DEPARTMENT OF MICROBIOLOGY
UNIVERSITY OF PUNE

M. Sc. (MICROBIOLOGY)

REVISED SYLLABUS
FOR
CREDIT BASED
POST GRADUATE COURSE IN MICROBIOLOGY

M. Sc. Part I – w. e. f. June 2008
GENERAL INSTRUCTIONS

1. Eligibility: B. Sc. with Microbiology as principal subject and performance at entrance examination. Students from Universities other than Univ. of Pune, must have Microbiology as one of the subjects at third year B. Sc.

2. A full Master’s degree course in Sciences would be of 100 credits, where one credit course of theory will be of one clock hour per week, running for 15 weeks and one credit for practical course will consist of 15 clock hours of laboratory exercises.

3. For M.Sc. in Microbiology a student should take admission in the Microbiology Department and complete at least 75% courses identified in the syllabus structure of Microbiology. If students so desires remaining 25% courses can be chosen from courses offered by other Departments with credit structure.

4. Course No. are designed to indicate the subject, semester, course serial number, credits assigned and the nature as theory or practicals.
   - MB indicates the subject, Microbiology
   - 1st digit indicates the semester
   - Last digit indicates the credits assigned to the course.
   - Middle number indicates the serial number. The serial number beginning with zero signifies that the course is a practical course.
   eg. MB 1.1.1 means 1st semester, 1st paper with one credit whereas, MB 1.01.5 means 1st semester, 1st practical course with five credits

5. Practical will be conducted throughout the academic year.

6. Some of the credit courses could consist of Seminars, Survey, field work, Special laboratory training in Research Laboratories etc.

7. The in semester and end semester examinations will be of 50% marks each. This will ensure that the students work regularly through the semester.

8. Question paper for each theory course will include at least one problem based on research reports (Mathematical / Data Interpretation / Comment type) related to concerned course.

Each course will be evaluated for 25 marks per credit of which 50% will be based on continuous / internal evaluation.

<table>
<thead>
<tr>
<th>Credit</th>
<th>Continuous/Internal Assessment Marks</th>
<th>End Assessment Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>37</td>
<td>38</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>62</td>
<td>63</td>
</tr>
</tbody>
</table>

9. Results at the end of the semester will be declared using a grade point system.

10. The formula for GPA will be based on weighted average. The final GPA will not be printed unless a student passed courses equivalent to minimum 100 credit hours. Total credit hours means sum of credit hours of the courses which a student has passed.
11. A seven point grade system (guided by the Government of Maharashtra Resolution No. UGC-1298/[4619]/UNI. 4 dt December 11, 1999 and the University regulations) will be followed. The corresponding grade table is as indicated

<table>
<thead>
<tr>
<th>Marks Obtained</th>
<th>Grade</th>
<th>Grade Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-75</td>
<td>O</td>
<td>06</td>
</tr>
<tr>
<td>74-65</td>
<td>A</td>
<td>05</td>
</tr>
<tr>
<td>64-55</td>
<td>B</td>
<td>04</td>
</tr>
<tr>
<td>54-50</td>
<td>C</td>
<td>03</td>
</tr>
<tr>
<td>49-45</td>
<td>D</td>
<td>02</td>
</tr>
<tr>
<td>44-40</td>
<td>E</td>
<td>01</td>
</tr>
<tr>
<td>39 and less</td>
<td>F</td>
<td>00</td>
</tr>
</tbody>
</table>

**Explanation of Grades and Grade Point Average (GPA)**

<table>
<thead>
<tr>
<th>Grade Points</th>
<th>Final Grade</th>
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</thead>
<tbody>
<tr>
<td>05.00-6.00</td>
<td>O</td>
</tr>
<tr>
<td>04.50-4.99</td>
<td>A</td>
</tr>
<tr>
<td>03.50-4.49</td>
<td>B</td>
</tr>
<tr>
<td>02.50-3.49</td>
<td>C</td>
</tr>
<tr>
<td>01.50-2.49</td>
<td>D</td>
</tr>
<tr>
<td>00.50-1.49</td>
<td>E</td>
</tr>
<tr>
<td>00.00-0.49</td>
<td>F</td>
</tr>
</tbody>
</table>

**Common formula for GPA:**

\[
\text{GPA (Grade Point Average)} = \frac{\text{Total of (Grade Points Earned X Credit hours for each course)}}{\text{(Total Credit Hours)}}
\]

‘B’ Grade is equivalent to at least 55% of the marks as per GR No. UGC-1298/[4619]/UNI. 4 dt December 11, 1999

12. If the GPA is higher than the indicated upper limit in the third decimal digit, then the student be awarded higher final grade (eg a student getting GPA of 4.492 may be awarded ‘A’).

13. There will be only final compilation and moderation at CGPA (Final) level done at the Department. While declaring the result, the existing relevant ordinances are applicable. There is also a provision for verification and revaluation. In case of verification the existing rules will be applicable. The revaluation result will be adopted if there is a change of at least 10% marks and in the grade of the course.

14. For grade improvement minimum 30 credit courses should be taken by the student. These courses will be from the parent Department.

15. The above circular supersedes all previous circulars on the credit system being operated at Department of Microbiology, University of Pune.
M. Sc. (Microbiology) Curriculum

Semester I:

<table>
<thead>
<tr>
<th>Course no.</th>
<th>Title</th>
<th>Total credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB 1.1.2</td>
<td>Systematics of Bacteria</td>
<td>2</td>
</tr>
<tr>
<td>MB1.2.1</td>
<td>Advanced Techniques in Taxonomy</td>
<td>1</td>
</tr>
<tr>
<td>MB 1.3.2</td>
<td>Basic Biochemistry</td>
<td>2</td>
</tr>
<tr>
<td>MB 1.4.1</td>
<td>Protein Chemistry</td>
<td>1</td>
</tr>
<tr>
<td>MB 1.5.1</td>
<td>Carbohydrate Chemistry</td>
<td>1</td>
</tr>
<tr>
<td>MB 1.6.1</td>
<td>Nucleic Acid Chemistry</td>
<td>1</td>
</tr>
<tr>
<td>MB 1.7.1</td>
<td>Lipid Chemistry</td>
<td>1</td>
</tr>
<tr>
<td>MB 1.8.1</td>
<td>Vitamin Chemistry</td>
<td>1</td>
</tr>
<tr>
<td>MB 1.9.2</td>
<td>Biology of Yeasts and Moulds</td>
<td>2</td>
</tr>
<tr>
<td>MB 1.10.1</td>
<td>Ultra structure of Cell Membrane</td>
<td>1</td>
</tr>
<tr>
<td>MB 1.11.1</td>
<td>Cell wall of Bacteria and Fungi</td>
<td>1</td>
</tr>
<tr>
<td>MB 1.12.1</td>
<td>Microscopy</td>
<td>1</td>
</tr>
<tr>
<td>MB 1.13.2</td>
<td>Biochemical and Molecular Biology Techniques</td>
<td>2</td>
</tr>
<tr>
<td>MB 1.14.2</td>
<td>Biostatistics</td>
<td>2</td>
</tr>
</tbody>
</table>

**Theory credits** 19

<table>
<thead>
<tr>
<th>Practical</th>
<th>Title</th>
<th>Total credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB 1.01.5</td>
<td>Studies on Extremophiles</td>
<td>3</td>
</tr>
<tr>
<td>MB 1.02.5</td>
<td>Biochemical techniques</td>
<td>3</td>
</tr>
</tbody>
</table>

**Practical credits** 6

**Total Credits** 25
<table>
<thead>
<tr>
<th>Course no.</th>
<th>Title</th>
<th>Total credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB 2.1.2</td>
<td>General Virology</td>
<td>2</td>
</tr>
<tr>
<td>MB 2.2.1</td>
<td>Animal Virology</td>
<td>1</td>
</tr>
<tr>
<td>MB 2.3.1</td>
<td>Plant Virology</td>
<td>1</td>
</tr>
<tr>
<td>MB 2.4.1</td>
<td>Molecular Biology of Bacteriophages</td>
<td>1</td>
</tr>
<tr>
<td>MB 2.5.2</td>
<td>Bioenergetics</td>
<td>2</td>
</tr>
<tr>
<td>MB 2.6.2</td>
<td>Enzymology</td>
<td>2</td>
</tr>
<tr>
<td>MB 2.7.1</td>
<td>Photosynthesis</td>
<td>1</td>
</tr>
<tr>
<td>MB 2.8.1</td>
<td>Respiration: Aerobic, Anaerobic</td>
<td>1</td>
</tr>
<tr>
<td>MB 2.9.2</td>
<td>Environmental Biology</td>
<td>2</td>
</tr>
<tr>
<td>MB 2.10.2</td>
<td>Mathematics for Biologists</td>
<td>2</td>
</tr>
<tr>
<td>MB 2.11.2</td>
<td>Systematics of yeasts and molds</td>
<td>2</td>
</tr>
<tr>
<td>MB 2.12.1</td>
<td>Bioinformatics</td>
<td>1</td>
</tr>
<tr>
<td>MB 2.13.1</td>
<td>Biophysical techniques</td>
<td>1</td>
</tr>
<tr>
<td>MB 2.14.1</td>
<td>Radioisotopes in Biology</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><strong>Theory credits</strong></td>
<td><strong>20</strong></td>
</tr>
<tr>
<td>MB 2.01.5</td>
<td>Experimental Enzymology</td>
<td>3</td>
</tr>
<tr>
<td>MB 2.02.5</td>
<td>Ecology and Environmental Biology</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Practical credits</strong></td>
<td><strong>6</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Total Credits</strong></td>
<td><strong>26</strong></td>
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</tbody>
</table>
# Revised Syllabus for M. Sc. I Credit Course – w. e. f. July 2008

<table>
<thead>
<tr>
<th>Course no.</th>
<th>Title</th>
<th>Description</th>
<th>Total credits</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB 1.1.2</td>
<td>Systematics of Bacteria</td>
<td>Species concept, Biological Nomenclature, theories of biological classification, structural and biochemical systematics, numerical taxonomy, chemotaxonomy. Biodiversity- characterization, generation maintenance and loss; Magnitude and distribution of Biodiversity, economic value, wild life biology, conservation strategies, cryopreservation</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Taxonomy**

**Diversity**
<table>
<thead>
<tr>
<th>Course no.</th>
<th>Title</th>
<th>Description</th>
<th>Total credits</th>
<th>References</th>
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</thead>
<tbody>
<tr>
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</tbody>
</table>
2. Important biochemical reactions in metabolism e.g. Substitution, Addition, Elimination, Rearrangement, Oxidation, Reduction, Ring closure, Transamination, Isomerisation, Epimerization, Adenylation and Phosphorylation Methylation, Hydrolysis, Dehydrase reaction, Tautomerisation, etc.  
4. Concept of weak and strong acids and bases, pH, Henderson-Hasselbalch equation, concept of buffer, strength of buffer, range of buffer, | 2             |                                                                                                                      |
|           |                              |                                                                                               |               |                                                                                                                      |

**Chemical Composition of Living Systems**

<table>
<thead>
<tr>
<th>Course no.</th>
<th>Title</th>
<th>Description</th>
<th>Total credits</th>
<th>References</th>
</tr>
</thead>
</table>
| MB 1.5.1  | Carbohydrate Chemistry | Mono, di, oligosaccharides and polysaccharides, with examples, asymmetric centre in sugars, D-series, L-series, dextro, leavo-rotatory, reducing and non-reducing sugars, sugar anomers, sugar epimers, sugar derivatives such as sugar alcohols, amino sugars, sugar acids, deoxy sugars. | 1             | Introduction to Bioorganic Chemistry  
<p>| MB 1.6.1  | Nucleic Acid Chemistry | Structure of bases, nucleosides, nucleotides, phospho-diester linkages, 5’ phosphate, 3’hydroxyl polarity of nucleic acids, tautomeric forms of bases and their implication in pairing of bases, structure of DNA (A, B and Z forms), Tm value, detailed structure of t-RNA, r-RNA, and m-RNA. | 1             |                                                                                                      |</p>
<table>
<thead>
<tr>
<th>Course no.</th>
<th>Title</th>
<th>Description</th>
<th>Total credits</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB 1.9.2</td>
<td>Biology of Yeasts and Moulds</td>
<td>The vegetative cells of fungi, Growth and development of the vegetative cell, The life cycle, Asexual reproduction, Sexual reproduction, Physiology of fungi, Economic importance of fungi, Main groups of fungi</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
| MB 1.10.1 | Ultra structure of Cell Membrane     | **Ultrastructure and Organization of Eukaryotic Cell**  
<table>
<thead>
<tr>
<th>Course no.</th>
<th>Title</th>
<th>Description</th>
<th>Total credits</th>
<th>References</th>
</tr>
</thead>
</table>
| MB 1.11.1 | Cell wall of Bacteria and Fungi | Definition, important chemical features of the cell wall, structure, function and assembly in bacteria and archae, typical model of cell wall of bacteria and archae, chemical differentiation of fungal cell wall | 1 | 1. Ruiz-Herrera J. (1991) Fungal cell walls. CRC Press ISBN:0849366720  
| MB 1.13.2 | Biochemical and Molecular Biology Techniques | A. Principles and applications of gel filtration, ion exchange and affinity chromatography, thin layer and gas chromatography, high pressure liquid chromatography (HPLC), electrophoresis and electrofocussing, ultra centrifugation (velocity | 2 | Instrumentation  
<table>
<thead>
<tr>
<th>Course no.</th>
<th>Title</th>
<th>Description</th>
<th>Total credits</th>
<th>References</th>
</tr>
</thead>
</table>
| MB 1.14.2 | Biostatistics       | a. Quantitative methods in biology, sampling methods, scales and variables, data organization, tabulation, graphical representation  
b. Concepts, examples and problems for each of the following:  
<table>
<thead>
<tr>
<th>Course no.</th>
<th>Title</th>
<th>Description</th>
<th>Total credits</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factorial design, ANOVA and F test.</td>
<td></td>
<td></td>
<td>5. Murthy M.N. Sampling methods, Indian Statistical Institute, Kolkata.</td>
</tr>
<tr>
<td></td>
<td>Hypothesis testing: Comparison of two sample means: t-tests, non-parametric tests. The concepts of null hypothesis, significance level, type I and type II errors, one tailed and two tailed tests. Categorical data and proportion data: Chi square test and test for goodness of fit.</td>
<td></td>
<td>19</td>
<td></td>
</tr>
<tr>
<td><strong>M.Sc. I Sem I Practicals</strong></td>
<td><strong>Theory Credits</strong></td>
<td><strong>Practicals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MB 1.01.5</td>
<td>Studies on Extremophiles</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1. Isolation and characterization of anaerobic microorganisms</td>
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<td></td>
<td>2. Isolation and characterization of thermophilic microorganisms</td>
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<td>3. Isolation and characterization of Psychrophilic microorganisms</td>
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<td>4. Isolation and characterization of Alkalophilic microorganisms</td>
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<td></td>
<td>5. Isolation and characterization of Acidophilic microorganisms</td>
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<tr>
<td>Course no.</td>
<td>Title</td>
<td>Description</td>
<td>Total credits</td>
<td>References</td>
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</tbody>
</table>

**A) Basic Biochemistry**

1. **Buffer**: Determination of pKa of a monoprotic weak organic acid; Preparation of buffers using \( \text{KH}_2\text{PO}_4 \) and \( \text{K}_2\text{HPO}_4 \), acetic acid and sodium acetate, \( \text{K}_2\text{HPO}_4 \) and \( \text{H}_3\text{PO}_4 \)  
2. **Colorimetry and spectrophotometry**: Estimation of sugar and total carbohydrate, estimation of protein and nucleic acids (DNSA, phenol-sulphuric acid method, Lowry, Bradford and UV Spectrophotometry, Diphenyl amine and orcinol method)  
3. **Determination of saponification value and iodine number of fat**  
4. **Chromatography**: Separation of sugar and amino acids by paper and thin layer chromatography  
5. **Electrophoresis**: Agarose gel electrophoresis, PAGE and SDS-PAGE of proteins  
6. **Molecular weight determination by Molecular sieve chromatography**

**B) Cell Disruption and separation of cell components using Sucrose/ Ficoll Density Gradient (yeast)**

<table>
<thead>
<tr>
<th>Practical Credits</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Credits</strong></td>
<td>25</td>
</tr>
<tr>
<td>Course no.</td>
<td>Title</td>
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<td>-----------</td>
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</tbody>
</table>
| MB 2.1.2  | General Virology       | 1) Distinctive properties of viruses: size, acellular (non cellular) organization, nature of viral genome, etc.  
2) Morphology and ultra structure of viruses: Capsids; icosahedral, helical, envelope, glycoprotein, matrix proteins and lipids, Viral genome (double stranded viral DNA / RNA, single stranded viral DNA / RNA, etc); virus related agents (viroids, prions).  
3) Cultivation of viruses: Growth of viruses in embryonated egg, in experimental animals and in cell cultures-primary and secondary cell lines, suspension cell cultures and monolayer cell cultures.  
4) Assay of viruses: Physical and chemical methods of assay, (protein, nucleic acid, radioactivity tracers, electron microscopy, etc); Infectivity assay of animal viruses (plaque method, pock counting, end point method) and infectivity assay of plant viruses.  
|           |                        |                                                                                                                                                                                                            |               |                                                                                                                                                                                                                                                                          |
| MB 2.2.1  | Animal Virology        | 1) Classification and nomenclature of viruses: ICTV recommendations  
2) Life cycles and other details : DNA viruses with special reference to herpes, pox, adeno, SV40; RNA viruses with special reference to measles, rabies, polio, influenza, retroviruses; Oncoviruses and Lentiviruses (HIV).  
<table>
<thead>
<tr>
<th>Course no.</th>
<th>Title</th>
<th>Description</th>
<th>Total credits</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB 2.3.1</td>
<td>Plant Virology</td>
<td>and persistent viruses; Mechanism of virus host interaction / Mechanism of virus persistence.</td>
<td>1</td>
<td>Gibbs Adrian &amp; Bryan Harrison ( ) Plant Virology -The Principles. Edward Arnold Press</td>
</tr>
<tr>
<td>MB 2.5.2</td>
<td>Bioenergetics</td>
<td>Laws of thermodynamics, entropy, enthalpy, free energy, free energy and equilibrium constant, Gibbs free energy equation, determination of free energy of hydrolytic and biological oxidation reduction reactions, under standard and non-standard</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Course no.</td>
<td>Title</td>
<td>Description</td>
<td>Total credits</td>
<td>References</td>
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<tr>
<td>Course no.</td>
<td>Title</td>
<td>Description</td>
<td>Total credits</td>
<td>References</td>
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</table>
| MB 2.8.1   | Respiration: Aerobic, Anaerobic | **Aerobic Respiration:**  
Mitochondrial electron transport chain, structure and function of ATPase (bacterial and mitochondrial), generation and maintenance of proton motive force, oxidative phosphorylation, inhibitors and un-couplers of electron transport chain and oxidative phosphorylation, Atkinson’s energy charge, phosphorylation potential and its significance, Energy generation in all groups of chemolithotrophs.  
**Anaerobic Respiration:**  
<p>| MB 2.9.2   | Environmental Biology      | A. Interactions between environment and biota ; Concept of habitat and ecological niches; Limiting factor ; Energy flow, food chain, food web and tropic levels ; Ecological pyramids and recycling, biotic community – concept, structure, dominance, fluctuation and succession; N, P, C and S cycles in nature. | 2             | Meadows, P. S. and Campbell. (1978). An introduction to Marine Science. Blackie and Sons Ltd., Glasgow. |
|            |                            |                                                                                                                                             |               | Richards, B. N. (1987). Microbiology of Terrestrial                                                 |</p>
<table>
<thead>
<tr>
<th>Course no.</th>
<th>Title</th>
<th>Description</th>
<th>Total credits</th>
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<tr>
<td>Course no.</td>
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<td>Total credits</td>
<td>References</td>
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<td>--------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
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<td>-----------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>MB 2.14.1</td>
<td>Radioisotopes in Biology</td>
<td>Principles and applications of tracer techniques in biology; Radiation dosimetry; Radioactive isotopes and half life of isotopes; Effect of radiation on biological system; Autoradiography; Cerenkoy radiation; Liquid spectrometry.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Course no.</td>
<td>Title</td>
<td>Description</td>
<td>Total credits</td>
<td>References</td>
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<td>-----------</td>
<td>--------------------------------------------</td>
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<td>---------------------------------------------------------------------------</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Other books:</strong></td>
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</tbody>
</table>

**M.Sc. I Sem II Practicals**

<table>
<thead>
<tr>
<th>Course no.</th>
<th>Title</th>
<th>Description</th>
<th>Practical Credits</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MB 2.01.5</td>
<td>Experimental Enzymology</td>
<td>1. Purification of enzyme from natural source</td>
<td>3</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>2. Determination of Km and Vm values of enzyme : e.g., Invertase, amylase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MB 2.02.5</td>
<td>Ecology and Environmental Biology</td>
<td>1. Isolation of cellulose degraders</td>
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<td>2. Isolation of chitinase degraders</td>
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<td>3. Isolation of pesticide degraders</td>
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<td>4. Isolation of Aflatoxin producing organism</td>
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<td>5. Detection of Aflatoxin in food / culture</td>
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**Total Credits**

| Total Credits | 26 |