Ph.D. Entrance Test – SYLLABUS
MICROBIOLOGY
PART- 1
RESEARCH METHODOLOGY (50%)

1. **Analytical Methods in Biology : Microscopy and Autoradiography :** Tissue fixation and staining techniques, Principles of TEM & SEM, Phase Contrast, Fluorescence Microscopy, Autoradiography. Basic principles of Spectroscopy, UV-VIS, NMR, ESR, Principle of GC-MS, LC – MS Ion Exchange Chromatography, gel permeation, HPLC and FPLC. Principle and applications of Centrifugation techniques, principles of Electrophoresis, Agarose gel, native and SDS-PAGE, Isoelectric focusing, 2D- PAGE and their uses in protein research, Fractionation and Blotting Techniques, Antigen Antibody, Structure of Ig, Ig Classes & Biological Activities, Antigen-Antibody Interactions: ELISA Test, Agglutination, Precipitation, Immunofluorescence.

2. **Biostatistics & Computer Applications:** Significance tests: Student's't' test: Hypotheses, acceptance and rejections, significance levels. Analysis of Variance: General principles, completely randomized and random-block design ANOVA. Regression and correlation – biveriate analysis. Chi-Square and its applications. Use of different software packages. Data Analysis, Graphics, PowerPoint Presentations.

3. **Methods in Cell & Molecular Biology, Genetics & Biochemistry**: Ultrastructure and role of Mitochondria, Chloroplasts, Lysosomes, Golgi Apparatus Peroxisomes & Glyoxisomes and other cellular organelles. Cytoskeleton, Ultrastructure and functions of Microtubules, microfilaments, Apoptosis: Mechanism and significance. Principles of Mendelian genetics, DNA Structure, Genetic Code, Loci, alleles, and Gene structure, spontaneous and induced mutations, Carbohydrates, Lipids and Fatty Acid metabolism, Protein Structure and Function, Principles and mechanism of enzymes catalysis, Coenzymes and cofactors, laws of thermodynamics, Glycolysis and Citric Acid Cycle,

4. **Methods in Biodiversity & Environmental Science:** Concepts of Biodiversity, Genetic, species and ecological diversity, Terrestrial, Marine Biodiversity, Eco-tourism and Biodiversity. Conservation and Sustainable use of Biodiversity. Ecosystem monitoring and Rehabilitation. Definition, principles and Scope of Environmental science. Threats to Biological Diversity: Habitat Destruction, Invasive species, Disease, Over-exploitation, Pollution, Climate change and Biodiversity. Structure and functions, abiotic and Biotic components, food chains, food web, ecological pyramids, population & community ecology and parasitism, prey-predator relationships, Air, Water and Soil pollution. Global Environmental problems: Ozone depletion, global warming and climatic change, clean development mechanism. EIA. Remote sensing and its applications of environmental sciences, Application of GIS in Environmental management.

PART- 2
CORE SUBJECT
(MICROBIOLOGY) (50%)

1. **Genome Organization And Regulation of Gene Expression**: Genome organization, Histone like proteins in prokaryotes, Regulation of gene expression in prokaryotes, operon model, positive and negative control of *lac* operon and other operons, Regulation of gene expression in eukaryotes, Genetic exchange in Prokaryotes, Molecular mechanism of transformation and transduction, Plasmid Biology, Transposons, viroids and prions, Genetic regulation of lysogenic / lytic control, λ- phage.
2. **Fermentation Technology:** Screening and strain improvement of industrially important microorganisms, Preservation of industrial microorganisms, substrates for fermentations, design of bioreactor, aeration and agitation, kinetics of batch and continuous process, sterilization of media and air and its scaling up, production of foreign protein by heterologous expression, monitoring and control process, on line process monitoring and biosensors, microbial production of solvents, enzymes and polysaccharides, Immobilization of enzymes and cells
3. **Environmental Biotechnology:** Methods in Microbial ecology, Nutritional types, Microbial habitats and ecology, Interactions between diverse microbial populations, Biotransformation of Fe, Mn, Phosphorous, Biodegradation-Parameters affecting it, Biodeterioration, Biodegratation of cellulose, Hemicellulose, lignin and pectins, Biodegaradtion of xenobiotics, Bioremediation, Plant Growth Promoting Rhizobacteria
4. **Food Biotechnology:** Starter cultures, production of alcoholic beverages, Production of Single cell protein and Baker's yeast; Mushrooms, dairy products: Cheese, bread and yogurt, Fermented vegetables and meat, Probiotics, Genetically modified foods and crop, Food borne infections and intoxications, Mycotoxins in food, Food preservation: canning, dehydration, ultrafiltration, sterilization, irradiation, Quality assurance, Government regulatory practices and policies
5. **Molecular Biotechnology:** Gene detection and expression, Southern and Northern hybridization, western hybridization, PCR and RT-PCR, Peptide sequencing and synthesis, Primer designing, Protein- protein interactions, Yeast-2-hybid, Yeast-3-hybid approaches, Reporter genes, Vectors and Expression Systems,
6. **Molecular phylogeny and diversity:** Microbial evolution and phylogeny, phylogenetic trees, Chronometers and chronological distances, Cultivable vs. non-cultivable microbes, PCR, DGGE, TGGE, RFLP, T-RFLP, ARDRA, nucleic acid hybridization and SIP, Biotechnological significance of non-cultivable microbes, Gram-negative Proteobacteria, Proteobacteria: alpha and beta groups, actinomycetes, lactobacilli, clostridia, Metagenomics and Next Generation Sequencing
7. **Extremophiles:** Extreme Environments and distribution of extremophiles, Extremophilic bacteria and archaea, Ecology and habitats of Archaea, adaptations in extremophiles, regulation of gene expression in hype extremophiles, Biotechnology and extremophiles
8. **Bimolecular engineering:** Protein structure, Domains and topology with reference to catalytic action, Protein folding and molecular chaperones, *In-vitro* protein folding and it's biotechnological significance, methods of protein engineering, Directed evolution and gene shuffling, Recombinant biocatalysts, strategies for primer designing, molecular cloning and selection of recombinant clones
9. **Immunology:** Molecular cells and organs of Immune system, Antigens, Antibody & Ag-Ab Interaction, Mechanism of Immune response, MHC & Transplantation Immunology, The Immune system in Health & Disease, Autoimmunity, Hypersensitivity