

SYLLABUS

B.Sc. WITH MAJOR IN MICROBIOLOGY CBCS-2013

SYLLABUS

HIMACHAL PRADESH UNIVERSITY

SHIMLA

Effective from session 2013-14

COURSE: *Micro-101
GENERAL MICROBIOLOGY

L	T	P	C
3	0	1	4

Semester end examination: 40 marks

Practical examination: 25 marks

Internal Assessment: 35 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 heterologous 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- Prescott 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: 25

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: 25 marks

Internal Assessment: 35 marks

Credit hours: 36

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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: 25

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: 25 marks

Internal Assessment: 35 marks

Credit hours: 36

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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 archaeobacteria.

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, Neuberger's Schemes of Glucose fermentation, Mixed Acid Fermentation, Butyric Acid and solvents producing fermentations. Methyl glyoxal metabolism. Krebs cycle, Glyoxylate cycle, Electron Transport and Chemiosmotic 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: 25

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: 25 marks

Internal Assessment: 35 marks

Credit hours: 36

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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: 25

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: 25 marks

Internal Assessment: 35 marks

Credit hours: 36

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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, 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**
6. Microbial Biotechnology-**A. N. Glazer and H. Nikaido.**

List of practicals

Credit hours: 12
Maximum Marks: 25

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: 25 marks

Internal Assessment: 35 marks

Credit hours: 36

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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, Immunoblot, 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- **Stevens, C.D.**
8. Cell Biology: A Laboratory Handbook- **Celies, J.E.**
- 9.

List of practicals

Credit hours: 12
Maximum Marks: 25

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: 25 marks
Internal Assessment: 35 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 dichroism, 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: 25

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: 25 marks

Internal Assessment: 35 marks

Credit hours: 36

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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: 25

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: 25 marks

Internal Assessment: 35 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

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, virioids 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: 25

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-111
ENVIRONMENTAL MICROBIOLOGY

L	T	P	C
3	0	1	4

Semester end examination: 40 marks

Practical examination: 25 marks

Internal Assessment: 35 marks

Credit hours: 36

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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: 25

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: 25 marks

Internal Assessment: 35 marks

Credit hours: 36

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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, endonucleases and phosphatase.

Unit-II

Vectors

Plasmid, Cosmids, Lambda, Vectors (Intentional and 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. Higgins**
4. Recombinant Gene Expression Protocols- **Tuan Rockey S**
5. PCR Cloning Protocols- **White Bruce A**

List of practicals

Credit hours: 12

Maximum marks: 25

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

COURSE: Micro-121 PARASITOLOGY

L	T	P	C
3	0	1	4

Semester end examination: 40 marks
Practical examination: 25 marks
Internal Assessment: 35 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;

- Giardia (*G. lamblia*)
- Flagellates of genital tract Trichomonas (*T. tenax*, *T. hominis* and *T. vaginalis*).
- 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

Helminths

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

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

List of practicals

Credit hours: 12
Maximum marks: 25

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: 25 marks

Internal Assessment: 35 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.
3. Text book of pathology by William Boyd.

List of practicals

Credit hours: 12
Maximum marks: 25

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: 25 marks
Internal Assessment: 35 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. Ectomycorrhizal Fungi Caiey J.W.C 1999

8. The Mycota Esserk

List of practicals

Credit hours: 12
Maximum Marks: 25

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: 25 marks

Internal Assessment: 35 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: 25

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: 25 marks
Internal Assessment: 35 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: 25

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: 25 marks
Internal Assessment: 35 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 heterocyst, heterocyst 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: 25

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: 25 marks
Internal Assessment: 35 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*.