

PUNYASHLOK AHILADEVI HOLKAR SOLAPUR UNIVERSITY SOLAPUR



NAME OF FACULTY : SCIENCE AND TECHNOLOGY

NAME OF THE COURSE – Ph.D. ENTRANCE TEST (PET) (w.e.f. 2024)

SUBJECT - MICROBIOLOGY

(2024)

Ph.D. Entrance test (PET) for Ph.D. in Microbiology

Unit 1: Fundamentals of Microbiology and Microbial diversity

A. Historical Background:

- a. Contribution of Robert Hook, Antony Van Leuwenhoek, Ernst Ruska
- b. Theory of spontaneous generation
- c. Golden era of Microbiology (1857-1914) - i) Germ theory of fermentation ii) Germ theory of disease
- d. Contribution of Martinus Beijerinck, Sergei Winogradsky, Louis Pasteur, Joseph Lister and Dmitri Ivanovski, Edward Jenner, Eli Metchnikoff, Salmon Waksman, Alexander Fleming. In development of applied microbiology.

B. Microbial Diversity –

- a. Definition, nomenclature rules and identification, hierarchical organization and the position of microbes in the living world.
- b. Classification systems – artificial and phylogenetic– dendrogram. Haeckel's three-kingdom classification, Whittaker's five-kingdom approach, and Three domain classification of Carl Woese., Bergey's manual of systematic and determinative bacteriology.
- c. Major characteristics used in taxonomy – morphological, physiological, metabolic, genetic and molecular characteristics, comparison of proteins, nucleic acid hybridization, nucleic acid sequence comparison, DNA and RNA homology, and G+C ratio.
- d. Significance of rRNA in microbial taxonomy, Numerical Taxonomy and Chemotaxonomy.

C. General Characteristics of Microorganisms

- a. i) Bacteria ii) Mycoplasma iii) Rickettsia iv) Actinomycetes v) Algae vi) Fungi vii) Viruses viii) Protozoa ix) Archaeobacteria
- b. **Cellular organization of prokaryotic and eukaryotic Cell**

Unit 2: Microbial genetics

- A) Gene, Genome, Genetic Code, Nucleoid, Cistron, Muton, Recon, Transposons.
- B) Types of DNA, DNA replication, Mutation and its types, mutagenic agents and repair, recombination,

- C) Types of RNA, RNA synthesis and processing, Protein synthesis and processing, Control of gene expression (Operon) at transcription and translation level
- D) Genetic Engineering: Tools, Construction and applications of Genomic libraries and cDNA libraries, Constructions of recombinant DNA, Selection and Detection of recombinant DNA, Applications of Genetic engineering in various sectors, Ethical and legal aspects of Genetic engineering.

Unit 3: Microbial physiology

- A) Microbial growth and its types, environmental factors affecting growth, methods of measurement of growth,

B) Biomolecules: Classification, Structure and functions of

- a) Carbohydrates b) Proteins c) Lipids d) DNA e) RNA f) Enzyme g) Vitamins h) Hormones

C) Microbial Nutrition:

Nutritional requirements of microorganisms ii) Nutritional types of Microorganisms based on Carbon and Energy source. Transport mechanism of Nutrients across the cell membrane, types of reserve food materials and their functions.

- D) Bioenergetics: Carbohydrate catabolic pathways, EMP, HMP, ED, Phosphoketolase pathway, TCA cycle, and methylglyoxal bypass. Anaplerotic sequences, Substrate level Phosphorylation, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers. ETC, theories of ATP formation.

Unit 4: Industrial and Pharmaceutical Microbiology

A) Bioreactor Design, types and Operation.

B) Development of microbial processing.

- a) Fermentation media
- b) Screening, strain improvement, scale up, inoculum preparation, stock culture maintenance, contamination problems.

C) Industrial production of:

- a) Streptomycin, Amylase, Vitamin B12, L-Lysine, Insulin
- b) Production and applications of biopolymers, Xanthan gum, dextran, pullulan, mannan, curdlan and Alginate.
- c) Production of Mushroom, production steps, harvesting and preservation,

nutritive value

d) Industrial production of distilled alcoholic beverages. Whisky, Brandy, wine and beer.

D) Downstream processing and Quality control.

E) a) Antibiotics and Synthetic Antimicrobial Agents

b) Mechanism of Action of Antibiotics:

c) Regulatory Practices, Biosensors and Applications in Pharmaceuticals

Unit 5: Environmental Microbiology

A) Environment and Ecosystems

B) Eutrophication Water pollution and its control

C) Characterization of Industrial wastes, Working of treatment systems and their analysis

D) Environmental control Bodies, State, National and International

E) Waste disposal control and regulations

F) Novel Methods of Pollution Control

G) Global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

Unit 6: Agricultural Microbiology

A) Soil environment: Physicochemical and biological properties, soil microorganisms and soil fertility, soil enzymes, organic matter decomposition, biogeochemical cycles-C, N, S and P. Recycling of Agriculture and animal waste (Composting, FYM, Green Manure, Vermicompost)

B) Microbial Biofertilizers and Biopesticides: – Types, Production and methods of Applications:

C) Development of genetically modified crops and microorganisms:

Unit 7: Immunology and Clinical Microbiology

A) Immunity: types and mechanism of immunity, Immune System, Organs and cells involved

B) Immunogenetics

a) Major histocompatibility systems:

b) Immunoglobulin gene structure

C) Clinical Immunology

1. Autoimmunity

2. Hypersensitivity

3. Transplantation immunology:

D) Immunization & Immunological Techniques: types of Vaccines, immunization schedule.

Unit 8: Virology

A) Classification and Morphology of Viruses and viral genomes

B) Cultivation, Purification and assay of viruses

C) Viral Multiplication

D) Pathogenesis of Viruses

E) Control of Viruses and Emerging Viral Infections

Unit 9: Food and Dairy Microbiology

A) Food as substrates for microorganisms.

B) Microbiology and spoilage of Food. General mechanism of food spoilage.

C) Microbial Food borne diseases, Food poisoning, infections, investigation of food born outbreaks, prevention and control

D) General principles underlying food preservation and different methods of food preservation.

E) Fermented Food products and their Production

F) Microbiology of Milk and milk products

G) Food laws and standards, Indian and international food safety laws.

H) Quality and safety assurance in food and dairy industry, Sanitation and regulation in food and dairy industry.

Unit 10: Microbial Techniques and Instrumentation

A) Microscopy:- Principle, construction, image formation, resolution and application of light, phase contrast, Bright field, dark field, Fluorescence, Scanning and Transmission electron microscopy.

B) Principle Methodology and applications of chromatography techniques: Gel filtration, ion exchange and affinity chromatography, thin layer and gas chromatography, High performance liquid chromatography

C) Principle, Methodology and Applications of Centrifugation: density gradient and ultra-centrifugation.

D) Principle of biophysical method for analyzing biopolymer structure:

E) Electrophoresis, Principle and application of Native, SDS Agarose and 2D gel

Electrophoresis, Blotting techniques