> Total Microbial Count, Traditional counting Methods, Detection of objectionable organisms, Non-sterile products and microbial limit testing; 2. <b>In process material bioburden assessment;</b> Microbiological analysis of raw materials and finished products-Microbial count limit for finished products. 3. <b>Probability and kinetic models for food processing and HACCP</b> a. Probability of growth models b. Growth kinetic models 4. <b>Thermal Inactivation</b>	15

#### References:

1. Biostatistics A foundation for Analysis in the Health Sciences, by Wayne Daniel (7<sup>th</sup> Ed) Wiley- India edition
2. Biostatistics by N. Gurumani MJP Publishers

3. Statistical Methods for the Analysis of Repeated Measurements by C. S. Davis
3. Statistical Method in Biological Assays by D. J. Finney
4. Statistical Methods for Rates and Proportions by Fleiss, Joseph L., Levin Bruce and Paik Myunghee Cho
5. Fundamentals of Biostatistics (2nd Ed) Irfan Ali Khan and Atiya Khanum, Ukaaz Publications, Hyderabad.
6. Design and analysis of experiments by D.C. Montgomery, John Wiley & Sons.
7. Sampling methods by M.N. Murthy, Indian Statistical Institute, Kolkata.
8. Baxevanis, A. D., Bader, G. D., & Wishart, D. S. (Eds.). (2020). Bioinformatics. John Wiley & Sons.
9. Higgins, D., & Taylor, W. (Eds.). (2000). Bioinformatics: Sequence, Structure and Databanks: A Practical Approach (Vol. 236). OUP Oxford.
10. Murthy, C. S. V. Bioinformatics, Himalaya Publication House
11. Baxevanis, A. D., and Ouellette B. F. F Bioinformatics, A Practical Guide to the analysis of Genes and proteins.
12. Westhead D. R., Parish J. H., and Twyman R. M. Instant Notes of Bioinformatics
13. Geoff Hanlon and Norman Hodges- Essential Microbiology for Pharmacy and Pharmaceutical Science, John Wiley & Sons, Ltd.
14. Tim Sandle – Pharmaceutical Microbiology- Essentials for Quality Assurance and Quality Control, Woodhead Publishing publications, Elsevier.
15. Quantitative Microbiology in Food Processing Modeling the Microbial Ecology Edited by Anderson de Souza Sant'Ana Department of Food Science, University of Campinas, Brazil

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Semester III		
Credit	MMT 302: Medical Microbiology and Virology Core Compulsory Theory Paper <b>Total: 4 Credits; Workload: -15 hrs /credit</b> <b>(Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)</b> Course Outcomes: At the end of this course the students will be able to:	Lectures (Hours)
I	<ol style="list-style-type: none"> <li>1. Understand the new ways of microbial colonization during development of diseases.</li> <li>2. Learn the measurement of infectivity and virulence</li> <li>3. Understand the role of exotoxins in disease development and cosmetic uses of exotoxins</li> <li>4. Will know about emerging viral diseases and fungal diseases</li> </ol>	15
	<ol style="list-style-type: none"> <li>1. Emerging and Reemerging Infectious diseases: Types ( New-New diseases, New-old diseases, Old-new diseases, Old-old diseases)</li> <li>2. Modern medicine as a source of New diseases</li> <li>3. Microbiota shift diseases</li> <li>4. Germ warfare</li> <li>5. Concept of 'Opportunist' and 'Continuum' in the development of diseases.</li> <li>6. Measuring Infectivity and Virulence:               <ol style="list-style-type: none"> <li>i) Animal Models:                   <ul style="list-style-type: none"> <li>• Human volunteers</li> <li>• Non human animal models</li> </ul> </li> </ol> </li> </ol>	

	<ul style="list-style-type: none"> <li>• ID50 and LD50</li> <li>• Tissue culture models</li> <li>• Organ culture models</li> </ul>	
<b>II</b>	<ol style="list-style-type: none"> <li>1. Colonization and Invasion of bacteria in host surfaces: <ul style="list-style-type: none"> <li>• Penetrating Intact skin</li> <li>• Penetrating Mucin layer</li> <li>• Resisting Antibacterial peptides</li> <li>• Adherence (Role of Adherence, pili and fimbriae, signal transduction, adhesins of Gram positive bacteria, Afimbrial adhesins)</li> <li>• SIgA Proteases</li> <li>• Iron Acquisition mechanisms</li> </ul> </li> <li>2. Common means of colonization of respiratory viruses</li> </ol>	<b>15</b>
<b>III</b>	<ol style="list-style-type: none"> <li>1. Bacterial Exotoxins: <ul style="list-style-type: none"> <li>• Characteristics and Nomenclature</li> <li>• Exotoxin structure and Functions ( A-B / Type III Toxins, Membrane disrupting/ Type II Toxins, Superantigens /Type I Toxins)</li> <li>• Secretion and Excretion of Exotoxins</li> </ul> </li> <li>2. Exotoxin Induced Diseases <ul style="list-style-type: none"> <li>• Diphtheria</li> <li>• Tetanus</li> <li>• Botulism</li> <li>• Medical and cosmetic uses of bacterial exotoxins</li> </ul> </li> </ol>	<b>15</b>
<b>IV</b>	<ol style="list-style-type: none"> <li>1. Emerging viruses challenging health management in India: <ul style="list-style-type: none"> <li>• SARS-Cov-2</li> <li>• Nipah</li> <li>• Zika</li> <li>• Kyasanur Forest Disease <b>Virus</b> (KFDV)</li> <li>• Adeno virus</li> </ul> </li> <li>2. Fungal Diseases: Etiology, Clinical features, Pathogenesis, Laboratory diagnosis, Prevention and Control of, <ul style="list-style-type: none"> <li>• Superficial Mycosis: Pityriasis</li> <li>• Subcutaneous Mycoses : Mycetoma</li> <li>• Systemic Mycoses: Mucormycosis</li> </ul> </li> </ol>	<b>15</b>

### References:

1. Bacterial Pathogenesis A Molecular Approach Part 2, Abigail A. Salyers and Dixie D. Whitt ( Unit I , II. III)
2. Clinical Virology Editors Douglas D Richman, Richard J. Whitley, Fredrick G. Hayden, ASM Press, Washington DC
3. Medical Microbiology, 13th Edition by E. Jawetz, J. L. Melnick, E. A. Adelberg (Unit III and IV)
4. Medical Microbiology, 6th Edition by S. Gupte, Jaypee Brothers Publications (Unit III and IV)
5. Medical Microbiology, by W. Irving, T. Boswell and D. Aladeen (Unit III and IV)

6. Medical Microbiology, by R. Cruickshank, J. P. Duguid, B. P. Marmion, R. H. A. Swain (Unit III and IV)
7. The Textbook of Microbiology, by R. C. Dubey and D. K. Maheshwari (Unit III and IV)
8. Text book of Microbiology by R. Vasanthkumari (Unit III and IV)
9. Medical Microbiology by S. Rajan MJP Publishers (Unit III and IV)

**MET 303 A: Bioethics, Biosafety, Quality control in Microbiology**

<b>Semester III</b>		
<b>Credit</b>	<b>MET 303 A: Bioethics, Biosafety, Quality control in Microbiology</b>	<b>Lectures (Hours)</b>
	<p><b>Total: 4 Credits; Workload: -15 hrs /credit</b>  <b>(Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)</b></p> <p><b>Course Outcomes:</b>  <b>At the end of this course the students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Understand bioethics in microbiology</li> <li>2. Ensure and follow good microbiological practices</li> <li>3. Maintain biological safety in the laboratory</li> <li>4. Understand role of microbiologist in pharmaceutical industry</li> </ol>	
<b>I</b>	<p><b>Bioethics</b></p> <ol style="list-style-type: none"> <li>1. Introduction, definitions and history</li> <li>2. Ethical issues in microbiology – Introduction, Guidelines/codes of ethics</li> <li>3. Bioethics and microbiology, biowar or bioterrorism, biological weapons.</li> <li>4. Ethics in drug discovery and development - laboratory studies and location of clinical trials, timing of ethics</li> <li>5. Special ethical topics in drug discovery and development – laboratory animal, clinical studies in special risk groups, surrogate markers, pharmmacogenomics, research using human cells.</li> <li>6. Ethical aspects in Pharmaceutical clinical trials – History, informed consent, ethics committees</li> </ol>	<b>15</b>
<b>II</b>	<p><b>Good microbiological laboratory techniques –</b></p> <ol style="list-style-type: none"> <li>1. Safe handling of specimens in the laboratory; Use of pipettes; Avoiding the dispersal of infectious materials; Use of biological safety cabinets; Avoiding ingestion of infectious materials and contact with skin and eyes; Opening of ampoules containing lyophilized infectious materials; Storage of ampoules containing infectious materials; Standard precautions with blood and other body fluids, tissues and excreta;</li> <li>2. Contingency plans and Emergency procedures for microbiological laboratories.</li> </ol>	<b>15</b>
<b>III</b>	<p><b>Microbiological risk assessment</b></p> <ol style="list-style-type: none"> <li>1. Biological safety cabinets - Class I biological safety cabinet; Class II biological safety cabinets; Class III biological safety cabinet; Biological safety cabinet air connection;</li> <li>2. Selection of a biological safety cabinet;</li> <li>3. Using biological safety cabinets in the laboratory.</li> <li>4. Safety equipment - Negative-pressure flexible-film isolators; Pipetting aids; Homogenizers, shakers, blenders and sonicators;</li> </ol>	<b>15</b>



	Disposable transfer loops; Micro incinerators; Personal protective equipment and clothing.	
<b>IV</b>	<b>Quality Management Systems in Pharmaceutical Manufacturing</b> <ol style="list-style-type: none"> <li>1. Introduction;Pharmaceutical Quality System;</li> <li>2. Good Manufacturing procedures – Specifications, Batch Manufacturing records, Standard Operating Procedures;</li> <li>3. Validation- validation master plan, Qualifications and its types, GMP Inspections;</li> <li>4. Hazard Analysis and Critical ControlPoint (HACCP) - Definition, Principles and Guidelines for application of HACCP principles.</li> <li>5. Auditing the microbiology laboratory- Introduction; Record keeping – Batch Manufacturing Record; Quality audits; Auditors and the audit process; Auditing the microbiology laboratory</li> </ol>	<b>15</b>

### References:

1. Sam Salek and Andrew Edgar – Pharmaceutical ethics; 2002 John Wiley & Sons, Ltd. ISBNs: 0-471-49057-1 (Hardback); 0-470-85582-7 (Electronic)
2. Ethical issues in microbiology by P Desikan, A Chakrabarti, V Muthuswamy *Indian Journal of Medical Microbiology*, (2011) 29(4): 327-30
3. <https://www.britannica.com/topic/bioethics#ref251763>
4. Anaya-Velázquez F. Bioethics, bioweapons and the microbiologist. *Rev Latinoam Microbiol.* 2002 Jan-Mar; 44(1):38-45. PMID: 17061514.
5. Geoff Hanlon and Norman Hodges - Essential Microbiology for Pharmacy and Pharmaceutical Science, John Wiley & Sons, Ltd.
6. Tim Sandle - Pharmaceutical Microbiology - Essentials for Quality Assurance and QualityControl, Woodhead Publishing publications, Elsevier.
7. Laboratory biosafety manual. – 3rd ed. WHO Library Cataloguing-in-Publication Data ISBN9241546506.
8. Environmental Monitoring for cleanrooms and Controlled environments by Anne MarieDixon, Informa Healthcare Newyork, London, ISBN 13;978-0-8247-2359-0.
9. Cleanroom Microbiology for the non-Microbiologists, Second Ed, by Devid M. Carlberg,CRC Press,USA.

### MET 303 B: Bioinformatics, Biostatistics and Bionanotechnology

	<b>Semester III</b>	
<b>Credit</b>	<b>Total: 4 Credits; Workload: -15 hrs /credit</b> <b>(Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)</b>  <b>Course Outcomes:</b> <b>At the end of this course the students will be able to:</b> <ol style="list-style-type: none"> <li>1. Learn basic tools of the bioinformatics</li> <li>2. Implement statistical approaches in microbiological experiments</li> <li>3. Understand applications of nanotechnology in life sciences</li> <li>4. Familiar with analytical tools and their applications.</li> </ol>	<b>Lectures (Hours)</b>
<b>I</b>	<b>Bioinformatics</b> <ol style="list-style-type: none"> <li>1. <b>Definition and components</b>, databases – definition, biological databases, types and examples, database management systems (DBMS)</li> <li>2. Applications of bioinformatics –</li> </ol>	15

	<ol style="list-style-type: none"> <li><b>Data visualisation</b> – sequence and structure of nucleic acids and proteins, data visualisation tools.</li> <li><b>Pattern matching and sequence alignment of nucleic acids and proteins</b> – fundamental principles of pairwise sequence alignment, local and global alignment, multiple sequence alignment, sequence alignment tools and databases.</li> <li><b>Modeling and Simulation</b> – components and process of modeling and simulation, algorithms – Monte Carlo, Metropolis, methods and tools used for proteins structure (secondary, motifs and domains).</li> <li><b>Phylogenetic analysis:</b> basic principles and methods of preparation of phylogenetic trees.</li> <li><b>Drug discovery and development:</b> fundamental principles, rational drug design, chemoinformatics and pharmainformatics resources, pharmacogenomics</li> </ol>	
II	<p><b>Biostatistics</b>  <b>Basic concepts:</b> definitions – statistics and biostatistics, population, sample, variable and the various types, statistic and parameter</p> <p><b>Demography</b></p> <ol style="list-style-type: none"> <li>Definition, Census, Vital statistics</li> <li>Population projection,</li> <li>Population growth and Estimation</li> <li>Vital statistics rate</li> </ol>	15
III	<p><b>Bionanotechnology</b></p> <ol style="list-style-type: none"> <li><b>Nanotechnology:</b> Basic concepts, definition, Historical background</li> <li><b>Synthesis methods:</b> Top-Down and Bottom-Up Approach- Physical, chemical and biological synthesis methods,</li> <li><b>Nanobiotechnology-</b> Introduction, Green synthesis- Microbial synthesis (Bacteria, Fungi, Algae, Virus)</li> <li><b>Analysis of Nanomaterials:</b> Methods and characterization techniques-UV-Visible spectroscopy, FT-IR Spectroscopy, X-ray Crystallography, Dynamic Light Scattering (DLS) spectroscopy, Zeta potential spectroscopy, Energy Dispersive X-Ray Analysis (EDAX), Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), Scanning Tunneling Microscope (STM), Atomic Force Microscope (AFM)</li> </ol>	15
IV	<p><b>Bionanotechnology</b></p> <ol style="list-style-type: none"> <li>Agricultural Applications: Nanopesticides, Nanofertilizers, Stress nanosensor</li> <li>Bio-remedial Applications: Adsorption and Degradation of dyes, organic compounds, Pesticides, Heavy metal removal</li> <li>Healthcare Application: Diagnosis, Drug design and Drug Delivery, Gene Delivery Antimicrobial and Wound Healing Activity, Antitumor and Anticancer, Bioimaging,</li> <li>Toxicity: Toxicity towards Human, Plant and Environment</li> <li>Challenges for Bionanotechnology: Medicine, Food, Environment</li> </ol>	15

**References:****BIOSTATISTICS**

1. Biostatistics A foundation for Analysis in the Health Sciences, by Wayne
2. Daniel (7<sup>th</sup> Ed) Wiley- India edition
3. Biostatistics by N. Gurumani MJP Publishers
4. Statistical Methods for the Analysis of Repeated Measurements by C. S.Davis

**BIOINFORMATICS**

1. Bioinformatics: A Beginner's Guide by Jean-Michel Claverie and C. Notredame (2003), Wiley Dreamtech India (P) Ltd., New Delhi – 110 002
2. Elementary Bioinformatics by I. A. Khan (2005), Pharma Book Syndicate, Hyderabad
3. Bioinformatics Computing by B. Bergeron (2003), Prentice-Hall of India Private Limited, New Delhi – 110 001
4. Bioinformatics (Instant Notes Series) by D. R. Westhead, J. H. Parish and R. M. Twyman (2003), Viva Books Private Limited, New Delhi, Mumbai, Chennai, Kolkata

**BIONANOTECHNOLOGY**

1. Green Nanoparticles: The Future of Nanobiotechnology, edited by Shilpi Srivastava, Atul Bhargava, Springer Nature Singapore Pte Ltd., ISBN 978-981-16-7106-7.
2. Woodhead Publishing Series in Food Science- Technology, and Nutrition Agricultural Nanobiotechnology Biogenic Nanoparticles, Nanofertilizers, and Nanoscale Biocontrol Agents, edited by Sougata Ghosh, Sirikanjana Thongmee, Ajay Kumar, Elsevier Inc., ISBN- 978-0-323-99936-6.
3. Pan Stanford Series on Nanobiotechnology—Vol. 1 Nanobiotechnology and Nanobiosciences by Cludio Nicolini, World Scientific Publishing Co. Pte. Ltd, Singapore, ISBN-10 981-4241-38-5.
4. Nanoparticle Technology Handbook— Third Edition, edited By Makio Naito, Toyokazu Yokoyama, Kouhei Hosokawa Kiyoshi Nogi, Elsevier Inc., ISBN: 978-0-444-64110-6.

**MET 303 C: Agricultural Microbiology**

	<b>Semester III</b>	
<b>Credit</b>	Total: 4 Credits; Workload: -15 hrs /credit (Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)  <b>Course Outcomes:</b> At the end of this course the students will be able to: 1. Conduct different practicals of agricultural microbiology 2. Estimate different pesticide residues from the soil 3. Learn details about PGPR 4. Understand the bioremediation of soil	<b>Lectures (Hours)</b>
<b>I</b>	<b>Cell Structure and Functions:</b> 1. Prokaryotic and Eucaryotic cell architecture - cell wall, plasma membrane, structure and functions of cell organelles, vacuoles, mitochondria, plastids, golgi apparatus, ER, peroxisomes, glyoxysomes. 2. Cell division: regulation of cell cycle, protein secretion and targeting. 3. Cell growth and differentiation.	<b>15</b>
<b>II</b>	<b>Microbial Ecology and elemental cycles</b> 1. The soil environment, Bacteria, Actinomycetes, Fungi, Algae, Protozoa, Viruses.	<b>15</b>

	2. Details of the <b>Carbon Cycle</b> : Some aspects of Microbial Physiology, Organic matter decomposition, Microbiology of cellulose, hemicelluloses, Lignin decomposition, Microbiology of other polysaccharides, Transformation of Hydrocarbons and pesticides. 3. <b>The nitrogen cycle</b> : Mineralization and immobilization of Nitrogen, Nitrification, Denitrification, Nitrogen fixation: symbiotic, non-symbiotic, 4. Phosphorous cycle, 5. Potassium cycle	
<b>III</b>	<b>Microbial Products influencing plant growth</b> 1. Indole acetic acid, Gibberellins, Cytokinins, Ethylene, Antibiotics, Mechanism of Antibiotic Action, Resistance, 2. Aflatoxin, Toxins in Plant diseases, Bacterial and fungal insecticides, Viral insecticides, 3. Microbial herbicides 4. Biological control of plant diseases	<b>15</b>
<b>IV</b>	<b>Biodegradation of Pesticides and Pollutants</b> 1. <b>Insecticides</b> : DDT, BHC, Lindane, Aldrin, Dieldrin, Heptachlor, Chlordane, etc., Malathion, Parathion, Diazinon. 2. <b>Herbicides</b> : 2, 4-D,,Simazine and Atrazine, Linuron, TCA Dalapon, Chloropham, Dicamba, Dichlobenil (Casoron), Bromoxynil (Brominal), Bentazon, Diquat and Paraquat. 3. <b>Fungicides</b> :Thiram, Maneb, Ferbam, Nabam and Zineb PCP, PCNB, Chloroneb, etc.nCaptan, Carboxin and Oxycarboxin, Benomyl (Benlate), Streptomycin, Cycloheximide, Blastidicid-S, Terramycin. 4. Fate of Pesticides in Soil (Biodegradation) 5. Bioavailability of Pesticides/ Pollutants, Acceleration of Biodegradation 6. Bioremediation	<b>15</b>

### References:

1. Introduction to Soil Microbiology - Martin Alexander II 1961.
2. Soil Microbiology by N. S. Subba Rao, 2006
3. Soil Microorganisms and Plant growth by N. S. Subba Rao. 1995
4. Plant Biotechnology by Adrian Slater, Nigel Scott and Mark Fowler.2003.
5. Introduction to Plant Biotechnology by H. S. Chawla, 2004.
6. Agricultural Biotechnology by Prober Kanti Biswas, 2005.
7. Agricultural Applications of Microbiology by NeelimaRajvaidya and DilipkumarMarkandey 2009.
8. Techniques in Agricultural Microbiology by ThamizzhVendan, Pandiyarajan and Thangaraju, 2008.

### MMPR- 304 PRACTICAL COURSE-1

UNITS	Semester	CREDITS
	<b>Total credits = 04</b> <b>Course Outcomes:</b> <b>At the end of the practical course, students will be able to</b> <ol style="list-style-type: none"> <li>1. Use statistical methods in data analysis</li> <li>2. Learn basic practical skills in Bioinformatics</li> <li>3. Learn basic practical skills in medical microbiology</li> </ol>	
<b>I</b>	<ol style="list-style-type: none"> <li>1. Representation of statistical data by Histogram and Pie diagram.</li> <li>2. Measures of central tendency – Mean, median and mode</li> <li>3. Determination of measure of dispersion - Mean deviation, Standard deviation and coefficient of variation.</li> <li>4. Tests of significance - Chi-square test, t-test</li> <li>5. Analysis of Variance (ANOVA) – CRD, RBD</li> </ol>	<b>1</b>
<b>II</b>	<ol style="list-style-type: none"> <li>1. Preparing tables and charts using MS Excel</li> <li>2. Preparing a PowerPoint presentation</li> <li>3. Retrieving protein and nucleic acid sequences from databases</li> <li>4. Prediction of protein structure using expasy server</li> <li>5. Visualization of 3D structure by using RASMOL</li> <li>6. Determine the microbial load (quantitative) in finished pharma or food product</li> </ol>	<b>1</b>
<b>III</b>	<ol style="list-style-type: none"> <li>1. Isolation of fungal pathogens from clinical sample</li> <li>2. Isolation of bacterial pathogens from clinical sample</li> <li>3. Determination of antibiotic sensitivity of bacterial pathogens isolated from clinical samples</li> <li>4. Demonstration of SARS – Cov-2 by rapid antigen test</li> </ol>	<b>1</b>
<b>IV</b>	<ol style="list-style-type: none"> <li>1. Isolation of siderophore producing microorganisms from body fluids</li> <li>2. Determination of susceptibility to dental caries by Snyder test</li> <li>3. Demonstration of bacterial exotoxins from clinical sample.</li> </ol>	<b>1</b>

### References:

1. Alberts. B.; Johnson. A, Lewis J. Raff, M. Roberts. K. and P. Walter (2002) Molecular Biology of the cell 4<sup>th</sup> Edition. Garland Science, Taylor & Francis Group.
2. Benjamin Cunnings publishing Co. Inc. 2<sup>nd</sup> Edition
3. Boyer. R. (2000) Modern Experimental Biochemistry. 3<sup>rd</sup> Edition. Pearson Education Asia.
4. Cruse J and R. Lewis (2004) Atlas of Immunology 2<sup>nd</sup> Edn. CRC Press
5. Elliott. W.H. and D.C. Elliot (2001) Biochemistry and molecular Biology. 2<sup>nd</sup> Edn. Oxford University Press.
6. Hand book of experimental immunology Vol. I by PM. Weinor (editor) 1978. Black Well scientific publications.
7. Jayraman – Laboratory manual in Biochemistry, New Age International. Publishers, New Delhi
8. Mathews C.K. and K.E. Van Holde (1996) Biochemistry. The Benjamin Cunnings publishing Co. Inc. 2<sup>nd</sup> Edition
9. Plummer D.T, (1992) An introduction to Practical Biochemistry Tata cGraw Hill Publisher, New Delhi
10. Reed, R; Homes, D; Weyers, J. and A. Jones. Practical skills in Biomelecular Sciences. Addison Wesley Longman Limited.

### MEPR- 305 PRACTICAL COURSE-II

UNITS	Semester	CREDITS
	<b>Total credits = 02</b> <b>Course Outcomes:</b> <b>At the end of this course the students will be able to:</b> <ol style="list-style-type: none"> <li>1. Use basic softwares for bacterial systematics</li> <li>2. Cultivate extremophiles.</li> <li>3. Conduct experiment for detection of pollution strength.</li> </ol>	
<b>I</b>	<ol style="list-style-type: none"> <li>1. Retrieving protein and nucleic acid sequences from databases</li> <li>2. Single and multiple Sequence alignment using BLAST</li> <li>3. Study of GenBank genomic entries</li> <li>4. Preparation of SOP for Laboratory instruments – hot air oven, incubator, pH Meter and autoclave</li> <li>5. Preparation of HACCP flow chart</li> </ol>	<b>1</b>
<b>II</b>	<ol style="list-style-type: none"> <li>1. Determination of MIC of pesticide against soil microflora</li> <li>2. Isolation and screening of plant growth promoting rhizobacteria</li> <li>3. Estimation of Nitrogen from biomass of Nitrogen fixing bacteria isolated from soil by Kjeldahl method</li> <li>4. Isolation and characterization of <i>Bacillus thuringiensis</i> from soil by using selective medium.</li> </ol>	<b>1</b>

#### References:

1. Bioinformatics: A Beginner's Guide by Jean-Michel Claverie and C. Notredame (2003), WileyDreamtech India (P) Ltd., New Delhi – 110 002
2. Bioinformatics: A practical guide to the analysis of genes and proteins (2<sup>nd</sup> Ed) by A. D. Baxevanis and B. F. F. Ouellette (2001), John Wiley & Sons, New York.
3. Operate Computers yourself Part – 2 by D. S. Minhas and G. Minhas, Dreamland Publications, j-128, Kirti Nagar, New Delhi – 110 015
4. Agricultural Applications of Microbiology by Neelima Rajvaidya and Dilipkumar Markandey 2009.
5. Techniques in Agricultural Microbiology by Thamizh Vendan, Pandiyarajan and Thangaraju, 2008

## Semester IV

Semester IV		
Credit	MMT 401: Food and Dairy Microbiology	Lectures (Hours)
	<p><b>Total: 4 Credits; Workload: -15 hrs /credit</b>  <b>(Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)</b></p> <p><b>Course Outcomes:</b>  <b>At the end of this course the students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Understand different methods of food preservation</li> <li>2. Learn different food borne diseases</li> <li>3. Acquire knowledge about probiotic and different food safety and standards</li> <li>4. Commercial values of fermented foods.</li> </ol>	
<b>I</b>	<ol style="list-style-type: none"> <li>1. Food as a substrate for Microorganisms</li> <li>2. General principles underlying microbial spoilage of food</li> <li>3. Microbial spoilage of meat, fruits and vegetables</li> <li>4. Microbial spoilage of heated canned food</li> <li>5. General principles of Preservation of food: Asepsis, Removal of microorganisms, killing of microorganisms, reducing the growth rate of microorganisms</li> <li>6. Methods of food preservation: Thermal processing, cold preservation, Preservation by using chemical preservatives, Food dehydration, Preservation by using Irradiation, Canning of food</li> </ol>	<b>15</b>
<b>II</b>	<ol style="list-style-type: none"> <li>1. Milk: Definition, composition, Factors affecting composition, Nutritive value of milk</li> <li>2. Spoilage of milk and milk products:               <ol style="list-style-type: none"> <li>a. Milk as a substrate for microorganisms</li> <li>b. Microbial contamination of milk - sources of contamination, types of microorganisms present in milk</li> <li>c. Biochemical activities during microbial spoilage of milk</li> </ol> </li> <li>3. Fermented foods: Microbiology and biochemistry of               <ol style="list-style-type: none"> <li>a. Fermented cereal foods: Amboli, Jalebi</li> <li>b. Fermented cereal legume foods: Idli, Dhokla</li> <li>c. Fermented vegetable products: Sauerkraut, Pickles</li> </ol> </li> <li>4. Fermented milk products: Yoghurt, Cultured butter milk</li> </ol>	<b>15</b>
<b>III</b>	<ol style="list-style-type: none"> <li>1. Food born diseases:-Food born intoxications: Botulism and staphylococcal intoxication and Foodborne infections</li> <li>2. Prevention and control of food borne diseases</li> <li>3. Fermented dairy products and their role in controlling food borne diseases:               <ol style="list-style-type: none"> <li>a. Types of fermented dairy products, methods of preparation</li> <li>b. Therapeutic significance and their health properties - mode of action of lactic acid bacteria on enteric pathogens</li> <li>c. Fermented dairy products and their role in controlling gastro intestinal tract disorders</li> </ol> </li> </ol>	<b>15</b>
<b>IV</b>	<ol style="list-style-type: none"> <li>1. Probiotics: probiotic microbial strains, role of probiotics in gastrointestinal disorders, probiotics in reducing risks of cancer, immunogenic effects of probiotics</li> <li>2. Enzymes in food processing: Need of enzymes, sources of enzymes</li> <li>3. Applications of enzymes in: Production of high fructose syrup; Fruit</li> </ol>	<b>15</b>

	juice industry, Baking industry, Oils and fat processing 4. Food safety and standards: Food safety issues, Food adulteration, Contaminations with harmful microbes, Metallic contamination, Food Laws and standards, Industrial food safety Laws and standards, HACCP, Indian Food Laws and standards	
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## REFERENCE BOOKS

1. Food processing Biotechnological application (2000) by S. S. Marwaha & K. Arora, Asiatech Publishers INC, New Delhi
2. Food science, Fifth Edition, Norman N. Potter 1996, CBS publishers and distributors
3. The technology of food preservation, Fourth Edition, Norman W. Desrosier BI Publisher and Distributors, Delhi (1987)
4. Food Microbiology - Adams & Moss
5. Dairy Microbiology by Robinson
6. Outlines of Dairy technology by Sukumar De
7. Milk and Milk Products – Clarence
8. Food Science (5<sup>th</sup> ed) Norman N. Potter, Joseph N. Hotchkiss

Semester IV		
Credit	MMT 402: Molecular Biology Tools and Applications	Lectures (Hours)
	<p><b>Total: 4 Credits; Workload: -15 hrs /credit</b>  <b>(Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)</b></p> <p>Course Outcomes:  <b>At the end of this course the students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Understand Modern tools and techniques in molecular biology.</li> <li>2. Understand methods of cloning and its significance.</li> <li>3. Learn the role of Recombinant DNA technology in industries</li> </ol>	
<b>I</b>	<p><b>Basic tools of rDNA Technology</b></p> <ol style="list-style-type: none"> <li>1. Enzymes: restriction endonucleases, exonucleases – DNA and RNA; DNA polymerases, DNA ligases, alkaline phosphatase, terminal transferase, reverse transcriptase,</li> <li>2. Linkers and adaptors</li> <li>3. Cloning vehicles (vectors):  Desirable features of ideal cloning vehicles  Plasmids:- pUC, pBR322 and its derivatives, IncP-group,  Viral based:- <math>\lambda</math> phage – basic and derivative vectors, M13, f1, fd viruses, other viruses - addition, self- inactivating, helper-dependent and helper-independent  Cosmids, phasmids, phagemids  Specialist purpose vectors:- M13 based, expression, shuttle, gene inactivation, integrative, RNA probe and RNAi vectors, strong promoter vectors, purification tag vectors, protein solubilisation vectors, secretion vectors  Artificial chromosomes:- BAC, YAC, PAC</li> <li>4. Gene probes: development and labeling of DNA and RNA probes</li> </ol>	<b>15</b>
<b>II</b>	<p><b>Basic Cloning Strategies</b></p> <ol style="list-style-type: none"> <li>1. General principles: DNA fragmentation, ligation to vectors, introduction into the host cell, cell based and PCR based strategies</li> <li>2. Cloning in <i>Escherichia coli</i> and other bacteria:</li> </ol>	<b>15</b>



	<ol style="list-style-type: none"> <li>a. Construction of genomic libraries – Maniatis’ strategy, EMBL 3A vector strategy</li> <li>b. Construction of complementary DNA (cDNA) libraries – Maniatis’ hairpin-primed second-strand DNA synthesis, oligo-dC tail method, the Gubler-Hoffman method, direction cDNA cloning, plasmid-linked cDNA synthesis, CAPture method</li> <li>3. Screening of gene libraries: hybridization, PCR, Immunochemical, Protein-protein interactions, Protein-ligand interaction, functional complementation, gain of function</li> <li>4. Expression of foreign DNA in transformed bacteria</li> </ol>	
<b>III</b>	<p>Cloning in Eukaryotes</p> <ol style="list-style-type: none"> <li>1. Cloning in yeast and fungi: Vector systems: YE<sub>p</sub>, YC<sub>p</sub>, YAC, modular expression vector, yeast secretion vector (pGAP), introduction of DNA, selectable markers Heterologous protein production – source of DNA, level of heterologous RNA, amount of protein produced, nature of product</li> <li>2. Cloning in animals: Vectors systems: plasmid based vectors - pSV2-dhfr, pRSV-neo, virus based vectors - adenovirus, adeno-associated, baculovirus, herpes virus, retrovirus, Sindbis and Semliki forest disease virus, vaccinia and pox virus, EB virus Cloning in mammalian cell-lines: methods of DNA transfection – chemical, physical and biological (viral, bacterial) methods, choice of cell-lines, transient and stable expression Transgenesis of whole animals: microinjection of DNA in mice and other animals, Embryo stem cell technology, DNA construct, aberrant expression</li> <li>3. Cloning in Plants: Vectors systems: Ti plasmid of <i>Agrobacterium tumefaciens</i> and Ri plasmid of <i>Ag. Rhizogenes</i>, viruses – caulimovirus, geminivirus, BMV, TMV, PVX Cloning in Plants: <i>Agrobacterium</i>- mediated gene transfer, direct DNA transfer, gene targeting, <i>in planta</i> transformation</li> </ol>	<b>15</b>
<b>IV</b>	<p>Applications of rDNA Technology</p> <ol style="list-style-type: none"> <li>1. Production of useful molecules in bacteria, plants and animals</li> <li>2. Improvement of agronomic traits in plants</li> <li>3. Study, prevention and cure of diseases</li> <li>4. Genetically modified foods Protein engineering and its applications</li> </ol>	<b>15</b>

## References

1. Principles of Gene Manipulation and Genomics by S. B. Primrose and R. M. Twyman, Blackwell Publishing, Oxford, UK
2. Molecular Biology and Biotechnology (4<sup>th</sup> Ed) by J. M. Walker and R. Rapley, Panima Publishing Corporation, New Delhi
3. Recombinant DNA by J. D. Watson and others
4. Genetic Engineering by Chakravarty, CRC Publications
5. Genetic Engineering by Sandhya Mitra
6. Molecular Cloning (Volumes 1, 2, 3) by Sambrook and Russell. Cold Spring Harbor Laboratory Press International Edition
7. Principles of Genetics by E. J. Gardner. John Wiley and Sons, New York
8. Maximizing Gene Expression by W. Reznikoff and L. Gold, Butterworths Biotechnology Series
9. Yeast Genetic Engineering by P. J. Barr and others, Butterworths Biotechnology Series

### MET 403 A: Industrial Waste Management

Semester IV		
Credit	MET 403 A : Industrial Waste Management	Lectures (Hours)
	<p><b>Total: 4 Credits; Workload: -15 hrs /credit</b>  <b>(Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)</b></p> <p>Course Outcomes:  <b>At the end of this course the students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Characterize industrial effluents and their adverse effects on environment</li> <li>2. Learn the role of microorganisms in treatment of industrial waste</li> <li>3. Know about the rules and regulations of waste disposal</li> </ol>	
<b>I</b>	<ol style="list-style-type: none"> <li>1. Types and Characterization of industrial wastes:               <ol style="list-style-type: none"> <li>a. Types of industrial wastes</li> <li>b. General characteristics of different industrial wastes, pH, suspended solids, volatile solids, COD, BOD and organic carbon</li> </ol> </li> <li>2. Effects of industrial wastes on aquatic life- Effects of industrial wastes of high BOD, effects of waste with toxicants</li> <li>3. Self purification in natural waters: Introduction, physical process, chemical process, biological process</li> </ol>	<b>15</b>
<b>II</b>	<ol style="list-style-type: none"> <li>1. Introduction to Microbiology and biochemistry of wastewater treatment.</li> <li>2. cell physiology and important microorganisms – important microorganisms, role of enzymes, principles of growth, plasmid borne metabolic activities; Impact of pollutants on biotreatment</li> <li>3. Methods of industrial waste treatment: Part-I:- Physico-chemical Methods - neutralization, oxidation of cyanides, Chromium reduction, reverse osmosis, carbon adsorption, destruction of phenolic compounds</li> </ol>	<b>15</b>
<b>III</b>	<ol style="list-style-type: none"> <li>1. Methods of industrial waste treatment: Part-II:-                Biological methods – I –                Activated sludge process- Process, microbiology, sludge bulking                Trickling filters- Process, Microbiology and applications</li> <li>2. Methods of industrial waste treatment: Part-III:-                Biological methods – II                Lagooning- Aerobic and anaerobic, applications                Anaerobic digestion- Process, microbiology of bio-gas formation, applications</li> </ol>	<b>15</b>
<b>IV</b>	<ol style="list-style-type: none"> <li>1. Biomangement of industrial waste: technological options for treatment of liquid and solid wastes – bioaugmentation, packaged microorganisms, use of genetically engineered microorganisms in wastewater treatment</li> <li>2. Industrial waste treatment: methods of treatment of wastes from Dairies, Distilleries, paper and pulp industries, fertilizer industries and Pharmaceutical industries.</li> <li>3. Zero waste discharge concept in industries.</li> <li>4. Waste disposal control and regulations: Water pollution control, Regulation and limits for disposal into lakes, rivers, oceans and land</li> </ol>	<b>15</b>

## References

1. Industrial Pollution Control Vol. - I by E. J. Middlebrooks
2. The treatment of industrial wastes. (2nd ed) by E. B. Besselièvre and M. Schwartz
3. Environmental Biotechnology (Industrial pollution management) by S. N. Jogdand, Himalaya Publishing House
4. Water and water pollution Handbook Vol. – I by Leonard L. Ciaccio
5. Wastewater Treatment by M.N. Rao and A. K. Datta
6. Industrial Pollution by N. L. Sax. Van Nostrand Reinhold Company
7. Encyclopaedia of Environmental Science and Technology Vol. – II by Ram Kumar
8. Water Pollution Microbiology by R. Mitchell
9. Handbook of Water Resources and Pollution Control by H.W. Gehm and J. I. Bregman
11. Environmental Microbiology by P. D. Sharma, Narosa Publishing House, New Delhi

## MET 403 B : Enzymology and Enzyme Technology

Semester IV		
Credit	MET 403 B : Enzymology and Enzyme Technology	Lectures (Hours)
	<p>Total: 4 Credits; Workload: -15 hrs /credit (Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)</p> <p>Course Outcomes: <b>At the end of this course the students will be able to:</b></p> <ol style="list-style-type: none"> <li>1. Learn basic concept of enzymology</li> <li>2. Understand kinetics of enzyme catalyzed reaction</li> <li>3. Know about industrial applications of enzyme</li> </ol>	
<b>I</b>	<ol style="list-style-type: none"> <li>1. History and special properties of enzymes as catalysts</li> <li>2. IUB system of nomenclature and classification of enzymes</li> <li>3. Specificity of enzymes: <ol style="list-style-type: none"> <li>a. Types:- substrate and product, group or relative, absolute – stereochemical and spatial specificity</li> <li>b. Theories to explain specificity – Lock and Key and Induced Fit hypotheses</li> </ol> </li> <li>4. Structure of enzymes: monomeric and oligomeric enzymes, Ogsten's experiment and the concept of the Active Site</li> <li>5. Methods employed to identify functional groups in the active site – trapping of the intermediate, use of substrate analogues, modification of amino acid side chains, some common functional groups and amino acids, chemistry of the active site</li> <li>6. Co-factors in enzyme action: <ol style="list-style-type: none"> <li>a. Organic – prosthetic groups, coenzymes and cosubstrates</li> <li>b. Inorganic – metal ions in enzyme function, metal activated enzymes and metallo-enzymes, ternary complexes</li> </ol> </li> </ol>	<b>15</b>
<b>II</b>	<ol style="list-style-type: none"> <li>1. Kinetics of single-substrate enzyme catalysed reactions - Wilhelmy's and Brown's work, Henri and Michaelis-Menten relationships, Briggs and Haldane assumption and derivation, Lineweaver- Burk, Eadie-Hofstee, Hanes and Eisenthal and Cornish-Bowden modifications of the M-M equation to derive KM, Significance of the M-M equation and KM</li> <li>2. Kinetics of multisubstrate reactions</li> <li>3. Haldane's relationship for reversible reactions</li> <li>4. Sigmoid kinetics – Hill and Adair equations for cooperativity</li> <li>5. Enzyme inhibition: basic concepts, kinetics, examples</li> </ol>	<b>15</b>

	and significance of reversible and irreversible inhibition	
<b>III</b>	<ol style="list-style-type: none"> <li>1. Covalent modification of enzyme structure – irreversible and reversible modification</li> <li>2. Ligand induced conformational changes – basic concepts of allosterism and allosteric enzymes, models proposed to explain the mechanism of functioning (MWC and KNF); structural aspects of aspartate carbamoyltransferase, role of allosteric enzymes in metabolic regulation – feedback inhibition</li> <li>3. Multienzyme systems – basic concepts, types with examples, structural and functional aspects of pyruvate dehydrogenase, fatty acid synthetase, ‘Arom’ complex and tryptophan synthetase</li> <li>4. Membrane bound enzymes in metabolic regulation</li> <li>5. Isoenzymes – basic concepts, method of detection, examples and their metabolic significance</li> </ol>	<b>15</b>
<b>IV</b>	<ol style="list-style-type: none"> <li>1. Applications of enzymes in medicine:               <ol style="list-style-type: none"> <li>a. In diagnosis – general principles and use of alanine amino transferase, aspartate amino transferase, lactate dehydrogenase, creatine kinase, acid and alkaline phosphatase</li> <li>b. In therapy – specific applications of few selected enzymes, prodrug activation with examples, enzyme replacement therapy</li> </ol> </li> <li>2. Industrial applications of enzymes – catalysts in the manufacturing and other conversion processes</li> <li>3. Enzymes as analytical tools</li> <li>4. Immobilisation of enzymes: basic concepts, methods used, properties of IME and their applications in industry, medicine, enzyme electrodes</li> <li>5. Newer approaches to the application of enzymes – reactions in organic solvents</li> </ol>	<b>15</b>

### REFERENCE BOOKS

1. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry by T. Palmer Affiliated East West Press Pvt. Ltd. New Delhi
2. Fundamentals of Enzymology – N. C. Price and L. Stevens, Oxford University Press
3. Nature of Enzymology – R. L. Foster, Croom Helm Applied Biology Series, London
4. Enzyme Technology – Pandey, Webb, Soccol and Larroche. Asiatech Publishers, INC New Delhi
5. Enzyme Nomenclature by IUBMB Academic Press Inc.
6. Enzyme structure and function – A. Fuerst, Freeman, USA

7. Immobilised Enzymes – M. D. Trevan
8. Enzymes – Boyer, Academic Press
9. Advances in Enzymology – Series edited by N. O. Kaplan, Academic Press
10. Enzyme Biotechnology by G. Tripathi, Technoscience Publications
11. Enzyme Reaction Engineering by T. P. Jayadev Reddy, Biotech Books, Delhi
12. Enzymes and Immobilised Cells in Biotechnology by A. Laskin Butterworths Biotechnology Series

### MET 403 C: Clinical Microbiology

	Semester IV	
Credit	<b>MET 403 C: Clinical Microbiology</b>  <b>Total: 4 Credits; Workload: -15 hrs /credit</b> <b>(Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)</b>  Course Outcomes: <b>At the end of this course the students will be able to understand</b> <ol style="list-style-type: none"> <li>1. Specimen collection, transportation and scientific disposal of Biomedical Waste</li> <li>2. Emerging methods in Clinical Microbiology</li> <li>3. Different methods to be used in clinical laboratory</li> <li>4. Biosafety levels and their significance</li> </ol>	Lectures (Hours)
<b>I</b>	<b>Basics of Clinical Microbiology:</b> <ol style="list-style-type: none"> <li>1. Concept of Clinical Microbiology</li> <li>2. Specimen Collection for Microbial Testing</li> <li>3. Test Methods and Method validation in clinical laboratory</li> <li>4. Transportation Media used for clinically important pathogens</li> <li>5. Disposal of contaminated using 'Common Biomedical Waste Facility Centers.</li> <li>6. Laboratory set up for clinical microbiology</li> <li>7. Need of Laboratory Accreditation by NABL</li> <li>8. Benefits of Laboratory Accreditation</li> </ol>	<b>15</b>
<b>II</b>	<b>Evolution of Microbial Identification Methods</b> <ol style="list-style-type: none"> <li>1. Advantages and Limitations of Automation in Clinical Microbiology Laboratory</li> <li>2. VITEK System and its applications</li> <li>3. MALDI-TOF MS for the identification of clinically important pathogens</li> <li>4. Syndrome based multiplex molecular testing</li> <li>5. Blood Culture Panels</li> </ol>	<b>15</b>
<b>III</b>	<b>Routine Tests for Clinical Labs:</b> <ol style="list-style-type: none"> <li>1. Principle and working of blood cell counter:</li> <li>2. Liver Function Tests: SGOT, SGPT, ALKALINE PHOSPHATASE, VAN DEN BERG TEST</li> <li>3. Kidney Function Tests: (Serum Creatinine Test, Glomerular Filtration Test)</li> <li>4. Collection and examination of CSF</li> </ol>	<b>15</b>
<b>IV</b>	<b>Inevitable Methods in Clinical Microbiology:</b>	<b>15</b>

	1. Flow Cytometry 2. Precipitation 3. Agglutination 4. ELISA 5. Biosafety Levels: BSL-1, BSL-2, BSL-3 and BSL-4	
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### References

1. Clinical Microbiology. Procedure's Handbook.' 5<sup>th</sup> Edition May 2023, ASM Publication.
2. Official Website of National Accreditation Board for Testing and Calibration.
3. Official Website of Central Pollution Control Board
4. 'Clinical Microbiology. Procedure's Handbook.' 5<sup>th</sup> Edition May 2023, ASM Publication.
5. Poornima Ramanan, Alexandra L. Bryson, Matthew J. Binnicker, Bobbi S. Pritt, and Robin Patel '**Syndrome Panel Based Testing in Clinical Microbiology**', Clinical Microbiology Reviews. 2018 Jan; 31(1): e00024-17, Published online 2017 Nov 15. doi: 10.1128/CMR.00024-17
6. Synopsis of Clinical Pathology and Microbiology, 8<sup>th</sup> Edition, J. Sengupta, CBS Publishers
7. Biomedical Instrumentation and measurement by R. Ananda Natrajan Amazon
8. Principles and Techniques of Biochemistry and Molecular Biology, Wilson and Walker
9. Immunology, K.R.Joshi, 5<sup>th</sup> Edition Amazon
10. WHO Manual for Laboratory Biosafety (Official Website)
11. CDC Official website

### MEPR- 404 PRACTICAL COURSE-I

UNITS	Semester	CREDITS
	<b>Total credits = 02</b> Course Outcomes: <b>At the end of this course the students will be able to:</b> <ol style="list-style-type: none"> <li>1. Learn about different qualitative tests used dairy industry</li> <li>2. Know about modern molecular biology techniques</li> <li>3. Apply molecular diagnostic technique</li> </ol>	
<b>I</b>	1. Chemical analysis of foods: pH, benzoate, and sorbate 2. Microbiology of butter and cheese 3. Platform tests in dairy industry: COB, alcohol precipitation, titratable acidity. 4. Quantitative phosphatase test 5. Chemical examination of milk: pH, fat, protein, sugar and ash	<b>1</b>
<b>II</b>	1.To study bacterial transformation 2.To study restriction digestion by endonucleases 3.Isolation and curing of plasmid 4.Demonstration of PCR amplification of gene	<b>1</b>

### References

1. Laboratory Methods in Food Microbiology by D. W. Harrigan, Academic Press
2. Handbook of Techniques in Microbiology by A. S. Karwa, M. K. Rai and H. B. Singh

- Scientific Publishers, Jodhpur
3. Dairy Microbiology by Robinson
  4. Outlines of Dairy technology by Sukumar De
  5. Genetic Engineering by Chakravarty, CRC Publications
  6. Genetic Engineering by Sandhya Mitra
  7. Molecular Cloning (Volumes 1, 2, 3) by Sambrook and Russell. Cold Spring Harbor Laboratory Press International Edition.

### MEPR- 405 PRACTICAL COURSE - II

UNITS	Semester	CREDITS
	<b>Total credits = 02</b> Course Outcomes: <b>At the end of this course the students will be able to:</b> <ol style="list-style-type: none"> <li>1. Learn about industrial waste management</li> <li>2. Purify enzyme and study its kinetics</li> <li>3. Use techniques of an enzyme assay to characterize enzyme and find out its applications</li> </ol>	
<b>I</b>	<ol style="list-style-type: none"> <li>1. Characterization of industrial wastes: pH, Alkalinity, TOC, DO, total solids (TS), total suspended solids (TSS), total dissolved solids (TDS), total volatile solids (TVS)</li> <li>2. Treatability test for industrial effluents</li> <li>3. Development of an activated sludge culture</li> </ol>	<b>1</b>
<b>II</b>	<ol style="list-style-type: none"> <li>1. Quantitative estimation and determination of specific activity of <math>\alpha</math>-amylase</li> <li>2. Salt (ammonium sulphate) precipitation of <math>\alpha</math>-amylase</li> <li>3. Study of the effect of:               <ol style="list-style-type: none"> <li>a. Substrate concentration [S<sub>0</sub>] on <math>\alpha</math>-amylase and determination of V<sub>max</sub> and K<sub>M</sub></li> <li>b. Hydrogen Ion concentration (pH) and determination of optimum pH for activity of <math>\alpha</math>-amylase</li> <li>c. Temperature – determination of optimum temperature for activity of <math>\alpha</math>-amylase</li> <li>d. Metal ions on <math>\alpha</math>-amylase</li> </ol> </li> <li>4. Immobilisation of <math>\alpha</math>-amylase by entrapment in alginate gel and determination of loading efficiency</li> </ol>	<b>1</b>

#### References

1. Laboratory Manual in Biochemistry by J. Jayaraman. New Age International Publishers
2. An Introduction to Practical Biochemistry by D. T. Plummer TMH Publishers
3. Immobilised Enzymes – M. D. Trevan
4. Advances in Enzymology – Series edited by N. O. Kaplan, Academic Press
5. Standard Methods in Water and Wastewater Analysis by APHA, AWWA and WPCF
6. Analysis of Plants, Irrigation water and Soils by R. B. Somawanshi and others. Mahatma Phule Agricultural University, Rahuri

## Nature of question paper and scheme of marking:

### a) External Evaluation (Semester exam) Theory paper: Maximum marks – 80

- ✓ Equal weightage shall be given to all units of the theory paper
- ✓ Total number of questions – 07
- ✓ All questions will carry equal marks.
- ✓ Out of the seven questions, five are to be attempted of which Question 1 will be compulsory
- ✓ Question No. 1 will be of an objective type
- ✓ Total No. of bits – 16, Total marks – 16
- ✓ **Nature of questions** - multiple choice, fill in the blanks, definitions, true or false, match the following
- ✓ These questions will be answered along with the other questions in the same answer book
- ✓ Remaining six questions will be divided into two sections, I and II.
- ✓ Four questions are to be attempted from these sections in such a way that not more than two questions are answered from each section.
- ✓ Both sections are to be written in the same answer book

### Total Marks: 80

- Instructions:
1. A total of **FIVE** questions are to be answered from the entire paper
  2. Answers to all the **FIVE** questions are to be written in the **SAME** answer book
  3. Question – 1 is **COMPULSORY**
  4. Attempt **ANY TWO** questions from Section – I (Q. 2 to Q. 4) and **ANY TWO** questions from Section – II (Q. 5 to Q. 7)
  5. **No** supplements will be provided
  6. Figures to the **RIGHT** indicate **FULL MARKS**

Q.1 State whether the given statements are TRUE or FALSE/MCQ. (16)

### SECTION – I

Q. 2. (16)

**OR**

Q. 2. (16)

Q. 3 Discuss in brief (ANY TWO) (16)



a)

b)

c)

Q. 4 Write short notes on (ANY FOUR) (16)

a)

b)

c)

d)

e)

f)

## SECTION – II

Q. 5 (16)

OR

Q. 5 (16)

Q. 6 Describe in brief (ANY TWO) (16)

a)

b)

d)

Q. 7 Write short notes on (ANY FOUR) (16)

a)

b)

c)

d)

e)

f)

**b) Internal Evaluation Theory paper: Maximum marks – 20**

Objective- multiple choice/True or false/ fill in the blanks/match the following

Total number of questions will be 10 each carrying 01 mark

**PRACTICAL EXAMINATION**

- There will be semester wise practical examination to be conducted at the end of each semester.
- Total marks -150 per semester out of which 120 marks will be assessed by external examiner.
- Nature of question paper for practical examination will be provided by BOS before the practical examination.

**Equivalence of courses**  
**M. Sc. Part II (Semester III and IV)**

<b>Old Course</b>				<b>Equivalent Course</b>		
Sem. No.	Course Code	Title of Old Course	Credit	Course Code	Title of New Course	Credit
I	MIC - 301	Biostatistics, Bioinformatics and Scientific Writing	4	MMT - 301	Quantitative Biology	4
I	MIC - 302	Enzymology and Enzyme Technology	4	MMT - 302	Medical Microbiology and Virology	4
I	MIC - 303	Fermentation Technology	4	MET - 303	A – Bioethics, Biosafety, Quality control in Microbiology B – Bioinformatics, Biostatistics and Bionanotechnology C – Agricultural Microbiology	4
I	MIC - 304	Quality Control Microbiology I	4	RP -306	Research Project	4
I	MIC - 305	Practical Course – V	4	MMPR 304	Practical Course I	4
I	MIC - 306	Practical Course – VI	4	MEPR 305	Practical Course II	2
II	MIC - 401	Food and Dairy Microbiology	4	MMT - 401	Food and Dairy Microbiology	4
II	MIC - 402	Industrial waste management	4	MMT - 402	Molecular Biology Tools and Applications	4
II	MIC - 403	Recombinant DNA Technology	4	MET - 403	A – Industrial waste management B – Enzymology and Enzyme technology C- Clinical Microbiology	4
II	MIC - 404	Quality Control Microbiology-II	4	RP-406	Research Project	6
II	MIC - 405	Practical Course – VII	4	MMPR - 404	Practical Course I	2
II	MIC - 406	Practical Course – VIII	4	MEPR - 405	Practical Course II	2

## ANNEXURE I

### DECLARATION BY THE CANDIDATE

I .....(Name of the candidate)..... hereby declare that the dissertation project/OJT entitled ..... Submitted by me to Shivaji University Kolhapur for the degree of ‘ **Master of Science**’in the subject of ‘**Microbiology**’under the ‘**Faculty of Science**’ is an original piece of work carried out by me under the supervision of .....(name of the guide). I further declare that it has not been submitted to this or any other university or the institution for the award of degree or diploma. I also confirm that all material which I have borrowed from other sources and incorporated in this thesis is duly acknowledged. Failure to acknowledge or cite the scientific resources in the submitted thesis will be entirely my responsibility. I am fully aware of the implications of any such act which might have been committed by me advertently or inadvertently.

Place;

Date:

**Name and Signature of the student**

Note: Attach Plagiarism report duly signed by the candidate and Head of the Department/DAIP Member.

## ANNEXURE II

### DEPARTMENTAL ACADEMIC INTEGRITY PANEL (DAIP)

#### CERTIFICATE

This is t o certify that, the work incorporated in the dissertation entitled, '.....' for the degree of **'MASTER OF SCIENCE'** in the subject of **Microbiology** under the **'Faculty of Science'** has been carried out by.....(name of the student)..... in the.....(name of the institute/college)..... During the period from DD/MM/YY to DD/MM/YY. With the reference of 'Gazette of India' dt. 31<sup>st</sup> July 2018, Extraordinary Part III, Section 4, the level of plagiarism in the submitted dissertation is..... (PUT LEVEL). Hence the candidate is allowed to submit the dissertation work

Place:

Date:

**Chairman DAIP External Member DAIP**

**Head of the Department**

**Principal**

(Note: Composition of DAIP committee should be as per 'Gazette of India' dt. 31<sup>st</sup> July 2018, Extraordinary Part III)

### ANNEXURE III

#### A

#### CERTIFICATE OF GUIDE

This is to certify that, the work incorporated in the dissertation project/OJT entitled '.....' Submitted by .....(Name of the candidate) for the degree of **'Master of Science'** in the subject of **'Microbiology'** under the **'Faculty of Science'** has been carried out in the .....(Place of work/OJT).....during the period of DD/MM/YYYY to DD/MM/YYYY under my direct supervision/guidance.

Place:

Date:

Name and Signature of Guide