# COURSE OUTLINE

## B.Sc. WITH MAJOR IN MICROBIOLOGY CBCS-2015

### HIMACHAL PRADESH UNIVERSITY

## SHIMLA

## Effective from session 2015-16

**HIMACHAL PRADESH UNIVERSITY**
SUMMER-HILL, SHIMLA-171005

# 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:

| | |
|---|---|
| ≥ 75% but < 80% | 1 marks |
| ≥ 80% but <85% | 2 marks |
| ≥ 85 but <90% | 3 marks |
| ≥ 90% but < 95% | 4 marks |
| ≥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]**<br><br>**L: Lecture T: Tutorial P: Practical C: Total credits** | | | | | |
|---|---|---|---|---|---|
| **Code** | **Hard core courses** | **L-T-P-C** | **Code** | **Soft core courses** | **L-T-P-C** |
| *Micro -101 | General Microbiology | 3-0-1-4 | Micro-121 | Parasitology | 3-0-1-4 |
| Micro-102 | Basic Biochemistry | 3-0-1-4 | Micro-122 | Applied Microbiology | 3-0-1-4 |
| *Micro -103 | Microbial Metabolism | 3-0-1-4 | Micro-123 | Mycology | 3-0-1-4 |
| *Micro -104 | Genetics & Molecular Biology | 3-0-1-4 | *Micro-124 | Medical Microbiology | 3-0-1-4 |
| *Micro -105 | Industrial Microbiology | 3-0-1-4 | Micro-125 | Animal Cell Culture Techniques | 3-0-1-4 |
| Micro-106 | Immunology | 3-0-1-4 | Micro-126 | Phycology | 3-0-1-4 |
| Micro-107 | Instrumental Methods of Analysis | 3-0-1-4 | Micro-127 | Fermentation Technology | 3-0-1-4 |
| Micro-108 | Intellectual Property Rights & Entrepreneurship | 3-1-0-4 | | | |
| *Micro -109 | Animal Virology | 3-0-1-4 | | | |
| Micro-110 | Bacteriology | 3-0-1-4 | | | |
| *Micro -111 | Environmental Microbiology | 3-0-1-4 | | | |
| Micro-112 | Recombinant DNA Technology | 3-0-1-4 | | | |

**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] |
|---|
| Commercial arts |
| German language |
| Russian language |
| Spoken English |
| Photography |
| General computer applications |
| Fine arts |
| Playing musical instrument(s) |

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

| Semester | Courses to be opted | Course name | Credits | |
|---|---|---|---|---|
| | | | Course | Cumulative |
| **I [ODD]** | Compulsory Course-I | Select from the listed compulsory courses | 3 | Compulsory: 03<br>Core: 08<br>Elective: 08<br>GI & H: 01<br>**Total: 20** |
| | **Major Core Course-I Micro-101** | **General Microbiology** | **4** | |
| | **Major Core Course-II Micro-102** | **Basic Biochemistry** | **4** | |
| | Minor Elective Course-I (a) | To be selected from the list of minor elective courses | 4 | |
| | Minor Elective Course-I (b) | To be selected from the list of minor elective courses | 4 | |
| | GI & H Course-I | To be selected from the list of GI & H courses | 1 | |
| **II [EVEN]** | **Major Core Course-III Micro-103** | **Microbial Metabolism** | **4** | Compulsory: 03<br>Core: 08<br>Elective: 08<br>GI & H: 01<br>**Total: 20** |
| | **Major Core Course-IV Micro-104** | **Genetics & Molecular Biology** | **4** | |
| | Compulsory Course-II [Skill based] | To be selected from the list of compulsory courses | 3 | |
| | Minor Elective Course-II (a) | To be selected from the list of minor elective courses | 4 | |
| | Minor Elective Course-II (b) | To be selected from the list of minor elective courses | 4 | |
| | GI & H Course-II | To be selected from the list of GI & H courses | 1 | |
| **III [ODD]** | **Major Core Course-V Micro-105** | **Industrial Microbiology** | **4** | Compulsory: 03<br>Core: 08<br>Elective: 08<br>GI & H: 01<br>**Total: 20** |
| | **Major Core Course-VI Micro-106** | **Immunology** | **4** | |
| | Compulsory Course-III | To be selected from the list of compulsory courses | 3 | |
| | Minor Elective Course-III (a) | To be selected from the list of minor elective courses | 4 | |
| | Minor Elective Course-III (b) | To be selected from the list of minor elective courses | 4 | |
| | GI & H Course-III | To be selected from the list of GI & H courses | 1 | |
| **IV [EVEN]** | **Major Core Course-VII Micro-107** | **Instrumental Methods of Analysis** | **4** | Compulsory: 03<br>Core: 08<br>Elective: 08<br>GI & H: 01<br>**Total: 20** |
| | **Major Core Course-VIII Micro-108** | **Intellectual Property Rights & Entrepreneurship** | **4** | |
| | Compulsory Course-IV [Skill based] | To be selected from the list of compulsory courses | 3 | |

| | | | | |
|---|---|---|---|---|
| | Minor Elective Course-IV (a) | To be selected from the list of minor elective courses | 4 | |
| | Minor Elective Course-IV (b) | To be selected from the list of minor elective courses | 4 | |
| | GI & H Course-IV | To be selected from the list of GI & H courses | 1 | |
| **V [ODD]** | **Major Core Course-XI Micro-109** | **Animal Virology** | **4** | Core: 12<br>Elective: 08<br><br>**Total: 20** |
| | **Major Core Course-X Micro-110** | **Bacteriology** | **4** | |
| | **Major Core Course-XI Micro-111** | **Environmental Microbiology** | **4** | |
| | Minor Elective Course-V (a) | To be selected from the list of minor elective courses | 4 | |
| | Minor Elective Course-V (b) | To be selected from the list of minor elective courses | 4 | |
| **VI [EVEN]** | **Major Core Course-XII Micro-112** | **Recombinant DNA Technology** | **4** | Core: 12<br>Elective: 08<br><br>**Total: 20** |
| | **Major Soft Core Course [Micro-121 to 127]** | To be selected from the list of Major Soft core courses | **4** | |
| | **Major Soft Core Course [Micro-121 to 127]** | To be selected from the list of Major Soft core courses | **4** | |
| | Minor Elective Course-VI (a) | To be selected from the list of minor elective courses | 4 | |
| | Minor Elective Course-VI (b) | To be selected from the list of minor elective courses | 4 | |

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.
2. Microbiology: an introduction- Tortora, G.J., Funke, B.R. and Case, C.L.
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. Dilution and pour plating techniques.
6. Enumeration of microorganism's vs viable counts.
7. Identification of isolated bacteria
8. Gram staining, other staining methods, metabolic characterization (e.g. IMVIC) tests
9. Growth curve of microorganisms.
10. Antibiotics sensitivity of microbes using antibiotic discs.
11. Testing of water quality
12. Test for antibodies against given bacterium
13. One step growth of bacteriophage.
14. Culture from body fluids (stool, Urine, blood).
15. 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, pI, 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.**
2. Principles of Biochemistry- **Lehninger, A.L. Nelson, D.L. and Cox, M.M**
3. Biochemistry- **Stryer, L.**
4. Principles of Biochemistry: Student Study Art Notebook- **Zubay, G.L, Parson, W.W. and Vance, D.E.**
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**

Credit hours: 12
Maximum Marks: 30

1. Preparation of physiological buffers.
2. Verification of Beer and Lamberts law for *p*-nitrophenol or cobalt chloride.
3. Determination $pK_a$ value of *p*-nitrophenol.
4. The colorimetric estimation of inorganic phosphates.
5. Estimation of carbohydrates in a given solution by Anthrone method.
6. Estimation of sugars in biological samples.
7. Protein estimation by Lowry's method.
8. Protein estimation by Bradford methods.
9. Analysis of urine for urea, glucose, uric acid and chloride.
10. The determination of acid value of a fat.
11. Saponification value of a fat.
12. Separation of lipids by thin layer chromatography.

## COURSE: *Micro-103
## MICROBIAL METABOLISM

| 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

**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 archaebacteria.

Microbial nutrition, classification of microorganisms on the basis of their nutrition requirements. Uptake of nutrients.

8 Credit hours

### Unit-II

**Metabolic pathways**

Detailed study of carbohydrates catabolism with special emphasis of bacteria and yeasts. Glycolysis, Phosphogluconate Pathway, Heterolactic Fermentation, Enter-Dudoroff Pathway, Neuberg's Schemes of Glucose fermentation, Mixed Acid Fermentation, Butyric Acid and solvents producing fermentations. Methyl glyoxal metabolism. Krebs cycle, Glyoxylate cycle, Electron tTransport and Chemiosomotic theory. Metabolism of nitrogen compounds, anaerobic amino acids catabolism, paired degradation of amino acids (Stickland reaction).

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**


1. Principles of Biochemistry- **Lehninger, A.L. Nelson, D.L. and Cox, M.M.**
2. Biochemistry of Industrial Micro-organisms – **Eds., C. Rainbow, A. H. Rose and A.C. Press, New York**.
3. Chemical Microbiology – **A. H. Rose**
4. Bacterial Metabolism - **G. Gottschalk,** Springer Verlag.
5. Principles of Fermentation Technology - **Whittaker**
6. Biochemistry- **Stryer, L**
7. The Microbial World-**Stanier, R.Y. et al. Prentice Hall (India) Pvt. Ltd.**
8. Microbial Physiology-**Moat, A.G. & Foster, J.W. John Wiley & Sons.**


**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.
4. Analysis of bacterial growth and calibration of a growth curve.
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

| 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

**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**

Mendelian Laws of inheritance, gene interactions. Extra-chromosomal inheritance, mitochondrial and chloroplast genetic systems: sex linked inheritance.

Linkage and recombination of genes in chromosomes, crossing over and its molecular mechanism, gene mapping by three point test crosses, mapping by tetrad analysis, somatic cell hybridization for gene linkage studies, recombination within genes.

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.**
6. Genetics: Analysis of Genes and Genomes- **Hartl, D.L. Jones, E.W.**

**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

| 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

**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**

Introduction, plant microbe interactions, BT gene in BT cotton, *Rhizobium*, *Azospirillum*, *Azobacter*, *Anabena* in nitrogen fixation, *Agrobacterium*, *Spirulina* production, soil treatment with microbes, Mycorrhizal fungi, microbial pesticides, mycoherbicides.

12 Credit hours

### Unit-IV

**Microbial process in industrial biotechnology**

Introduction, primary and secondary metabolites production, production of vitamins, $B_{12}$, 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**
6. Microbial Biotechnology-**A. N. Glazer and H. Nikaids.**

**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.
4. Measurement of bacterial size by using micrometers.
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

| 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

**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.**
3. Principles of Cellular and Molecular Immunology- **Austyn, J.M. and Wood, K.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.**
8. Cell Biology: A Laboratory Handbook- **Celies, J.E.**
9.

**List of practicals**

Credit hours: 12
Maximum Marks: 30

1. Differential leucocytes count.
2. Total leucocytes count.
3. Total RBC count.
4. Hemagglutination assay.
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

| 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

**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 spectroflourimetry, 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.)**
3. Molecular Fluorescence: Principles and Application- **Bernard Valeur**

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

| L | T | P | C |
|---|---|---|---|
| 3 | 1 | 0 | 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

**Concept of National and International patent laws**

Introduction to Indian Patent Law. World Trade Organization and its related intellectual property provisions.

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.
Patentable subject matter and legal aspects of transfer of Biotechnology in India. Writing a patent specification. Information sources in Patent Literature search.

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**


1. Agriculture and Intellectual Property Rights: Economic, Institutional and Implementation Issue in Biotechnology-**V Santaniello, R.E. Evenson, D. Zilberman, G. A. Carlsons.**

**Tutorial:**

Credit hours: 12
Maximum Marks: 30

1. Concept of patent writing.
2. Patent search.

## COURSE: *Micro-109
## ANIMAL VIROLOGY

| 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

**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**

Pathogenesis and immune mechanism of viral infections. Transmission of viruses and epidemiology of viral infections, prevention and control measures of viral infections.

7 Credit hours

### UNIT III

**Pathogenesis**

Mechanism of cellular injury, viruses and immuno deficiency –HIV and AIDS, cellular viruses and cancer. Prevention and therapy of viral infections. Novel infectious agents: Emergent viruses, satellites, viriods and prions.

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.
2 Borrow Textbook of Microbiology: Freeman.
3 Text Book of Microbiology :Ananthanarayan and Panikar.

4 Introduction to Modern Virology : NJ Dimmock.
5 Principles of Molecular Virology. Alan J Conn Academic Press.

**List of practicals**

Credit hours: 12
Maximum Marks: 30

1. Electron microscopy and preparation of EM grid.
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.

## COURSE: Micro-110
## BACTERIOLOGY

| 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 and development of medical microbiology. Biological properties of etiological agents. Mechanisms of bacterial pathogenicity. Nature of damage to the tissue caused by infectious agents and the defenses of host. Epidemiology and control of community infections. Salient features of laboratory diagnosis of common bacterial infections.

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-II

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 meningititis* and *N. gonorrhoeae*, *Haemophilus influenza*, *Bordetella pertusis*, *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.
3. Medical microbiology- Greenwood, Stack and Penthre.
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**

| 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

**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**


1. Environmental Microbiology, Rose, Vol. I, II, III, 1995.
2. Soil Microbiology by Martin Alexander, 1996.
3. Soil Biochemistry, Vol. I, II by Paul, Meclaren Vol. I, 1995.
4. Microbial Communities, Insam, H., Rangger, A., 1997
5. Environmental and Microbial Relationships, Wicklow D. T & Soders from B.E., 1997.
6. Methods in Soil Biology, Schinner, F., 1996
7. Microbial Biochemistry, Zagic, 1994.
8. Comprehensive Biotechnology, Moo Young, 1995.
9. Environmental Microbiology, Rose Vol. III – V, 1999.


**List of practicals**

Credit hours: 12
Maximum Marks: 30

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.
7. Estimation of fat content in milk by Gerber test.
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.

## COURSE: Micro-112
## RECOMBINANT DNA TECHNOLOGY

| 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

**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**


1. Molecular cloning: A Laboratory Manual- **J.Sambrook, E.F. Fritsch and T.Maniatis**
2. Principles of Gene Manipulation: An introduction to Genetic Engineering- **R.W. Old and S.B. Primrose**
3. Gene Probes I.A. Practical Approach- **B.D. Hames and S.J. Higginis**
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.
8. Making bacterial competent cells.
9. Transformation of competent bacterial cells.

# SOFT CORE COURSES

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## COURSE: Micro-121
## PARASITOLOGY

| 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

**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**

Genaral introduction of helminthes and classification, medically important hemimths . Immunity in *Taenia saginata*, *T. solium*, *Echinococcus granulosis*, Trematodes, Schistosomes (*S. haematobium*, *S.mansoni* and *S. japonicum*). Nematodes. *Ascaris lumbriicoides* and *Ancylostome duodenale*, Strongyloides stercoralis, Enterrobius, wuchereria bancrofti, Brugia Malayi, Dracunculus medinesis.

9 Credit hours

### UNIT IV

**Medical entomology**

Role of arthrophods 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).
3. Modern Parasitology (F.E.G Cox).
4. Essential of Parasitology (Schimidt).

**List of practicals**

Credit hours: 12
Maximum marks: 30

1. To perform microscopic examination of cyst like *E. histolytica*, *E. coli*., *Giardia. intestinalis* in the given stool sample.
2. To observe the given stool sample &identify helmenthic ova.
3. To perform microscopic examination for the given urine sample.
4. To perform microscopic examination for the given stool sample.
5. Examination of stool sample using concentration technique for ova.
6. Examination of blood film for Malaria, Filaria and Leishmania.

## COURSE Micro-122
## APPLIED 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

**Host parasite relationship of infectious diseases**
General physical, chemical barriers and biological barriers. Specific and non-specific immune defense mechanisims 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 chalamydiae , rickettsiae, Gram positive and Gram negative organisms, human mycotic and paracitic 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, isochaemia, odema, thrombosis and embolism.

**Recommended books**

1. Microbiology by Pelczar *et al*
2. Pathology by Anderson. vol. I & II.
3. Text book of pathology by William Boyd.

**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.
5. Estimation of E.S.R and P.C.V. Value.
6. Negative staining
7. Acid- fast staining.
8. To demonstrate the bacterial motility.

## COURSE: Micro-123
## MYCOLOGY

| 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

**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**


1. The Fungi by Ain Sworth vol 2, 3, 4 (1997)
2. Introduction to Fungi by Webster (1992)
3. The Biology of Fungi, In gold (1994)
4. Phycotoxin & Mycotoxin Steyn Vleggaar (1994)
5. Human Mycoses –Ben eke Rippan and Rogers (1995)
6. The Fungi Vol 1 and Vol 2 (1993)
7. Ectomycorrihizal 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**

| 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

**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.
3. Medical microbiology- Greenwood, Stack and Penthre.
4. Medical microbiology- Mims *et al.*

**List of practicals**

Credit hours: 12
Maximum Marks: 30

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

| 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

**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, I., and Downes, C.S.**
8. Molecular Biotechnology Therapeutic Application and Strategies- **Maulik S. and Patel, S.D.**
9. Mammalian Cell Biotechnology. A practical approach- **Butler, M.C.**
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

| 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

**Introduction to algae**

The position of algae in continuation of life, general classification, comparative morphology and reproduction. Phycoviruses: Structure and multiplication of phyco-viruses (Mainly Cyanophages).

Physiological aspects of ecology: Fresh water algae, soil algae, marine algae (seaweeds), aerial algae and algae as symbiont.

9 Credit hours

### UNIT II

**Nitrogen fixation**

Site of nitrogen fixation, heterocyst, ultrastructure of heteorocyst, heteorocyst in nitrogen fixation in cyanobacteria, nitrogenase and biochemistry of nitrogen. Nitrogen assimilation, amino acids and proteins, inorganic phosphorous uptake and metabolism. Sulphur, halogen, major cations and inorganic micronutrients.

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

| 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

**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.*