



HIMALAYAN UNIVERSITY, ARUNACHAL PRADESH

MASTER OF SCIENCE

(M.SC. – Micro Biology)

1st YEAR

S. NO.	SUB. CODE	SUBJECT NAME	MARKS			
			INTERNAL	THEORY	TOTAL	PASS
1	101	Microbiology and Molecular Genetics	30	70	100	40
2	102	Microbial Physiology and Metabolism	30	70	100	40
3	103	Immunology	30	70	100	40
4	104	Bioinstrumentation	30	70	100	40
5	105	Virology	30	70	100	40
6	106	Microbial Technology	30	70	100	40
7	107	Basic Practical	30	70	100	40

2nd YEAR

S. NO.	SUB. CODE	SUBJECT NAME	MARKS			
			INTERNAL	THEORY	TOTAL	PASS
1	201	Medical Microbiology	30	70	100	40
2	202	Biostatistics and Research Methodology	30	70	100	40
3	203	Environmental and Agricultural Microbiology	30	70	100	40
4	204	Genomics and Proteomics	30	70	100	40
5	205	Food and Industrial Microbiology	30	70	100	40
6	206	Advanced Practical	30	70	100	40
7	207	Project Work	30	70	100	40

HIMALAYAN UNIVERSITY, ARUNACHAL PRADESH

MASTER OF SCIENCE

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1st Year

PAPER 101 :- MICROBIOLOGY & MOLECULAR GENETICS

UNIT-I

- 1.1 Basic understanding and organization of genome in prokaryotes and eukaryotes
- 1.2 Mutant methodology: Isolation of mutants; Phenotypic expression and detection
- 1.3 Means of genetic exchange in microorganisms: Transformation
- 1.4 Transduction
- 1.5 Conjugation

UNIT-II

- 2.1 Molecular genetics of selected operons : Lactose
- 2.2 Arabinose
- 2.3 Histidine
- 2.4 Tryptophan
- 2.5 Gene control in eukaryotes; post-transcriptional and post translational modification

UNIT-III

- 3.1 Genetic mapping in bacteriophages and bacteria Plasmid biology
- 3.2 Plasmid biology
- 3.3 Examples in microbial genetics: Bacillus and Pseudomonas genetics
- 3.4 Genetics of Streptomyces and Yeast

3.5 Nif genetics

UNIT-4

4.1 Transposone, viroids and prions

4.2 Viral genetics : virulent phages T1, T2 and T4

4.3 Temperate phages P22

4.4 λ X-174, MB and other miniphages

4.5 Viral recombination and replication

PAPER 102 :- MICROBIAL PHYSIOLOGY & METABOLISM

UNIT-1

1.1 Nutritional diversity in microbes

1.2 Microbial growth

1.3 Growth kinetics

1.4 Methods of measurement of growth

1.5 The growth cycle, characteristics of growth phases

UNIT-2

2.1 The batch culture(closed) & continuous culture(open) systems

2.2. Efficiency of microbial growth: Growth Yields, Yield coefficient and Methods of measurement of growth

2.3 Chemosynthesis: Carbohydrate metabolism; Interlinkages of pathways

2.4 Aerobic metabolic processes

2.4.1 TCA cycle

2.4.2 Glyoxylate cycles and gluconeogenesis

UNIT-3

3.1 Oxidation of methane, fats & fatty acids, hydrocarbons (hydrocarbons & aromatics) Incomplete oxidation

3.2 Anaerobic metabolic processes

3.3 Chemolithotrophy

3.4 Metabolism of amino acids

UNIT-4

4.1 Biochemistry of drug resistance

4.2 Biochemistry of antibiotic action

4.3 Nitrogen fixation

4.4 Denitrification

PAPER 103 :- IMMUNOLOGY

UNIT-1

1. Cytokines

- a. Types and general properties of cytokines and chemokines, characteristics of cytokine receptors and antagonists
- b. Source and effect of Tumor necrosis factors and Interferons
- c. Role of IL-1 in immune activation and pyrogenesis
- d. Immunoregulatory role of cytokines (in particular IL-4, IFN- γ and TNF- β)
- e. Cytokines in therapy and disease, Super antigens and septic shock syndrome
- f. Cytokine assays – immunological and functional assay systems

UNIT-2

2. T-Cell Receptor:

Structure and types - $\alpha\beta$ and $\gamma\delta$ TCR, Diversity of TCR (gene organization and rearrangements), T cell accessory membrane molecules (CD and adhesion molecules), Role in immune activation: TCR-CD3 complex and signal transduction pathways

UNIT-3

3. Regulation of Immune Response:

- a. Negative regulation - Immunological tolerance, Mechanisms of tolerance induction, T cell mediated suppression of immune response

b. Regulation of immune responses by: antigen, antigen-antibody complexes, Network theory and its experimental evidence

c. Regulation of complement system – Classical and alternative pathway

UNIT-4

4. Immune System Evolution:

a. Status of immune system in invertebrates and vertebrates with reference to diversity, complexity and efficiency of cells and molecules, anatomical organization,

b. Functional and structural evolution of immunoglobulin

UNIT-5

5. Tumor Immunology:

a. Cellular transformations during neoplastic growth, Classification of tumors based on histological, physiological, biochemical and immunological properties, Tumors of lymphoid system (lymphoma, myeloma, Hodgkin's disease)

b. Escape mechanisms of tumor from host defense, Host immune response to tumor - Effector mechanisms, Immuno- surveillance theory

c. Diagnosis of tumors – biochemical and immunological tumor markers

d. Approaches in cancer immunotherapy: Immunomodulation (definition and concept), Immune adjuvant and tumor vaccine therapy, Biological Response Modifiers (BRMs) and their application in cancer therapy and in other diseases

UNIT-6

6. Clinical Immunology

a. Immunity to infection – immune mechanisms to intracellular and extra-cellular infectious agents (with examples of bacterial, protozoan and parasitic infections, strategies for vaccine development)

b. Immunodeficiency disorders (pathophysiology, diagnosis and prognosis) –

i. Infective disorders: HIV-AIDS, Herpes infections

ii. Non-infective disorders: Phagocytic deficiencies, humoral deficiencies, T-cell deficiencies, and combined deficiencies, complement deficiencies

c. Hypersensitivity disorders (pathophysiology, diagnosis and prognosis) – Asthma, Systemic Lupus Erythematosis (SLE), Myasthenia gravis

d. Therapeutic aspects in immunopathology – chemotherapy, strategies for immunotherapy (cytokine and vaccine therapy) and stem cell therapy

UNIT-7

7. Experimental Immunology:

In vitro systems – kinetics of antigen antibody reactions, hemolytic plaque assay, ELISPOT assay, functional assays for phagocytosis In vivo systems – Experimental animals in immunology research (Inbred animal strains, transgenic animals), Animal models for autoimmunity and AIDS

References:

1. Akihiko Yoshimura, Tetsuji Naka and Masato Kubo, (2007), SOCS proteins, cytokine signaling and immune regulation, Nature Reviews, Immunology, 7:454-465
2. Austyn J. M. and Wood K. J. (1993) Principles of Molecular and Cellular Immunology, Oxford University Press,
3. Baron D. N. Short Text book on Chemical Pathology, ELBS, London.
4. Barret James D. (1983) Text Book of Immunology 4th edition, C. V. Mosby & Co. London.
5. Biotechnology by open learning series (BIOTOL), (1993), Defense Mechanisms, Butterworth and Heinemann Ltd., Oxford
6. Boyd William C. (1966) Fundamentals of Immunology, Interscience Publishers, NY.
7. Chatterji C. C. (1992) Human Physiology Vol. 1 &2, Medical Allied Agency, Calcutta.
8. David A. Hafler, (2007), Cytokines and interventional immunology, Nature Reviews, Immunology, 7: 423
9. Garrison Fathman¹ C., Luis Soares, Steven M. Chan¹ & Paul J. Utz¹, (2005), An array of possibilities for the study of autoimmunity, Nature Rev., 435|2:605- 611Bendelac Albert, Paul B. Savage, and Luc Teyton, (2007), The Biology of NKT Cells Ann. Rev. Immunol. 25:297–336
10. Guyton A. C. and Hall J. E. (1996) Text Book of Medical Physiology, Goel Book Agency, Bangalore

PAPER 104 :- BIOINSTRUMENTATION

UNIT-I

Basic laboratory Instruments

Principle and working of pH meter, Laminar-air flow. Centrifugation: Types of centrifuge machines, preparative and analytical centrifuges, differential centrifugation, sedimentation velocity, sedimentation equilibrium, density gradient methods and their applications.

UNIT-II

Chromatographic techniques

Theory, principles and applications of paper, thin layer, gel filtration, ion exchange, affinity, hydrophobic, gas liquid, high pressure/ performance liquid chromatography (HPLC)

UNIT-III

Electrophoretic techniques

Basic principles of electrophoresis, theory and application of paper, starch gel, agarose, native and denaturing PAGE, isoelectric focusing.

UNIT-IV

Spectroscopy

Spectroscopic techniques, theory and applications of Uv, Visible, IR, NMR, Fluorescence, Atomic Absorption, CD, ORD, Mass, Raman Spectroscopy.

UNIT-V

Radioisotopic techniques

Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger-Muller and Scintillation counters, autoradiography and its applications. Dosimetry.

References

1. Instrumental Methods of Analysis. 6th Edition by H.H. Willard, L.L. Merritt Jr. and others 1986. CBS Publishers and Distributors.
2. Instrumental Methods of Chemical Analysis. 1989 by Chatwal G and Anand, S. Himalaya Publishing House, Mumbai
3. A Biologists Guide to Principles and Techniques of Practical Biochemistry. 1975 by Williams, B.L. and Wilson, K.
4. Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.

5. Gel Electrophoresis of Proteins- A Practical Approach by Hanes.

PAPER 105 :- VIROLOGY

UNIT-I

Classification of viruses, Methods of cultivation, detection, quantitation Propagation and maintenance of viruses (bacterial, plant and animal viruses). Structure and replication of plant viruses (a) TMV (b) Cauliflower mosaic virus

UNIT-II

Structure and replication of bacteriophages: Lytic ds linear DNA viruses (T2, T7); Lysogenic ds linear DNA virus (Lambda); ss Circular DNA virus (ϕ X 174); Male specific filamentous ss RNA virus (F17 and M13)

UNIT-III

Recombination in phage, multiplicity reactivation and phenotypic mixing Structure and replication of animal viruses (Adenovirus (eg. Type 2)

UNIT-IV

Structure and replication of Myxoviruses (eg. Influenza); Pox virus (eg. Vaccinia); Hepatitis virus

Effect of animal virus infection on host cell; Viral interference and interferon; Tumor viruses (DNA and RNA)

Recommended Books

General Virology by Luria and Darnel

Virology and Immunology by Jokli

Text book of Virology by Rhodes and Van Royen

Plant Virology by Smith

Genetics of bacteria and their viruses by W. Hayes

Molecular Biology of the gene by Watson, Roberts, Staitz and Weiner

A laboratory guide in virology by Charles H. Lunningham

Basic lab procedures in diagnostic virology by Marty Cristensen

PAPER 106 :- MICROBIAL TECHNOLOGY

UNIT-I

1. Biotechnology and prospecting with microbes.

- i. advantages of using microbial technology over chemical and physical technology.
- ii Increasing relevance of Microbiology in all Biotechnologies.
- iii. Ethics in the use of GEMs.
- iv Commercialization of Microbial Biotechnology

UNIT-II

2. Microbial technology in agriculture

Production of microbial biofertilizers, biopesticides, soil conditioners to enhance crop yields.

UNIT-III

3. Microbial technology in mining.

- i. Bioleaching,
- ii. Biomining,
- iii. Recovery of oil.MEOR

Microbial technology in waste and pollution management in mining:

- i. Bioconversions, ii.Bioremediation iii.Biosedimentation, iv. Bio-beneficiation,
- v. Aquifer cleaning.

UNIT-IV

4. Microbial technology for energy production

- i. Microbial fuel cell, ii Biogas, iii. Microbial cell mass.

UNIT-V

5. Microbial technology in Human health & aquaculture

Pigments, Nutraceuticals, Probiotics, Bioactives, Bioplastics Microbes as bio-weapons

PAPER 107 :- PRACTICAL

2nd YEAR

PAPER 201 :- MEDICAL MICROBIOLOGY

UNIT-I

Introduction of Medical Microbiology:

History, Koch & River's postulates, Role of Microbiology in Medicine, Classification of medically important microbes, Normal Microbial flora, Infections- Source, Mode of transmission, Prevention of medically important microbes.

UNIT-II

Systematic Medical Bacteriology:

Mechanism of Bacterial pathogenesis of medically important bacteria Staphylococcus aureus, Group A Streptococci, Pathogenic, Enterobacteriaceae, Vibrio, Neisseriae, Haemophilus influenza, Corynebacterium, Pseudomonas, Chlamydia, Mycoplasma, anaerobic bacteria & infections, Mycobacterium tuberculosis, Atypical Mycobacterium, Chlamydia, Bacillus, Rickettsia, Zoonotic bacteria, Helicobacter pylori.

UNIT-III

Mycology & Protozoology:

Mechanisms of Fungal Pathogenesis, Superficial and Cutaneous Mycoses, Subcutaneous Mycoses, Systemic Mycoses, Opportunistic Mycoses, Mycotoxicoses, Intestinal, Blood and Tissue Protozoa.

UNIT-IV

Viral diseases:

Influenza viruses, Measels, Mumps, Chicken Pox, Hepatitis A,B,C, D& E, Poliomyelitis, AIDS, Human Papilloma Virus (HPV), Rabies, Yellow fever, Dengue and Japanese Encephalitis.

UNIT-V

Laboratory Diagnosis:

Laboratory diagnosis of bacterial diseases, Laboratory diagnosis of mycological and Parasitological diseases, Laboratory diagnosis of viral diseases, Antibiotic sensitivity test. Molecular diagnosis.

References:

Medical Microbiology(2001) Jawetz, Melnick and Adelberg's 22nd edition McGraw Hill

Medical Publication division

Medical Microbiology(2000) David Greenwood, Richard Slack and John Peutherer 15th edition, Church Hill Living stone Publication.

Medical Microbiology (1990) Anathanarayanan & Jeyaram Paniker, Orient Publications, New Delhi.

Medical Parasitology (2007) K.D Chatterjee 7th edition

Foundations in Microbiology (2005) Cathleen park Talaro 6th edition, McGraw Hill

Medical Publication division

Microbiology Lab Manual (2007) John P. Harley 7th edition McGraw Hill Medical

Publication division

Microbiology (2007) Prescott, Harley, Klein's 7th edition McGraw Hill Medical

Publication division

Medical Microbiology (2007) S. Rajan MJP Publishers Chennai

PAPER 202 :- RESEARCH METHODOLOGY, BIOSTATISTICS & BIOINFORMATICS

UNIT-I

Research Methodology - Meaning and importance Statement, Constraints, Review of literature - Review and synopsis presentation. Types of research, Research tools, Qualities of a good researcher.

UNIT-II

Research process, Research designs - Experimental and non - experimental. Preparation of research report. Guidelines for preparing an article - ISSN, ISBN, impact factor, citation index, h-index, I-index, Google scholar, Scopus, Thomson & Rueter, Web of Science. Computers in biological research

UNIT-III

Biostatistics - Introduction - Basic concepts, Measurement and measurement scales, Sampling and data collection, Data presentation, Descriptive Statistics - Measures of central tendency and Measures of dispersion, Population parameters, sample estimates and confidence intervals. Basic concepts of probability. Probability distributions, Z - scores, Student's t - test, Chi square test, Correlation, regression, ANOVA, RSM.

UNIT-IV

Bioinstrumentation - Principles and applications of pH meter, Centrifuge & Electrophoresis apparatus. Chromatography - Thin layer, Column, Gas and high pressure liquid chromatography. Nuclear Magnetic Resonance spectrometry (NMR), IR Spectroscopy Microbial Identification System ELISA Reader. Gas chromatography - Mass spectrometry (GC-MS). Matrix Assisted Laser Desorption/Ionization – Time of Flight (MALDI-Tof).

UNIT-V

Bioinformatics - Biological databases- Database searching, Sequence analysis, Pair alignment, Visualizing protein structures, Predicting structure and function of protein using sequences, QSAR, computer based drug designing.

References

1. Balagurusamy, E, 1992, Programming in ANSIC, Tata Mcgraw Hill.
2. Bernard Rosner, 1999, Fundamentals of Biostatistics, Duxbury Press
3. Attwood T.K. and D.J. Parry-Smith, 2001. Introduction to Bioinformatics, Pearson Education Asia
4. Jeffrey A. Witmer Myra L. Samuels, 2002. Prentice Hall Statistics for the Life Sciences (3rd Edition)

PAPER 203 :- ENVIRONMENTAL AND AGRICULTURAL MICROBIOLOGY

UNIT-I

Biogeochemical cycles & Air microbiology

Roles of microbes in biogeochemical cycles – carbon, nitrogen, phosphorus, sulphur. Soil microbes and fertility of soil Air microbiology: a brief account.

UNIT-II

Aquatic microbiology and bioremediation

Microbes in marine and fresh water environment – eutrophication – Biodegradation and bioaccumulation – bioremediation concepts, microbial and phytoremediation – composting – solid waste treatment – saccharification and pyrolysis.

UNIT-III

Liquid waste and treatment

Water pollution – sources and nature of pollutants in water – sewage – treatment of liquid waste – primary, secondary and tertiary treatment – water born diseases – Assessment of water quality – BOD and COD determinations.

UNIT-IV

Soil Microbiology

Microbial association – beneficial – nitrogen fixing organism – symbiosis, asymbiosis, associate symbiosis – bacteria, actinomycetes, cyanobacteria – mycorrhiza – ecto and endo mycorrhiza – phosphate solubilizers – application of biofertilizers in agriculture. Biology of nitrogen fixation – genes and regulations in Rhizobium – Agrobacterium and plant tumours

UNIT-V

Plant diseases and its control

Plant pathogens – bacterial – viral – fungal pathogens Morphological, physiological changes with reference to disease establishment in plants – plant protection – phenolics – phytoalexins and related compounds Bioinsecticides – viral, bacterial and fungal – a brief note.

References:

Atlas Ronald, M., Bartha, and Richard (1987) Microbial Ecology 2nd Edition

Benjamin/Cummings Publishing Company, California.

Dirk, J. Elsas, V., Trevors, J.T., Wellington, E.M.H. (1997) Modern Soil

Microbiology, Marcel Dekker INC, New York, HongKong.

Ec Eldowney S, Hardman DJ, Waite DJ, Waite S. (1993). Pollution: Ecology and

Biotreatment – Longman Scientific Technical.

PAPER 204 :- GENOMICS AND PROTEOMICS

UNIT-I

Features of prokaryotic, eukaryotic, and organellar genomes, Genome sizes – C value paradox, gene counting; Principles of DNA sequencing, automated Dna sequencing, Shotgun sequencing, contig assembly.

UNIT-II

Whole genome analysis methods: Physical vs. Genetic mapping, Gene finding methods for prokaryotes, eukaryotes, RNA structural analysis, analysis of sequences, Gene Ontology, examples with bacterial, plant and animal model organisms.

UNIT-III

Functional Genomics – Analysis of Gene Expression, subtractive cDNA library, differential display analysis, SAGE, TOGA, cDNA microarrays, creation of knockout plants and animal cell lines.

UNIT-4

Proteomics: Methods for protein characterization: 2-D Gels, western blotting, Edman protein microsequencing, amino acid composition, mass spectrometry; protein-protein interactions screening methods and databases, protein ligand interactions.

UNIT-V

Human Genome Project, Genes and Diseases, SNP analysis, pharmacogenomics, Metabolic engineering

Text Book:

1. Functional Genomics, Practical Approach, edited by S.P.Hunt and F.J. Livesay, Oxford Indian Edition (2002)
2. Principles of Protein structure, G.E. Schulz and R.H. Schirmer, Springer International Edition (2004)

PAPER 205 : FOOD AND INDUSTRIAL MICROBIOLOGY

UNIT-I

Microorganisms associated with foods and the sources of microbial contamination of foods.

Enumeration of microorganisms in foods- Standard Plate Count, Direct Microscopic Count, Most Probable Number Method, Dye Reduction Tests, Membrane Filtration technique, ATP photometry, Direct epifluorescent membrane filter method, Electrical Impedance methods.

Food spoilage – Causes of food spoilage and microbial spoilage of vegetables, fruits, cereal grains, eggs and poultry, meat and canned foods.

Food preservation methods – low temperature, high temperature, drying, chemicals and irradiation

UNIT-II

Microorganisms in milk, Pasteurization of milk, quality testing of milk and microbial spoilage of milk

Fermented foods – Sauerkraut, Cheddar cheese, beer and wine, and vinegar.

Microbes as food – Single cell protein, Mushroom cultivation.

Food poisoning and food-borne infections – Botulism, Staphylococcus food intoxication, Clostridium perfringens gastroenteritis, Salmonellosis and Vibriosis

UNIT – III

Fermentation processes – component parts of a fermentation process, range of fermentation processes.

Fermentor – Design of a fermentor, body construction, aeration and agitation, maintenance of aseptic conditions, types of fermentors.

Fermentation media – components of fermentation media, carbon sources, nitrogen sources, minerals, growth factors, chelators, buffers, precursors, inducers, inhibitors, antifoams

Screening of microorganisms for the production of commercially important metabolites

Strain improvement of industrial microorganisms – mutations, recombination, rDNA technology

UNIT-IV

Culture systems – Batch culture, fed-batch culture, semi-continuous culture, continuous culture, dual or multiple fermentations

Recovery and purification of fermentation products – cell harvesting (filtration, centrifugation, sedimentation, cell aggregation and flocculation, foam separation), cell disruption, liquid-liquid extraction, chromatography (adsorption, ion-exchange, gel permeation, affinity, HPLC), crystallization, drying

Solid state fermentations – characteristics of SSF, fermentor design for SSF, advantages and disadvantages

Economic aspects of fermentation

Fermentative production of antibiotics (penicillin), amino acids (glutamic acid), organic acids (citric acid) and enzymes (amylase)

REFERENCE BOOKS

1. Food Microbiology - Frazier WC and Westhoff Dc (1988)
2. Food Microbiology - Adams, MR and Moss, MO (1996)
3. Modern Food Microbiology - James M.Jay (1996)
4. Basic Food Microbiology - George J. Banwart (1989)
5. Outlines of Dairy Technology – Sukumar De (1997)
6. Biotechnology-A text book of Industrial Microbiology. W. Crueger and A.Cruegar, 2000.
7. Manual of Industrial Microbiology and Biotechnology. A.L.Demain and J.W.Davies (Eds), 1999.
8. Microbial Biotechnology. A.N.Glazer and H.Nikaido, 1995.
9. Principles of fermentation technology. P.F.Stanbury, A.Whitaker and S.J.Hall, 1997

PAPER 206 :- PRACTICAL

PAPER 207 :- PROJECT WORK