



Dept. of P.G. Studies and Research in Microbiology

Syllabus for Ph.D. Entrance Examination

Section-A

Part I : Introduction to Microbiology

1 The History and Scope of Microbiology

Members of the Microbial World, The Discovery of Microorganisms, The Conflict over Spontaneous Generation, The Golden Age of Microbiology, Disease, Koch's Postulates, The Development of Industrial Microbiology and Microbial Ecology, The Scope and Relevance of Microbiology, The Future of Microbiology

2. The Study of Microbial Structure:

Microscopy and Specimen Preparation, Lenses and the Bending of Light, The Light Microscope Preparation and Staining of Specimens, Electron Microscopy.

3.Procaryotic Cell Structure and Function: An Overview of Prokaryotic Cell Structure, Procaryotic Cell Membranes, Microbial Diversity & Ecology, Monstrous Microbes, The Cytoplasmic Matrix, Microbial Diversity & Ecology, Living Magnets, The Nucleoid, Plasmids, The Bacterial Cell Wall, Archaeal Cell Walls, Protein Secretion in Prokaryotes, Components External to the Cell Wall, Chemotaxis, The Bacterial Endospore.

4.Eucaryotic Cell Structure and Function: An Overview of Eukaryotic Cell Structure, The Plasma Membrane and Membrane Structure, The Cytoplasmic Matrix, Microfilaments, Intermediate Filaments, and Microtubules, Organelles of the Biosynthetic-Secretory and Endocytic Pathways, Eucaryotic Ribosomes, Mitochondria, Chloroplasts, Microbial Diversity & Ecology, The Origin of the Eucaryotic Cell, The Nucleus and Cell Division, External Cell Coverings, Cilia and Flagella, Comparison of Procaryotic and Eucaryotic Cells.

Part II Microbial Nutrition,Growth and Control

5. Microbial Nutrition: The Common Nutrient Requirements, Requirements for Carbon, Hydrogen, Oxygen, and Electrons, Nutritional Types of Microorganisms, Requirements for Nitrogen, Phosphorus, and Sulfur, Growth Factors, Uptake of Nutrients by the Cell, Culture Media, Historical Highlights, The Discovery of Agar as a Solidifying Agent and the Isolation of Pure Cultures Techniques & Applications.

6. Microbial Growth: The Prokaryotic Cell Cycle, The Growth Curve, Measurement of Microbial Growth, The Continuous Culture of Microorganisms, The Influence of Environmental Factors on Growth, Microbial Diversity & Ecology, Life Above 100°C, Microbial Growth in Natural Environments.

7. Control of Microorganisms by Physical and Chemical Agents: Definitions of Frequently Used Terms, Techniques & Applications, Safety in the Microbiology Laboratory, The Pattern of Microbial Death, Conditions Influencing the Effectiveness of Antimicrobial Agents, The Use of Physical Methods in Control, The Use of Chemical Agents in Control, Techniques & Applications. Universal Precautions for Microbiology Laboratories, Evaluation of Antimicrobial Agent Effectiveness.

Part III Microbial Metabolism

8. Metabolism:Energy, Enzymes and Regulation, An Overview of Metabolism, Energy and Work, The Laws of Thermodynamics, Free Energy and Reactions, The Role of ATP in Metabolism, Oxidation-Reduction Reactions, Electron Carriers, and Electron Transport Systems, Enzymes, The Nature and Significance of Metabolic Regulation, Metabolic Channeling, Control of Enzyme Activity.

9. Metabolism:Energy Release and Conservation, Chemoorganotrophic Fueling Processes, Aerobic Respiration, The Breakdown of Glucose to Pyruvate, The Tricarboxylic Acid Cycle, Electron Transport and Oxidative Phosphorylation, Anaerobic Respiration, Fermentations, Catabolism of Carbohydrates and Intracellular Reserve Polymers, Lipid Catabolism, Protein and Amino Acid Catabolism, Chemolithotrophy, Phototrophy, Microbial Diversity & Ecology, Acid Mine Drainage.

10. Metabolism:The Use of Energy in Biosynthesis, Principles Governing Biosynthesis, The Precursor Metabolites, The Fixation of CO₂ by Autotrophs, Synthesis of Sugars and Polysaccharides, Synthesis of Amino Acids, Synthesis of Purines, Pyrimidines, and Nucleotides Lipid Synthesis,

Part IV Microbial Molecular Biology and Genetics

11. Microbial Genetics:Gene Structure, Replication, and Expression, Historical Highlights, The Elucidation of DNA Structure, DNA as Genetic Material, The Flow of Genetic Information, Nucleic Acid Structure, DNA Replication, Gene Structure, Transcription, Catalytic RNA (Ribozymes), The Genetic Code, Translation.

12. Microbial Genetics:Regulation of Gene Expression, Levels of Regulation of Gene Expression, Regulation of Transcription Initiation, The Discovery of Gene Regulation, Regulation of Transcription Elongation, Regulation at the Level of Translation, Global Regulatory Systems, Regulation of Gene Expression in Eucarya and Archaea.

13. Microbial Genetics:Mechanisms of Genetic Variation, Mutations and Their Chemical Basis, Detection and Isolation of Mutants, DNA Repair, Creating Genetic Variability, Transposable Elements, Bacterial Plasmids, Bacterial Conjugation, DNATransformation, Transduction, Mapping the Genome, Recombination and Genome Mapping in Viruses,

Part V DNA Technology and Genomics.

14. Recombinant DNA Technology: Historical Perspectives, Synthetic DNA, The Polymerase Chain Reaction, Gel Electrophoresis, Cloning Vectors and Creating Recombinant DNA, Construction of Genomic Libraries, Inserting Recombinant DNA into Host Cells, Expressing Foreign Genes in Host Cells, Techniques & Applications, Visualizing Proteins with Green Fluorescence, Applications of Genetic Engineering, Techniques & Applications, Plant Tumors and Nature's Genetic Engineer, Social Impact of Recombinant DNA Technology.

15. Microbial Genomics: Introduction, Determining DNA Sequences, Whole-Genome Shotgun Sequencing, Bioinformatics, Functional Genomics, Comparative Genomics, Proteomics, Insights from Microbial Genomes, Environmental Genomics.

Part VI The Viruses

16. The Viruses: Introduction and General Characteristics, Early Development of Virology, General Properties of Viruses, The Structure of Viruses, Virus Reproduction, The Cultivation of Viruses, Virus Purification and Assays, Principles of Virus Taxonomy, The Origin of Viruses.

17. The Viruses: Viruses of Bacteria and Archaea, Classification of Bacterial and Archaeal Viruses, Virulent Double-Stranded DNA Phages, Microbial Diversity & Ecology, Host-Independent Growth of an Archaeal Virus, Single-Stranded DNA Phages, RNA Phages, Temperate Bacteriophages and Lysogeny, Bacteriophage Genomes.

18. The Viruses: Eukaryotic Viruses and Other Acellular Infectious Agents, Taxonomy of Eukaryotic Viruses, Reproduction of Vertebrate Viruses, Microbial Diversity & Ecology, SARS: Evolution of a Virus, Techniques & Applications, Constructing a Virus, Cytocidal Infections and Cell Damage, Persistent, Latent, and Slow Virus Infections, Viruses and Cancer, Plant Viruses, Viruses of Fungi and Protists, Insect Viruses, Viroids and Prions.

Part VII The Diversity of the Microbial World

19. Microbial Evolution, Taxonomy, and Diversity: Microbial Evolution, Introduction to Microbial Classification and Taxonomy, Taxonomic Ranks, Techniques for Determining Microbial Taxonomy and Phylogeny, Assessing Microbial Phylogeny, The Major Divisions of Life, Bergey's Manual of Systematic Bacteriology.

20. The Protists: Distribution, Nutrition, Morphology, Encystment and Excystment, Reproduction, Protist Classification. Disease, Harmful Algal Blooms (HABs), Techniques & Applications, Practical Importance of Diatoms.

21. The Fungi (Eumycota): Distribution, Importance, Structure, Nutrition and Metabolism, Reproduction, Characteristics of the Fungal Divisions, Ecology and Symbiosis.

22. Biogeochemical Cycling and Introductory Microbial Ecology: Foundations in Microbial Diversity and Ecology, Microbial Diversity & Ecology, Microbial Ecology Versus Environmental Microbiology, Biogeochemical Cycling, The Physical Environment, Microbial Ecology and Its Methods: An Overview, Techniques & Applications, Thermophilic Microorganisms and Modern Biotechnology.

23. Microorganisms in Marine and Freshwater Environments: Marine and Freshwater Environments, Disease, New Agents in Medicine— The Sea as the New Frontier, Microbial Adaptations to Marine and Freshwater Environments, Microorganisms in Marine Environments, Microorganisms in Freshwater Environments.

24. Microorganisms in Terrestrial Environments: Soils as an Environment for Microorganisms, Soils, Plants, and Nutrients, Microorganisms in the Soil Environment, Microorganisms and the Formation of Different Soils, Microorganism Associations with Vascular Plants, Microbial Diversity & Ecology, Mycorrhizae and the Evolution of Vascular Plants, Soil Microorganisms and the Atmosphere, Microbial Diversity & Ecology, Soils, Termites, Intestinal Microbes, and Atmospheric Methane, Techniques & Applications, Keeping Inside Air Fresh with Soil Microorganisms, The Subsurface Biosphere, Soil Microorganisms and Human Health.

25. Microbial Interactions, Microbial Diversity & Ecology: Wolbachia pipiens, The World's Most Infectious Microbe? Microbial Diversity & Ecology, Coevolution of Animals and Their Gut Microbial Communities, Human-Microbe Interactions, Normal Microbiota of the Human Body, Techniques & Applications Probiotics for Humans and Animals.

Part IX. Nonspecific (Innate) Resistance and the Immune Response.

26. Nonspecific (Innate) Host Resistance, Overview of Host Resistance, Cells, Tissues, and Organs of the Immune System, Phagocytosis, Inflammation, Physical Barriers in Nonspecific (Innate) Resistance, Chemical Mediators in Nonspecific (Innate) Resistance.

27. Specific (Adaptive) Immunity: Overview of Specific (Adaptive) Immunity, Antigens, Types of Specific (Adaptive) Immunity, Recognition of Foreignness, Techniques & Applications, Donor Selection for Tissue or Organ Transplants, T Cell Biology, B Cell Biology, Antibodies, Action of Antibodies, Techniques & Applications, Monoclonal Antibody Technology, Summary: The Role of Antibodies and Lymphocytes in Immune Defense, Acquired Immune Tolerance, Immune Disorders.

Part X Microbial Diseases and Their Control

28. Pathogenicity of Microorganisms: Host-Parasite Relationships, Pathogenesis of Viral Diseases, Overview of Bacterial Pathogenesis, Toxigenicity, Techniques & Applications, Detection and Removal of Endotoxins, Host Defense Against Microbial Invasion, Microbial Mechanisms for Escaping Host Defenses.

29. Antimicrobial Chemotherapy: The Development of Chemotherapy, Techniques & Applications, The Use of Antibiotics in Microbiological Research, General Characteristics of Antimicrobial Drugs, Determining the Level of Antimicrobial Activity, Antibacterial Drugs. Factors Influencing Antimicrobial Drug Effectiveness, Drug Resistance, Disease, Antibiotic Misuse and Drug Resistance, Antifungal Drugs, Antiviral Drugs, Antiprotozoan Drugs.

30. Clinical Microbiology and Immunology: Specimens, Techniques & Applications, Standard Microbial Practices, Identification of Microorganisms from Specimens, Biosensors, Clinical

Immunology, Techniques & Applications, History and Importance of Serotyping, Susceptibility Testing, Computers in Clinical Microbiology.

31. The Epidemiology of Infectious Disease: Recognition of an Infectious Disease in a Population, Historical Highlights, Recognition of an Epidemic, The Infectious Disease Cycle: Story of a Disease, The First Indications of Person-to-Person Spread of an Infectious Disease, Virulence and the Mode of Transmission, Emerging and Reemerging Infectious Diseases and Pathogens, Control of Epidemics, Historical Highlights, The First Immunizations, Bioterrorism Preparedness, Historical Highlights, The First Recorded Biological Warfare Attack, Global Travel and Health Considerations, Nosocomial Infections.

32. Human Diseases Caused by Viruses and Prions: Airborne Diseases, Disease, Reye's and Guillain-Barré Syndromes, Arthropod-Borne Diseases, Viral Hemorrhagic Fevers, Direct Contact Diseases, Food-Borne and Waterborne Diseases, Brief History of Polio, Zoonotic Diseases, Prion Diseases.

33. Human Diseases Caused by Bacteria: Airborne Diseases, Arthropod-Borne Diseases, Direct Contact Diseases, Antibiotic-Resistant Staphylococci, A Brief History of Syphilis, Food-Borne and Waterborne Diseases, Techniques & Applications, Clostridial Toxins as Therapeutic Agents—Benefits of Nature's Most Toxic Proteins, Sepsis and Septic Shock, Zoonotic Diseases, Dental Infections.

34. Human Diseases Caused by Fungi and Protists: Pathogenic Fungi and Protists, Airborne Diseases, Arthropod-Borne Diseases, A Brief History of Malaria, Direct Contact Diseases, Food-Borne and Waterborne Diseases, Opportunistic Diseases, The Emergence of Candidiasis,

Part XI Food and Industrial Microbiology

35. Microbiology of Food: Microorganism Growth in Foods, Microbial Growth and Food Spoilage, Controlling Food Spoilage, Food-Borne Diseases, Typhoid Fever and Canned Meat, Detection of Food-Borne Pathogens, Microbiology of Fermented Foods, Techniques & Applications, Chocolate: The Sweet Side of Fermentation, Techniques & Applications, Starter Cultures, Bacteriophage Infections, and Plasmids, Microorganisms as Foods and Food Amendments.

36. Applied and Industrial Microbiology: Water Purification and Sanitary Analysis, Techniques & Applications, Waterborne Diseases, Water Supplies, and Slow Sand Filtration, Wastewater Treatment, Microorganisms Used in Industrial Microbiology, Techniques & Applications, The Potential of Thermophilic Archaea in Biotechnology, Microorganism Growth in Controlled Environments, Major Products of Industrial Microbiology, Biodegradation and Bioremediation by Natural Communities, Microbial Diversity & Ecology, Methanogens— A New Role for a Unique Microbial Group, Bioaugmentation, Microbial Diversity & Ecology, A Fungus with a Voracious Appetite, Microbes As Products, Techniques & Applications, Streptavidin-Biotin Binding and Biotechnology, Impacts of Microbial Biotechnology.

Section-B

Research Methodology

Foundations of research: Definition, importance and types; theoretical, empirical, nomothetic, idiographic and probabilistic. Research philosophy. *Analytical Methods and their Applications* – Separation methods – Principle, applications and types of electrophoresis, chromatography and centrifugation. *Biostatistics & Bioinformatics:* Measures of Central tendency, Measures of Dispersion, Probability Distribution, Hypothesis testing-t-test, Chi square and F- test, Correlation and Regression, Experimental Designs: Random Block Design, Latin Square Design and ANOVA. Statistical software – SPSS. Classification of Biological databases, Biological Sequence Retrieval systems, Pair wise alignment, BLAST and FASTA, multiple sequence alignment and applications, Protein structure prediction methods, prediction of transmembrane regions, Protein modeling: homology modeling, model refinement, evaluation of the model.


KUVEMPU UNIVERSITY
Department of PG Studies & Research in Microbiology
Ph.D. Entrance Test

[Time:3h]

[Max.marks:90]

PART —A

I. Answer the following

20X01=20

1. Who provide the evidence that bacteriophage nucleic acid but not protein enters the host cell during infection
a. Alfred D. Hershey & Leonard Tatum. b. Alfred D. Hershey & Zindar Lederberg c. Alfred D. Hershey & Martha Chase d. Alfred D. Hershey & Macleod
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PART-B

II. Write short notes on any FIVE of the following

5x6=30

- 21.
- 22.
- 23.
- 24.
- 25.
- 26.
- 27.
- 28.

III. Answer any FOUR of the following

4x10=40

29.

30

31.

32.

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34.