B.Sc. MAJOR IN MICROBIOLOGY PROGRAMME

GENERAL INSTRUCTIONS/ GUIDELINES FOR EXECUTION OF CURRICULUM

1. The B.Sc. Major in Microbiology will be of three years duration semester-based Choice Based Credit System [CBCS] course.

2. There will be broadly four types of courses for B.Sc. with Major in Microbiology programme.

   A. The **Compulsory Courses** will be of 3 credits each and a candidate has to choose a minimum of 3 Compulsory courses being offered by the concerned college/institute. Thus a minimum of 9 [3 X 3 credits] will be opted by a candidate. Each of 3-credit courses will carry 75 marks.

   B. The core courses will comprise **Hard Core Courses** [Compulsory subject courses where no choice will be available] and **Soft-Core Courses** [Choice for opting a course will be available] of 4-credits each, and a candidate will opt at least a total of 14 courses of 4-credits each [4 X 14 = 56 credits] including Soft-core courses. Each course will carry 100 marks. Each of Hard/ Soft-core courses will comprise a practical of 25 marks, theory End semester examination of 40 marks, and an Internal Assessment component of 35 marks. The Internal Assessment [35 marks] will include two Multi Choice Questions (MCQ)-based examinations of 10 marks each [20 questions of 0.5 mark each], a presentation and assignment of 10 marks and Classroom Attendance Incentive marks (5 marks). The Lab-based practical will be of 2-hours [One credit].

   Classroom Attendance Incentive: Those having greater than 75% attendance (for those participating in Co-curricular activities, 25% will be added to per cent attendance) will be awarded CCA marks as follows:

   - $\geq 75\%$ but < 80\% 1 marks
   - $\geq 80\%$ but <85\% 2 marks
   - $\geq 85\%$ but <90\% 3 marks
   - $\geq 90\%$ but < 95\% 4 marks
   - $\geq$95\% 5 marks

   C. **Elective Courses** will comprise related to Minor subjects. Each Elective course will be of 4-credits each and a candidate opts for 5 courses of a Minor subject [say Chemistry, Mathematics, Computers and Physics] or at least 5 courses of two different minor subjects. A minimum of 10 Elective courses [4 X 10 = 40 credits] will be chosen by a candidate to get specialization in one or two minor subjects.

   D. **General Interest and/ or Hobby Courses** will comprise such courses as the name suggests and each candidate will opt for at least one course of 1 credit and this course shall carry 25 marks.
3. (a) The admission to B.Sc. Major with Microbiology programme of Himachal Pradesh University will be as per guidelines of Himachal Pradesh University, Shimla from time to time.
(b) The candidate should have passed 10+2 (class XII) Examination or its equivalent from a recognized Board/University with any of the three subjects out of Physics, Chemistry and Biology or any other science subjects with 50% or equivalent grade (for SC/ST candidates marks of eligibility will be 45% or equivalent grade).
(c) In case of candidates who are studying in University/ Board/ College/ Schools in any of the foreign countries the eligibility/ Qualifying marks will be the same as recognized/equivalent to 10+2 by the University or the association of the Indian University with 50% marks of equivalent grade (for SC/ST candidates, eligibility will be 45% marks or equivalent grade).
(d) The candidate who has appeared in the qualifying examination but whose result has so far not been declared can also apply but his/her eligibility for the entrance test will be purely provisional subject to the condition that he/she has to produced a passing certificate scoring at least the minimum percentage of marks as prescribed for the qualifying examination on the day and the specified time of counseling.
(e) The candidate shall not be more than 22 years of age as on 01st July of the year of admission. Date of birth as recorded in the Secondary Education Board/ University Certificate Only will be considered as authentic.

4. Admission will be based on the merit of the entrance test to be conducted by HP University or any other mode as to be decided by the University from time to time.

5. The tuition fee and other monthly/annual charges will be as per University rules.

**Selection of various courses**

**A. Compulsory courses [Minimum 3 courses; 3 X 3 = 9 credits]**

(a) Languages
   i. Compulsory English
   ii. Compulsory Hindi

(b) Social Sciences/Commerce/Management
   iii. Compulsory Social Science/ Commerce/management course
   iv. Compulsory Geography of Himachal Pradesh
   v. Compulsory Indian Constitution
   vi. Compulsory Himachal Past, Present and Future

(c) Science
   vii. Compulsory Basic Science (not for students majoring in science subjects)
   viii. Climate Change and its impact on mountain sustainability
   ix. Compulsory Environnemental Science (Audit Pass Course)

(d) Skill-based courses
   x. Functional English
   xi. Office Computing
   xii. Functional Hindi
   xiii. Application Packages for finance
   xiv. Secretarial practice
   xv. Short hand and word processing
   xvi. Web applications
### B. Core courses

**CORE COURSES** [Minimum 14 courses; 14 X 4 = 56 credits]

<table>
<thead>
<tr>
<th>Code</th>
<th>Hard core courses</th>
<th>L-T-P-C</th>
<th>Code</th>
<th>Soft core courses</th>
<th>L-T-P-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Micro-101</td>
<td>General Microbiology</td>
<td>3-0-1-4</td>
<td>Micro-121</td>
<td>Parasitology</td>
<td>3-0-1-4</td>
</tr>
<tr>
<td>Micro-102</td>
<td>Basic Biochemistry</td>
<td>3-0-1-4</td>
<td>Micro-122</td>
<td>Applied Microbiology</td>
<td>3-0-1-4</td>
</tr>
<tr>
<td>*Micro-103</td>
<td>Microbial Metabolism</td>
<td>3-0-1-4</td>
<td>Micro-123</td>
<td>Mycology</td>
<td>3-0-1-4</td>
</tr>
<tr>
<td>*Micro-104</td>
<td>Genetics &amp; Molecular Biology</td>
<td>3-0-1-4</td>
<td>*Micro-124</td>
<td>Medical Microbiology</td>
<td>3-0-1-4</td>
</tr>
<tr>
<td>*Micro-105</td>
<td>Industrial Microbiology</td>
<td>3-0-1-4</td>
<td>Micro-125</td>
<td>Animal Cell Culture Techniques</td>
<td>3-0-1-4</td>
</tr>
<tr>
<td>Micro-106</td>
<td>Immunology</td>
<td>3-0-1-4</td>
<td>Micro-126</td>
<td>Phycology</td>
<td>3-0-1-4</td>
</tr>
<tr>
<td>Micro-107</td>
<td>Instrumental Methods of Analysis</td>
<td>3-0-1-4</td>
<td>Micro-127</td>
<td>Fermentation Technology</td>
<td>3-0-1-4</td>
</tr>
<tr>
<td>Micro-108</td>
<td>Intellectual Property Rights &amp; Entrepreneurship</td>
<td>3-1-0-4</td>
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<tr>
<td>*Micro-109</td>
<td>Animal Virology</td>
<td>3-0-1-4</td>
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<tr>
<td>Micro-110</td>
<td>Bacteriology</td>
<td>3-0-1-4</td>
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<tr>
<td>*Micro-111</td>
<td>Environmental Microbiology</td>
<td>3-0-1-4</td>
<td></td>
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</tr>
<tr>
<td>Micro-112</td>
<td>Recombinant Technology DNA</td>
<td>3-0-1-4</td>
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</tr>
</tbody>
</table>

**Elective Minor courses for students doing Major with other subject(s) except major with Microbiology:** The course number(s) Micro-101, Micro-103, Micro-105, Micro-109, Micro-111 and Micro-124 which have been highlighted (*) will be offered/ considered as Minor elective courses.

### C. Elective Courses

Details of the syllabus will be as prescribed by the University. Each elective course will be of 3 credits [Minimum 10 courses; 4 X 10 = 40 credits]. **These courses will be distinctly different from the various disciplines of Microbiology.** Chemistry shall be compulsory minor elective for B.Sc. students majoring with Microbiology and second minor elective will be one of following subjects:

1. Economics
2. Computer
3. Physics
4. Mathematics
D. General Interest (GI) and / or Hobby (H): Details of the syllabus will be as prescribed by the University.

General interest or Hobby  
[Minimum 1 course; 1 X 1 = 01 credit]

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Commercial arts</td>
<td></td>
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<tr>
<td>German language</td>
<td></td>
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<tr>
<td>Russian language</td>
<td></td>
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<tr>
<td>Spoken English</td>
<td></td>
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<tr>
<td>Photography</td>
<td></td>
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<tr>
<td>General computer applications</td>
<td></td>
</tr>
<tr>
<td>Fine arts</td>
<td></td>
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<tr>
<td>Playing musical instrument(s)</td>
<td></td>
</tr>
</tbody>
</table>

Semester-wise breakup of courses to be chosen by the candidate

<table>
<thead>
<tr>
<th>Semester</th>
<th>Courses to be opted</th>
<th>Course name</th>
<th>Course</th>
<th>Credits</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>I [ODD]</td>
<td>Compulsory Course-I</td>
<td>Select from the listed compulsory courses</td>
<td>3</td>
<td>Compulsory: 03</td>
<td>Core: 08</td>
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<tr>
<td></td>
<td>Major Core Course-I Micro-101</td>
<td>General Microbiology</td>
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<tr>
<td></td>
<td>Major Core Course-II Micro-102</td>
<td>Basic Biochemistry</td>
<td>4</td>
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<td></td>
<td>Minor Elective Course-I (a)</td>
<td>To be selected from the list of minor elective courses</td>
<td>4</td>
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<td>Minor Elective Course-I (b)</td>
<td>To be selected from the list of minor elective courses</td>
<td>4</td>
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<tr>
<td></td>
<td>GI &amp; H Course-I</td>
<td>To be selected from the list of GI &amp; H courses</td>
<td>1</td>
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<tr>
<td>II [EVEN]</td>
<td>Major Core Course-III Micro-103</td>
<td>Microbial Metabolism</td>
<td>4</td>
<td>Compulsory: 03</td>
<td>Core: 08</td>
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<tr>
<td></td>
<td>Major Core Course-IV Micro-104</td>
<td>Genetics &amp; Molecular Biology</td>
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<td></td>
<td>Compulsory Course-II</td>
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<td>Minor Elective Course-II (a)</td>
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<td>Minor Elective Course-II (b)</td>
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<td>GI &amp; H Course-II</td>
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<td>III [ODD]</td>
<td>Major Core Course-V Micro-105</td>
<td>Industrial Microbiology</td>
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<td>Compulsory: 03</td>
<td>Core: 08</td>
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<td>Major Core Course-VI Micro-106</td>
<td>Immunology</td>
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<td>Compulsory Course-III</td>
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<td>Minor Elective Course-III (b)</td>
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<tr>
<td>IV [EVEN]</td>
<td>Major Core Course-VII Micro-107</td>
<td>Instrumental Methods of Analysis</td>
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<td>Compulsory: 03</td>
<td>Core: 08</td>
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<tr>
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<td>Major Core Course-VIII Micro-108</td>
<td>Intellectual Property Rights &amp; Entrepreneurship</td>
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<tr>
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<td>Compulsory Course-IV</td>
<td>To be selected from the list of compulsory courses</td>
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<tr>
<td></td>
<td>[Skill based]</td>
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<tr>
<td>Course</td>
<td>Description</td>
<td>Credits</td>
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<tr>
<td>Minor Elective Course-IV (a)</td>
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<td>Minor Elective Course-IV (b)</td>
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<tr>
<td>GI &amp; H Course-IV</td>
<td>To be selected from the list of GI &amp; H courses</td>
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<tr>
<td><strong>V [ODD]</strong></td>
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<tr>
<td>Major Core Course-XI</td>
<td>Animal Virology</td>
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<td>Micro-109</td>
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<tr>
<td>Major Core Course-X</td>
<td>Bacteriology</td>
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<td>Micro-110</td>
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<tr>
<td>Major Core Course-XI</td>
<td>Environmental Microbiology</td>
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<tr>
<td>Micro-111</td>
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<td>Minor Elective Course-V (a)</td>
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<tr>
<td>Minor Elective Course-V (b)</td>
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<tr>
<td><strong>VI [EVEN]</strong></td>
<td></td>
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<tr>
<td>Major Core Course-XII</td>
<td>Recombinant DNA Technology</td>
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<tr>
<td>Micro-112</td>
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<tr>
<td>Major Soft Core Course [Micro-121 to 127]</td>
<td>To be selected from the list of Major Soft core courses</td>
<td>4</td>
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<tr>
<td>Major Soft Core Course [Micro-121 to 127]</td>
<td>To be selected from the list of Major Soft core courses</td>
<td>4</td>
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<tr>
<td>Minor Elective Course-VI (a)</td>
<td>To be selected from the list of minor elective courses</td>
<td>4</td>
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<tr>
<td>Minor Elective Course-VI (b)</td>
<td>To be selected from the list of minor elective courses</td>
<td>4</td>
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</tr>
</tbody>
</table>

Typological errors corrected on August 07, 2015
COURSE: *Micro-101
GENERAL MICROBIOLOGY

L T P C
3 0 1 4

Semester end examination: 40 marks
Practical examination: 30 marks
Internal Assessment: 30 marks
Credit hours: 36

Instructions for setting end semester examination question paper:

The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit I

History of Microbiology
A. Leeuwenhoek, L. Pasteur, R. Koch, J. Lister, J. Tyndall, etc. Biogenesis vs Abiogenesis, Koch’s postulates, discovery of antibiotics.

Principle of Microscopy
Bright field, Dark field, Phase contrast, Fluorescent, Electron Microscopy.

9 Credit hours

Unit II

Microbial classification
Bacteria, fungi and algae.
Morphology of bacteria, viruses and fungi with major emphasis on bacterial structure specially cell wall. Gram positive and Gram negative bacteria. Microbial spores and process of sporulation/ germination process.

9 Credit hours

Unit III

Microbial growth and antimicrobial treatments
Nutritional biodiversity, phases of growth, generation time, growth rates, monoauxic, diauxic and synchronous growth and concept of chemostat. Microbes in extreme environment like high temperature and high/ low pH values. Physical and chemical agents to kill microbes, sterilization and pasteurization processes.

9 Credit hours

Unit IV

Normal micro flora in humans/ animals and host defense
Types of microbial pathogens and disease caused by them. Microbial interactions like symbiosis and antibiosis etc. Host defense mechanism against pathogens. Nitrogen fixing microbes in agriculture.

Microbial metabolism
Unique pathways, photosynthesis, fermentation and its products, production of hetrologous proteins in microbes, nitrogen fixing microbes in agriculture.

9 Credit hours
**Recommended books**

1. Microbiology- Davis, B.D Dulbecco, R., Eiser, H.N. and Ginsberg, H.S.
3. General Microbiology- Stanier, R.Y.
4. Microbiology- Pelczar, M.T.
5. General microbiology- Schlegel, H.G.
6. Industrial Microbiology- Prescot and Dunn
7. Microbiology: fundamentals and Applications- Purohit, S.S.
8. Microbes and Man- Postgate, J.
9. Microbiology: Laboratory manual- Cappuccino, J.G and Sherman, N.

**List of practicals**

- Credit hour: 12
- Maximum Marks: 30

1. Aseptic techniques.
2. Cleaning of glasswares, preparation of media, cotton plugging and sterilization.
3. Personal hygiene-microbes from hands, Tooth-scum/ Tar-tar and other body parts.
4. Isolation of microorganisms from air, water and soil samples
5. Enumeration of microorganism’s vs viable counts. 
6. Identification of isolated bacteria 
7. Gram staining, other staining methods, metabolic characterization (e.g. IMVIC) tests 
8. Growth curve of microorganisms.
10. Testing of water quality 
11. Test for antibodies against given bacterium 
12. One step growth of bacteriophage.
13. Culture from body fluids (stool, Urine, blood).
14. Alcoholic and mixed acid fermentation
COURSE: Micro-102  
BASIC BIOCHEMISTRY

L  T  P  C
3  0  1  4

Semester end examination: 40 marks  
Practical examination: 30 marks  
Internal Assessment: 30 marks  
Credit hours: 36

Instructions for setting end semester examination question paper:

The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit I

Water and its property
Physico chemical properties of water, dissociation and association constants. pH and buffers, pl, pKa, Hasselberg Henderson equation and its implication.

Carbohydrate
Structure of important mono-, di-, oligo- and poly-saccharides, glycoproteins and peptidoglycan, glycolipids and lipopolysaccharides. Reaction of monosaccharides.

9 Credit hours

Unit II

Proteins
Structure of amino acids, non-protein and rare amino acids and their chemical reactions. Structural organisation of proteins (primary, secondary, quaternary domain structure), protein classification and function. Forces stabilizing primary, secondary and tertiary structure. Laboratory synthesis of protein, lectins and antibodies.

9 Credit hours

Unit III

Lipids
Classification of lipids and fatty acids, general functions of major lipid subclasses, acyglycerols, phosphoglycerols, phosphoglycerides, sphingolipids, glycosphingolipids and terpens, sterols, steroids. Prostagladins, Prostaryclins, Leukotrienes etc.

9 Credit hours

Unit IV

Nucleic acids
Structure of nucleosides, nucleotides and nucleic acids, biologically important nucleotides and their functions. Applications of biochip and microarray.

Vitamins and hormones
Types of vitamins and their chemistry vitamins as cofactors, steroids and peptide hormones

9 Credit hours
Books recommended

1. Biochemistry- **Rawn, J.D.**
3. Biochemistry- **Stryer, L.**
5. Carbohydrate Biotechnology Protocols- **Bucke C.**
6. Principles of Biochemistry- **Horton et al.**
7. An Introduction of practical biochemistry- **Plummer D.T.**
8. Practical Biochemistry- **Bansal, D.D., Khardori, R & Gupta, M.M.**

List of practicals

- Preparation of physiological buffers.
- Verification of Beer and Lamberts law for $p$-nitrophenol or cobalt chloride.
- Determination $pK_a$ value of $p$-nitrophenol.
- The colorimetric estimation of inorganic phosphates.
- Estimation of carbohydrates in a given solution by Anthrone method.
- Estimation of sugars in biological samples.
- Protein estimation by Lowry’s method.
- Protein estimation by Bradford methods.
- Analysis of urine for urea, glucose, uric acid and chloride.
- The determination of acid value of a fat.
- Saponification value of a fat.
- Separation of lipids by thin layer chromatography.
COURSE: *Micro-103  
MICROBIAL METABOLISM

Semester end examination: 40 marks  
Practical examination: 30 marks  
Internal Assessment: 30 marks  
Credit hours: 36

Instructions for setting end semester examination question paper

The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3–4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

**Unit-I**

**Bacterial types and nutrition**
Introduction, scope of microbial physiology studies, organization of prokaryotic and eukaryotic cells, organelles of the microbial cells and their functions. Brief account of archaeabacteria.  
Microbial nutrition, classification of microorganisms on the basis of their nutrition requirements. Uptake of nutrients.

8 Credit hours

**Unit-II**

**Metabolic pathways**

10 Credit hours

**Unit-III**

**Microbial growth**
Trophophase and idophase, primary and secondary metabolites, growth kinetics.

**Types of growth**
Batch, Fed-Batch, and Continuous and their industrial applications. Transport of compounds in microbes.

9 Credit hours

**Unit-IV**

**Macromolecular synthesis**
Sugar and polysaccharide synthesis, cell wall and teichoic acid, lipopolysaccharides biosynthesis. anaplerotic sequences, bacterial photosynthesis, synthesis of lipids, essential amino acid synthesis.
Regulation of bacterial metabolism
Enzyme induction, catabolite repression, feed-back inhibition and repression, properties of allosteric enzymes.

9 Credit hours

Recommended books

3. Chemical Microbiology – A. H. Rose
5. Principles of Fermentation Technology - Whittaker
6. Biochemistry- Stryer, L

List of practicals

Credit hours: 12
Maximum Marks: 30

1. Preparation of liquid and solid media for growth of microorganisms.
2. Isolation and maintenance of organisms by plating, streaking and serial dilution methods.
3. Isolation of pure; cultures from soil and water.
5. Measurement of bacterial population by turbidometry and serial dilution methods.
6. Direct microscopes counting of bacteria.
7. Motility by hanging drop techniques.
8. Microscopic examination of bacterial, yeast and molds and study of organisms by Gram stain, Acid fast stain and staining for spores.
COURSE: *Micro-104  
GENETICS & MOLECULAR BIOLOGY  

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Semester end examination: 40 marks  
Practical examination: 30 marks  
Internal Assessment: 30 marks  
Credit hours: 36  

Instructions for setting end semester examination question paper:  
The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3–4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.  

Unit-I  
Genetic material and organization of chromosomes  
Nature of genetic material, nucleic acids, DNA replication, genome size and complexity, supercoiling of DNA, the structure of prokaryotic and eukaryotic chromosome, Polytene chromosomes, euchromatin and heterochromatin, satellite DNA, centromere and telomere structure.  

9 Credit hours  

Unit-II  
Gene organization and expression in prokaryotes and eukaryotes  
Introduction to Genes and Proteins, Genome Sequences, ORFs, Genes, Introns, Exons, Splice Variants, DNA/RNA, Secondary structure, Triplet Coding, Protein sequences, Protein Structure, Secondary, Tertiary and Quaternary structures.  

9 Credit hours  

Unit-III  
Gene linkage and chromosome mapping  

9 Credit hours  

Unit-IV  
Mutation  
Spontaneous versus induced mutations, types of mutations, the molecular basis of mutations, mechanisms of DNA repair, mutations, frequency, correlation between mutagenicity and carcinogenicity, mutagenic agents, chemical and radiation.  
Population genetics  
Hardy-Weinberg equilibrium, gene and genotypic frequencies, introduction of eugenics.  
Basic microbial genetics  
Conjugation, transduction, transformation, isolation of auxotrophs, replica plating techniques, analysis of mutations in biochemical pathway, one gene– one enzyme hypothesis.  

9 Credit hours
Recommended books

1. Microbial Genetics - Maloy, S.R. Crown, J.E., and Freifelder, D.
2. Genetics - Hartl, D.L.
3. Genetics: Analysis and Principles - Brooker, R.J.
4. The Science of Genetics - Antherly A.G. Girton, J.R.
5. Microbial Genetics - Freifelder, D.

List of practicals

Credit hours: 12
Maximum Marks: 30

1. Demonstration of Law of segregation and Independent assortment (use of coloured beads, capsules etc.). Numerical for segregation and independent assortment. Use of Chi2 for prediction of phenotype/genotype frequencies of parents from progeny and vice-versa, epistasis.
2. Segregation demonstration in preserved material (Maize).
3. Detection of blood groups (A B O & Rh factors).
4. Inheritance of other human characteristics, ability to test PTC and thiourea.
5. Calculation of variance in respect of pod length and number of seeds/pod.
6. Calculation of gene frequencies and random mating (coloured beads, capsules).
7. Paternity disputes (blood groups).
8. Dermatographics: Palm print taking and finger tip patterns.
9. Preparation and study of mitosis slides from buccal mucosa and onion root tips by squash method.
10. Preparation and study of meiosis slides from meristem tissue by squash method.
11. Demonstration of sex chromatin from buccal smear using thionin stain.
COURSE: Micro-105
INDUSTRIAL MICROBIOLOGY

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Semester end examination: 40 marks
Practical examination: 30 marks
Internal Assessment: 30 marks
Credit hours: 36

Instructions for setting end semester examination question paper

The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit-I
Introduction
Basic concept of agriculture as industry: industrially important microbes, its screening, selection and identification. Maintenance and preservation of industrially important microbial cultures. Differences between microbial industrial processes and chemical industrial processes.

9 Credit hours

Unit-II
Improvement of industrial microbes
Improvement programme of industrial microbes, mutational programme of penicillin producing microorganisms, selection pressure in maintaining the hyper producing microbes, revertants of higher yielding microbes into lower production, media formulation and process optimization of industrial and agro industrial microbes.

6 Credit hours

Unit-III
Industrial and agro-industrial microbes
Microbes involved in antibiotics, pharmaceutical drugs, enzymes production, solvent production, surfactants, vermiculture, composting, biopesticides production, biotransformation, nitrogen fixation, organic acids production, vitamins, aminoacids, single cell protein, biofertilizers, wine, beers, mycotoxins.

Microbial processes in agro biotechnology

12 Credit hours

Unit-IV
Microbial process in industrial biotechnology
Introduction, primary and secondary metabolites production, production of vitamins, B12, alcohols, wine beer, cheese, bread, citric acid, penicillins, glutamic acid, cellulases, proteases in leather industries biochips.

9 Credit hours
Recommended books

1. Plant Biotechnology in Agriculture- K. Lindsey and M.G.K. Jones
2. Biotechnology : A Text Book of Industrial Microbiology-T.D. Brock
3. Industrial Microbiology-L.E. Casida
4. Industrial Microbiology- Prescott & Dunn
5. Biotechnology-A Hand Book of Industrial Microbiology-W. Crueger and A. Crueger

List of practicals

Credit hours: 12
Maximum Marks: 30

1. Concept and use of autoclave.
2. Microbial cells counting by serial dilution techniques.
3. Microbial cell counting by pore plate techniques.
5. Screening of cellulase producing microorganism from wood degrading soil.
6. Antibiotic sensitivity of the above microorganism.
7. Minimum inhibitory concentration of antibiotics for the above microorganism.
8. Additive and synergistic effect of two drugs on the above microorganisms.
9. Plating the milk samples for microbial contamination.
10. MBRT test for determination of milk quality.
COURSE: Micro-106  
CONCEPTS IN IMMUNOLOGY

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3 0 1 4

Semester end examination: 40 marks  
Practical examination: 30 marks  
Internal Assessment: 30 marks  
Credit hours: 36

Instructions for setting end semester examination question paper

The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit-I

Overview
Types of immunity-innate and adaptive; features of immune response-memory. Specificity and recognition of self and non-self; terminology and approaches to the study of immune system; immunity to viruses, bacteria and fungi.

9 Credit hours

Unit-II

Cells and organs of the immune system
Lymphoid cells, heterogeneity of lymphoid cells, T-cells, B-cells, Null cells; Monocytes, Polymorphs, primary and secondary lymphoid organs-thymus, Bursa of Fabricius, spleen, lymph nodes, lymphatic system, Mucosa Associated Lymphoid Tissue (MALT), Lymphocyte traffic.

9 Credit hours

Unit-III

Humoral immunity
Antigen-antibody interactions; affinity and avidity; high and low affinity antibodies, immuno-globulins, classes and structure, molecular mechanism of generation of antibody diversity, complement fixing antibodies and complement cascade.

9 Credit hours

Cell mediated immunity
T-cell subsets and surface markers, T-dependent and T-independent antigens, recognition of antigens by T-cells and role of MHC, structure of T-cell antigen receptors.

9 Credit hours

Unit-IV

Immuno-diagnostic procedures
Various types of immunodiffusion and immuno-electrophoresis, Immunblot, ELISA, RIA, Agglutination, Haemagglutination and Haemagglutination inhibition assays.

9 Credit hours
Recommended books

1. Immunology- Roitt, I.M. Brostoff, J. and Male, D.K.
2. Immunology- Kuby, J.
4. Fundamental Immunology- Paul, W.E.
5. Monoclonal Antibodies Principles and Application- Britch, J.R. and Lennox, E.S.
6. Medical Immunology- Strites, D.P. Terr, A.I. & Oparslow T.G.
7. Clinical Immunology and Serology: A laboratory perspective- Steverns, C.D.
9.

List of practicals

Credit hours: 12
Maximum Marks: 30

1. Differential leucocytes count.
2. Total leucocytes count.
3. Total RBC count.
5. Hemagglutination inhibition assay.
6. Double immunodiffusion test using specific antibody and antigen.
7. Latex agglutination test.
8. Isolation of mononuclear cells from peripheral blood using Histopaque and viability test by dye exclusion method.
9. Direct and Indirect ELISA.
COURSE: Micro-107  
INSTRUMENTAL METHODS OF ANALYSIS

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Semester end examination: 40 marks  
Practical examination: 30 marks  
Internal Assessment: 30 marks  
Credit hours: 36

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Unit I

Biomolecule purification techniques

Chromatography methods: Gel permeation, ion exchange and affinity chromatography and their applications.

Centrifugation: Principle, concept of RCF, various types of centrifuges and their applications.

Electrophoresis: Principle, native PAGE, SDS-PAGE, 2-D electrophoresis, Pulse-field gel electrophoresis and their applications.

12 Credit hours

Unit II

Spectroscopic techniques

Spectrophotometry (UV & Visible) and spectrofluorimetry, Atomic absorption and atomic emission spectrophotometry. Infrared and Raman spectroscopy, ORD and circular dichorism, nuclear magnetic resonance and electron spin resonance spectroscopy, magnetic resonance imaging.

6 Credit hours

Unit III

Structure analysis

Crystallography and X-Ray diffraction, Electron diffraction and Neutron diffraction.

8 Credit hours

Unit IV

Radioisotope techniques

Radioisotopes, GM Counter, proportional and scintillation counters, autoradiography, Mass spectrometry-GCMS and LCMS.

10 Credit hours

Recommended books

1. Principles and Techniques of Practical Biochemistry- Keith Wilson & John Walker (Eds.)
2. Spectroscopy of Biological Molecules: Modern Trends- P. Carmona, R. Navarro, A. Hernanz (Eds.)
4. Protein NMR for the Millennium (Biological Magnetic Resonance)- N. Rama Krishna, Lawrence J. Berliner (Eds.)

List of practicals

Credit hours: 12
Maximum Marks: 30

1. Verification of Beer and Lambert Law by Biuret Method.
2. To perform salting out for partial purification of protein(s) in a given mixture.
3. Preparation of serum by centrifugation.
4. To separate a mixture of amino acids by Ascending paper chromatography.
5. To separate a mixture of amino acids by Thin layer chromatography.
6. Agarose Gel electrophoresis of DNA.
7. SDS-PAGE of proteins.
8. Polymerase chain reaction.
9. To perform Sandwich ELISA.
10. To check the purity and determine the concentration of DNA by UV Spectrophotometry.
COURSE: Micro-108
INTELLECTUAL PROPERTY RIGHTS AND INTERPRENEURSHIP

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Semester end examination: 40 marks
Practical examination: 30 marks
Internal Assessment: 30 marks
Credit hours: 36

Instructions for setting end semester examination question paper:
The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit-I
Concept of National and International patent laws
8 Credit hours

Unit-II
Legal remedies
Intellectual/ Industrial property and its legal protection in research, design and development.
8 Credit hours

Unit-III
Concept of patenting
Patenting in Biotechnology, economic, ethical and depository considerations.
10 Credit hours

Unit-IV
Entrepreneurship
Selection of a product, line, design and development processes, economics on material and energy requirement, stock the product and release the same for making etc. The basic regulations of excise: Demand for a given product, feasibility of its production under given constraints of raw material, energy input, financial situations export potential etc.
10 Credit hours

Recommended books

Tutorial:

1. Concept of patent writing.

Credit hours: 12
Maximum Marks: 30
COURSE: *Micro-109  
ANIMAL VIROLOGY

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Practical examination: 30 marks  
Internal Assessment: 30 marks  
Credit hours: 36

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UNIT I

Viral structure and classification
Viruses as distinct living organisms. The origin of virology, classification and nomenclature of viruses, isolation, purification and titration of viruses.  
Particles – Structure of viruses – capsid symmetry and architecture, envelop viruses, complex viruses, virus receptors, interaction with the host cell, attachment and penetration. The Baltimore classification.

9 Credit hours

UNIT II

Virus transmission and control

7 Credit hours

UNIT III

Pathogenesis

10 Credit hours

UNIT IV

Important groups of viruses causing diseases in man
Picornaviruses, Papovaviruses, Herpes viruses, Poxviruses, Reoviruses, Paramyxoviruses, Rhabdoviruses, Hepatitis viruses [HAV, HBV and HCV], Orthomyxoviruses, Dengue, Yellow fever and Japanese encephalitis virus.

10 Credit hours

Recommended books

1 Topley and Wilsons Principles of bacteriology, virology and immunology Vol 1-4.  
3 Text Book of Microbiology: Ananthanarayan and Panikar.

**List of practicals**

2. Collection of samples for viral studies.
3. Detection of HAV from blood sample by agglutination test.
4. Detection of HBV from blood sample by agglutination test.
5. Detection of anti-HBsAg antibodies in the given blood samples.
6. Tissue culture methods.
7. Egg inoculation techniques.

Credit hours: 12
Maximum Marks: 30
COURSE: Micro-110  
BACTERIOLOGY

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Internal Assessment: 30 marks  
Credit hours: 36

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UNIT-I


8 Credit hours

UNIT-II

Normal microflora of human body; skin, respiratory system, genitourinary tract, sources of infection, mode of spread.

8 Credit hours

UNIT-III

A detailed account of clinical manifestations, morphological, physiological characteristics, and gross and histopathological changes in tissues caused by: *Staphylococcus aureus* and *S. epidermis*, *Streptococcus pyogenes*, *S. agalactiae* and *s. pneumoniae*, *Bacillus anthracis*, *Clostridium* spp. associated with tetanus, botulinum and gas gangrene diseases, *Listeria monocytogenes*, *Corynebacterium diptheriae*.

10 Credit hours

UNIT-IV

A detailed account of clinical manifestations, caused by the following disease causing organisms: *Mycobacterium tuberculosis* and *M. leprae*, *Neisseria meningitidis* and *N. gonorrhoeae*, *Haemophilus influenza*, *Bordetella pertussis*, *Francisella tularensis*, *Yersinia pestis* and *Y. enterocolitica*. General description and biological properties of Rickettsiae and Chlamydiae.

10 Credit hours

Recommended books

1. Topley and Wilson’ principles of Bacteriology, virology and immunology Vol.-1-IV  
2. Text Book of microbiology- Ananthanaryan and panikar.  
4. Medical microbiology- Mims *et al.*
List of practicals

Credit hours: 12

Maximum Marks: 30

1. Making of a smear of bacteria for simple staining, Gram staining and Acid fast (Ziehl Nelsen) staining.
2. To perform spore staining on a given *Bacillus* sp. culture.
3. Demonstration of motility of bacteria by various methods.
4. Preparation of routine culture broth (say Nutrient broth/ medium).
5. To perform inoculation of culture medium with a suitable bacterial culture.
6. Concept of sterilization methods and autoclaving
7. To perform the biochemical test used for the identification of bacteria.
COURSE: *Micro-111
ENVIRONMENTAL MICROBIOLOGY

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Semester end examination: 40 marks
Practical examination: 30 marks
Internal Assessment: 30 marks
Credit hours: 36

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Unit-I

Microbes and environment
Introduction to types of soil microbes, role of microbes in carbon, sulfur and nitrogen cycle. Factors affecting movement of microorganisms in soil. Isolation and characterization of microbial products of soil. Application of molecular techniques to soil biochemistry & microbiology. Predicting the products of biodegradations. Interaction between soil minerals and microorganisms.

Bioremediation: Microbiology of bioremediation and soil properties, controlling bioremediation.

Microbial degradation: Phenolics, herbicides and pesticides structure of lingo-cellulosics humus and their microbial degradation.

10 Credit hours

Unit-II

Petroleum microbiology
Effect of hydrocarbon on microorganisms. Evidence regarding biogenesis of petroleum. Bacterial products as indicators of petroleum biodegradation. Methanogens, their physiology, ecology, global carbon cycling and biodegradation of toxic chemicals. Microbial biodegradation petroleum products in terrestrial, aquatic environment.

8 Credit hours

Unit-III

Microbiology of air
Structure of atmosphere microbial distribution, organism of fermentation in the air, exhaust gas purification and methods of waste gas treatment.

8 Credit hours

Unit-IV

Sewage & water treatment
Significance of microorganisms present in sewage & water, BOD mechanism & kinetics, BOD in design and operation of biological treatment, BOD as an aid in regulation of water quality. Analysis of water, Quantitative and qualitative methods, coliform organisms in sewage, water borne diseases. Purification of water for industrial, municipal and domestic supply, recycling & treatment of domestic and industrial water.

10 Credit hours
**Recommended books**


**List of practicals**

1. To estimate the percentage of the organic matter in the given sample.
2. To estimate sulphur content in the soil sample.
3. To estimate the nitrate, nitrite concentration in the soil sample.
4. To estimate inorganic phosphorous in soil sample.
5. To isolate antibiotic producing organism, from the given soil sample.
6. To prepare selective media and there by isolate bacteria, fungi and actinomycetes from soil sample.
8. Determination of reducing, non-reducing sugar and total sugar in food sample.
9. Estimation of moisture content in food sample.
10. To determine potability of water (Presumptive and Coliform test).
11. Determination of total solid in milk by lactometer.

Credit hours: 12
Maximum Marks: 30
COURSE: Micro-112
RECOMBINANT DNA TECHNOLOGY

L T P C
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Semester end examination: 40 marks
Practical examination: 30 marks
Internal Assessment: 30 marks
Credit hours: 36

Instructions for setting end semester examination question paper

The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit-I
Historical enzymes
Restriction enzymes, ligases, DNA polymerase, kinases, reverse transcriptase, eEndonucleases and phosphatase.

Unit-II
Vectors
Plasmid, Cosmids, Lambda, Vectors (Intentional & Replacement vectors), M-13, Phagemids

Unit-III
Radioactive and non-radioactive DNA and RNA labeling techniques
Nick translation, random priming, sequencing, Southern and Northern blotting, hybridization

Unit-IV
Mutagenesis
Introduction to site directed mutagenesis, PCR and its applications, transformation of E. coli yeast, animal and plant cells, Genomic cloning, cDNA cloning and colony hybridization. Application of rDNA technology to medicine, agriculture and environment.

Recommended books

4. Recombinant Gene Expression Protocols- Tuan Rockey S
5. PCR Cloning Protocols- White Bruce A
List of practicals

Credit hours: 12
Maximum marks: 30

1. DNA isolation from plant tissue.
2. DNA isolation from *E. coli*.
3. Spectrophotometer analysis of DNA.
4. Agarose gel electrophoresis of DNA.
5. Plasmid DNA isolation.
6. Restriction digestion of DNA.
7. Southern blotting.
SOFT CORE COURSES

COURSE: Micro-121
PARASITOLOGY

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Practical examination: 30 marks
Internal Assessment: 30 marks
Credit hours: 36

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UNIT I
Protozoology
Brief history of protozoology, ecology and host parasite relationship (parasitism and symbiosis): Basis of host cell parasite interactions with special reference to autoimmune response and pathogenesis of protozoan diseases in general, zoonotic potentiality of protozoa.

9 Credit hours

UNIT II
Amoeba
Non pathogenic and pathogen amoeba. Morphology and life cycle of amoeba, pathology, symptomatology and laboratory diagnosis of the following:

a) Giardia (G. lamblia)
b) Flagellates of genital tract Trichomonas (T. tenax, T. hominis and T. vaginalis).
c) Malaria parasite (Plasmodium vivax, P. malariae and P. ovale) General life cycle of Malarial parasite in man and anopheles mosquito, sequale of malaria, Toxoplasma gondi, life cycle, symptomatology, transmission and lab diagnosis of toxoplasmosis.

9 Credit hours

UNIT III
Helmints

9 Credit hours

UNIT IV
Medical entomology
Role of arthropods in the spread and causation of parasite diseases .Classification and general characteristics of important insect-vectors. Mode of transmission of various diseases.

9 Credit hours
**Recommended books**

1. Parasitology (K.D. Chatterjee).
2. Medical Parasitology (Gillespie and Hawkey).
4. Essential of Parasitology (Schimidt).

**List of practicals**

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<tr>
<td>1. To perform microscopic examination of cyst like <em>E. histolytica</em>, <em>E. coli</em>, <em>Giardia. intestinalis</em> in the given stool sample.</td>
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<td>2. To observe the given stool sample &amp; identify helmenthic ova.</td>
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<td>3. To perform microscopic examination for the given urine sample.</td>
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<td>4. To perform microscopic examination for the given stool sample.</td>
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<td>5. Examination of stool sample using concentration technique for ova.</td>
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<td>6. Examination of blood film for Malaria, Filaria and Leishmania.</td>
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COURSE Micro-122
APPLIED MICROBIOLOGY

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Semester end examination: 40 marks
Practical examination: 30 marks
Internal Assessment: 30 marks
Credit hours: 36

Instructions for setting end semester examination question paper

The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

UNIT-I

Host parasite relationship of infectious diseases
General physical, chemical barriers and biological barriers. Specific and non-specific immune defense mechanisms of host defense.

Epidemiological features
Epidemiology of infectious diseases, infectious disease cycle, transmission of infectious agents, epidemics of nosocomial infections, salient features of prevention, surveillance and control of epidemics.

UNIT-II

Viral diseases
Influenza, measles, yellow fever, rabies, poliomyelitis and AIDS. Microbial disease of humans caused by chlamydiae, rickettsiae, Gram positive and Gram negative organisms, human mycotic and parasitic infections.

UNIT-III

Food and dairy microbiology
Food spoilage, food borne disease, assessing microbial contents of food. food preservation, food sanitation and microbiology of milk and dairy products.

Soil and agriculture microbiology
Agriculture and soil microbiology, pesticides, microbial insecticides, ruminants and microorganisms; Industrial microbiology, industrial fermentation of alcohol and alcoholic beverages, antibiotic fermentation, vitamins and amino-acids, microbial bioconversions, enzymes production by microorganisms.

UNIT-IV

Introduction to general pathology
History, development and relevance of study in relation to human. Study of homeostasis, febrile reaction, intra and extra cellular environment of cells and factors affecting the constancy of environment, degenerations, cloudy swelling, fatty degeneration glycogen infiltration, hyaline degeneration, amyloidosis.

Necrosis: Its pathogenesis and role of ischaemia in necrosis, inflammations, various type of acute and chronic inflammatory reactions pathogenesis. Types of wounds, ulcers, their pathogenesis and process of repair. Healing by primary and secondary infection. Factor
affecting wounds healing allergic inflammation and its role in diseases. Haemorrhage, shock, ischaemia, odema, thrombosis and embolism.

**Recommended books**

1. Microbiology by Pelczar *et al*
2. Pathology by Anderson. vol. I & II.

**List of practicals**

Credit hours: 12  
Maximum marks: 30

1. Isolation of microorganisms from air, water and soil sample.  
2. Bacterial examination of milk.  
3. To determine the quality of milk by dye reduction test.  
4. Estimation of haemoglobin.  
6. Negative staining  
7. Acid- fast staining.  
8. To demonstrate the bacterial motility.
COURSE: Micro-123  
MYCOLOGY  

Semester end examination: 40 marks  
Practical examination: 30 marks  
Internal Assessment: 30 marks  
Credit hours: 36

Instructions for setting end semester examination question paper

The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

UNIT I
Overview
General characteristics of molds, types of reproduction and spore types.  
Ecophysiology: Lichens, their associations and applications, syngamy, hormones, synthetic fungicides and fungal toxins.

9 Credit hours

UNIT II
Mycotechnology
Fungi in the production of antibiotics, organic acids, vitamins and single cell protein, alcohols, oriental food fermentation and solid substrate fermentation, mushrooms and their cultivation.

9 Credit hours

UNIT III
Nutrient transport
Absorption of nutrients, transport mechanism, chemical and physical environment for growth, and fungal attack mechanisms.  
Fungal genetics and mycoviruses: General information about genetics of fungi, various mycoviruses, their nature and multiplication.

9 Credit hours

UNIT IV
Medical mycology
Dimorphic fungi, fungal infection(s) of skin, nail and hair, subcutaneous mycoses systemic mycoses, opportunistic fungal infections, Mushroom food poisoning. Plant Pathology: Fungi in relation to plant diseases.

9 Credit hours

Recommended books

2. Introduction to Fungi by Webster (1992)
7. Ectomycorrhizal Fungi Caiey J.W.C 1999
8. The Mycota Esserk

**List of practicals**

Credit hours: 12
Maximum Marks: 30

1. Identification of pathogenic and non-pathogenic fungi.
2. Preparation of media for isolating fungi.
3. To find heterocyst frequency.
4. To examine the amylolytic activity of fungi.
5. To prepare media for isolating non-symbiotic-nitrogen fixing bacteria, ammonifying bacteria, and nitrifying bacteria.
Course: Micro-124
Medical Microbiology

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3 0 1 4

Semester end examination: 40 marks
Practical examination: 30 marks
Internal Assessment: 30 marks
Credit hours: 36

Instructions for setting end semester examination question paper

The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

UNIT-I

Sample collection and indexing
Preparation of container and swabs for collections of specimens for microbial examination. Portal regulation and transport of specimen, flowchart of lab diagnostic procedures, and documentation of specimen in laboratory.

9 Credit hours

UNIT-II

Handling pathogenic microbes
Infection syndrome and diagnostic procedure, strategy of antimicrobial therapy, prophylactic mass immunization, nosocomial infection and sterility testing of I.V. fluids and processing of various samples for various hospital infections.

9 Credit hours

UNIT-III

Bacterial culture and typing
Preservation of pure culture: Periodic subculture methods, cold storage, freezing, deep-freezing, lyophilization methods; Blood culture, cell tissue and organ culture; Total and viable counts of bacteria; Epidemiology markers of microorganisms: Serotyping and Bacteriophage typing.

9 Credit hours

UNIT-IV

Antimicrobial drug sensitivity
Diagnosis, treatment and control of common infections and infestations; Specific serological methods of diagnosis; Test of sensitivity to anti microbial agents and their preparation; Specific culture and drug sensitivity methods.

9 Credit hours

Recommended books

1. Topley and Wilson’ principles of bacteriology, virology and immunology Vol.-1-IV.
2. Text Book of microbiology- Ananthanaryan and Panikar.
4. Medical microbiology- Mims et al.
List of practicals

1. Antibiotic sensitivity (one organism).
2. Collection and processing of specimens like blood, urine, stool, pus etc. and isolating the causative organism (any one material).
3. Detection of antibody levels of sera taken from patients suspected to be suffering from a bacterial infection (one sample).
4. Antigenic characterization of an unknown organism (one sample).
5. Animal inoculation.
6. Antibiotic sensitivity (one organism).
COURSE: Micro-125
ANIMAL CELL CULTURE TECHNIQUES

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Semester end examination: 40 marks
Practical examination: 30 marks
Internal Assessment: 30 marks
Credit hours: 36

Instructions for setting end semester examination question paper
The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

Unit-I
Development of cell culture techniques
History of development of cell cultures, the natural surroundings of animal cells, stimulating natural conditions for animal cells, metabolic capabilities of animal cells.

Sterilization techniques in cell culture
Aseptic techniques in animal tissue culture; sterilization of culture media, glassware and tissue culture laboratory, detection of contamination, safety considerations in ATC laboratory.

9 Credit hours

Unit-II
Animal cell culture techniques
Dispersion and disruption of tissues; primary cultures, anchorage and non-anchorage dependent cells; secondary cultures, transformed animal cells, established/continuous cell lines; measurement of growth and viability of cells in culture, tissue culture media: Components their importance. Serum free media.

9 Credit hours

Unit-III
Cell line and their characteristics
Commonly used animal cell lines, their origin and characteristic, growth kinetics of cells in culture, differentiation of cells, organ culture, expressing cloned protein genes in animal cell cultures.

Applications
Cell fusion and production of monoclonal antibodies; scale up methods for propagation of anchorage dependent and suspension cell culture; bioreactors for large scale culture of cells, micro carrier culture, transplanting cultured cells.

8 Credit hours

Unit-IV
Genetic engineering in animal cells
Transformation of animal cells, vectors and expression vectors, Genetic Engineering in production or regulatory proteins, blood products, vaccines and hormones, transgenic animals and production of useful products in transgenic animals; in vitro fertilization, embryo transfer, cloning: methodology and its applications, ethics in cloning.

10 Credit hours
Recommended books

1. Mammalian Cell Biotechnology – A Practical Approach- Butler, M.
2. Culture of Animal Cells- Freshney, R. T.
3. Human Cell Culture Protocols- Gareth, E.J.
4. The Animal Cell Culture and Technology- Butler, M.
5. Cell Biology-A Laboratory hand books- Julio, E., Celis
6. Gene Therapeutics- Wolff, J.E.D.
7. Genes in Medicine- Rasko, L., and Downes, C.S.
8. Molecular Biotechnology Therapeutic Application and Strategies- Maulik S. and Patel, S.D.
10. Culture of Animal Cells- Freshney, R.T.

List of practicals

Credit hours: 12
Maximum marks: 30

1. Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization
2. Sources of contamination and decontamination measures.
3. Preparation of Hanks Balanced salt solution
4. Preparation of Minimal Essential Growth medium
5. Isolation of lymphocytes for culturing
6. Isolation of rat macrophages from peritoneum for culturing
7. Primary Lymphoid culture
8. DNA isolation from animal tissue
9. Quantification of isolated DNA
10. Resolving DNA on Agarose Gel.
COURSE: Micro-126  
PHYCOLOGY

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Semester end examination: 40 marks  
Practical examination: 30 marks  
Internal Assessment: 30 marks  
Credit hours: 36

Instructions for setting end semester examination question paper

The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

UNIT I

Introduction to algae

9 Credit hours

UNIT II

Nitrogen fixation

9 Credit hours

UNIT III

Photosynthesis
The physical nature of light, pigments in systems of photosynthesis, the photosynthesis apparatus path electron in photosynthesis, factors affecting the rate of photosynthesis and carbon fixation. Respiration, photorespiration, fermentation, substrate assimilation and heterotrophy.

9 Credit hours

UNIT IV

Applications
Algae as bio fertilizer, algae as food including single cell protein. Source of agar-agar, alginate, diatoms and iodine etc. Antibiotics from algae, role of algae in indicating pollution (water pollution), algal photosynthesis in sewerage treatment.

9 Credit hours
List of practicals

Credit hours: 12
Maximum marks: 30

1. Identification of pathogenic and non-pathogenic fungi.
2. Preparation of media for isolating fungi.
3. To find heterocyst frequency.
4. Quantification of total chlorophyll by cold extraction method.
5. Quantification of total chlorophyll by warm extraction method.
6. Quantification of carotenoids in given algal sample using organic solvents.
7. To examine the amylolytic activity of fungi.
8. To prepare media for isolating non symbiotic-nitrogen fixing bacteria ammonifying bacteria and nitrifying bacteria.
COURSE: Micro-127
FERMENTATION TECHNOLOGY

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Semester end examination: 40 marks
Practical examination: 30 marks
Internal Assessment: 30 marks
Credit hours: 36

Instructions for setting end semester examination question paper

The examiner will set nine questions in all. Q. No. 1 will be compulsory, objective type and covering entire syllabus. There will be 2 questions from each unit and each question will have 3-4 parts. Students will attempt one question from each unit including compulsory question and each question will carry 8 marks.

UNIT I
Fermentation
Definition and scope of fermentation, Isolation and preservation of industrial cultures, selection and design, Biochemical basis and overview of products based on enzyme catalysis and cell metabolism, Basic design and operation of fermenter, Economics of fermentation processes.

9 Credit hours

UNIT II
Solid state fermentation
Advantages and disadvantages of solid state fermentation, Effect of environmental parameters on kinetics and growth of product formation and cellular physiology, Process variables and process control, Principles of solid state bioreactor design and operation and product leaching, Primary and secondary metabolites, Integrated process analysis of a few bio-process technology products like baker's yeast, ethanol, acetone, butanol, organic acids and enzymes.

9 Credit hours

UNIT III
Bio-process technology
Bio-process technology for the production of recombinant vaccines, therapeutic proteins, antibiotics and diagnostics; Energy forming bio-processes for the production of liquid fuel (ethanol), and gaseous fuel (methane), Microbial production of hydrogen.

10 Credit hours

UNIT IV
Advanced control strategies
Monitoring and control of environmental parameters in fermentation process, enzyme and microbial cell based bio-sensors.

8 Credit hours
List of books

1. Biochemical Engineering: Aiba and Hemphery
2. Principles of Microbes and Cell Cultivation: S. John Pirt
4. Industrial Microbiology: L. E. Casida
4. Industrial Microbiology: Prescott and Dunn
5. Principles of fermentation technology: P.F. Stanbury and A. Whitekar

List of practicals

1. Basic design of a laboratory fermenter.
2. Cleaning and sterilization of fermenter vessel.
3. Determination growth curve in a batch culture.
4. Determination of viability of cells in a yeast culture by Methylene Blue staining, Plate count and Haemocytometer methods
5. Production of Ethanol by simple/complex carbohydrate sources (media) using Saccharomyces cerevisiae.
6. Production of wine from apple / grape juice by Saccharomyces cerevisiae.
7. Production of citric acid by solid-state-fermentation using Aspergillus niger.