

GUJARAT VIDYAPITH: AHMEDABAD
Faculty of Science and Applied Science, Sadra, Dist: Gandhinagar
Department of Biogas Research and Microbiology

Syllabus for PhD (Microbiology) Entrance Examination

Unit 1	General Microbiology
A	Basic microbiology- Landmark achievements in 20th century: Refutation of a biogenesis: discovery of penicillin: discovery of vaccination: proposal of one gene one enzyme hypothesis: discovery of double helix structure of DNA: discovery of recombinant DNA technology.
B	Major contribution of scientists– Leeuwenhoeck, Edward Jenner, Alexander Flemming, Joshep Lister, Robert Koch, Louis Pasteur, Hargobind Khorana
C	Scope of Microbiology
D	Microscopy- Principles and applications, dark field, bright field, resolving power, numerical aperture, chromatic aberration, phase contrast microscopy, fluorescent microscopy, inverted microscopy, stereo microscopy, electron microscopy, TEM and SEM.
E	Stains and staining- Principles of staining, simple staining, negative staining, differential staining, Gram and acid-fast staining, flagella staining, capsule and endospore staining.
F	Cultivation of bacteria– Types of growth media (natural, synthetic, complex, enriched, selective- definition with example), pure culture methods (streak plate, spread plate, pour plate, stab culture, slant culture). Anaerobic (thioglycolate, anaerobe
G	Major characteristics of microorganisms: Morphological, Chemical, Cultural, Metabolic , Antigenic ,Genetic Ecological and Pathogenicity
H	Microbial classification, Nomenclature and Identification
I	Microbial Diseases: Bacteria, Viruses, Fungi and Protozoa
Unit 2	Microbial Diversity, Virology and Mycology
A	Microbial Diversity- Origin of earth and life; Possible early Eubacteria and Archaea; Taxonomy of Eubacteria and Archaea; Classification of Bacteria- Artificial and Phylogenetic systems; Bacterial identification schemes; Prokaryotic diversity; Extremophiles; Applications of Microbial Diversity Biodiversity among Bacteria & Archaea: Morphological and cellular diversity, Physiological and metabolic diversity, Ecological diversity Biodiversity among Eukaryotic and Acellular Microorganisms Morphological, cellular, physiological, metabolic and ecological characteristics of a. Protozoans b. Slime molds c. Fungi, d. Algae. Lichens as consortium of algae and fungi Morphological, cellular, physiological, metabolic, and ecological characteristics of Acellular organisms: Viruses and prions
B	Viruses of Bacteria: Bacteriophages discovery and significance, General characteristics, Morphology and Structure, classification and Nomenclature

	of bacteriophages, Replication of Bacterial viruses, Virus multiplication (Replication) cycle, Lysogeny Viruses of Animals and Plants: History, Structure and composition, Virus replication, Classification of viruses, Isolation and identification of viruses, cultivation of animal viruses, cultivation of Plant viruses, Effects of virus infection on cells, viroid
C	Fungi: General, General characters: Somatic structure, ultra-structure of fungal cell, hyphal modification, Cultivation of fungi: Importance of fungi: Reproduction in fungi: Asexual and sexual methods of reproduction, par asexuality among fungi, fruiting bodies in fungi, Fungal classification: Criteria used for classification, recent classification system, criteria used for classification, recent classification system. Brief outline of different classes of fungi: (Structure, habitat, reproduction/ life cycle and economic importance in general) Phycomycetes (Phycomycotina)Ascomycetes (Ascomycotina)Basidiomycetes (Basiomycotina) Deutromycetes (Duteromycotina) Slime molds
Unit 3	Microbial Physiology and Microbial Genetics
A	Enzymes and their regulation: Characteristics of enzymes, chemical and physical properties of enzymes, Nomenclature of enzymes, nature and mechanism of enzyme, regulation of enzymes, Mechanism of regulation of enzymes, regulation of enzyme synthesis
B	Microbial metabolism: principles of Bio energetic, oxidation reduction reactions. Energy production by glycolysis, PP pathway, ED pathway, fermentation, TCA Cycle, catabolism of Lipids, Catabolism of Proteins, CO ₂ fixation, glyoxylate cycle, energy production by Photosynthesis: cyclic and non-cyclic photo phosphorylation
C	Use of energy in biosynthetic process: synthesis of Amino acids, synthesis of Macromolecules, polymerization of amino acids into polypeptides, nucleotide into nucleic acids, Peptidoglycan synthesis, Fatty acids synthesis
D	Structures of DNA, Molecular details about the process of DNA Replication, Transcription and Translation, Post-transcriptional, post-translational and post-replicative modifications.
E	The inheritance of characteristics and variability, phenotypic changes, genotypic changes, silent mutations and its reasons, conditionally lethal mutations, leaky mutations, suppressor mutations and its types, direct repair mechanisms, indirect repair mechanisms and post replicative repair mechanisms, bacterial recombination, Bacterial conjugation, transduction, Bacterial Transformation, the regulation and expression of gene activity, genetic engineering
Unit 4	Industrial and Applied Microbiology
A	Microbiology of Soil: Physical characteristics of soil, Microbial flora of soil, interactions among soil microorganisms, Biochemical role of Soil microorganisms, Biochemical transformation of Nitrogen cycle, Carbon cycle, Sulphur cycle Biodegradation of herbicides and pesticides
B	Microbiology of Domestic water and Wastewater: Water purification, Determining water quality, water pollution, wastewater, Wastewater treatment and disposal Wastewater treatment processes, Microorganisms and wastewater treatment procedures
C	Microbiology of Foods: Microbial flora of fresh foods, Microbial spoilage of foods, microbiological examination of foods, preservation of foods, fermented foods, microorganisms as a food- single cell proteins

D	Industrial Microbiology: Microorganisms and Industry, Bioengineering of microorganisms for industrial purposes, Industrial production of lactic acid, vinegar, amino acids, insulin, alcohol fermentation, Baker's yeast, penicillin production, citric acid production, enzyme production microbiology and mining, deterioration of paper, textiles
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Suggested reading books:

- Pelczar Jr, M J, Chan ECS, Krieg N R, (1986), *Microbiology: An Application Based Approach*, 5 th edn. McGraw-Hill Book Company, NY
- Ingraham J L and Ingraham C., *An Introduction to Microbiology*: Thomson Brooks/Cole
- Atlas R M, (2015), *Principles of Microbiology* 2nd Edition, McGraw Hill education, Mumbai
- Black J G, (2002) *Microbiology: Principles and Explorations*, 5th edn, John Wiley and Sons, Inc. NY
- Cambell R., (1983), *Microbial Ecology*, 2nd edn. Blackwell Scientific Publications, London
- Ogunseitan O., (2005) *Microbial Diversity: Form and Function in Prokaryotes*, Blackwell Publishing, Malden, MA, Oxford, Victoria
- Stanier R Y, Adelberg E A and Ingraham J L, (1991), *General Microbiology*, 5th edn. Mac Millan Press Inc
- Stanbury P F, Whitaker A, and Hall S J, (1995). *Principles of Fermentation Technology*, 2nd edn, Pergamon Press, London, UK
- Waites M J, and Morgam N L, (2002). *Industrial Microbiology: An Introduction* Blackwell Science
- Crueger W and Crueger A, (2000), *Biotechnology: A Textbook of Industrial Microbiology*, 2nd edn, Panima Publishing Corporation, New Delhi, India
- Trevan M D, Boffey S, Goulding K H, and Standury S, (eds), (1987), *Biotechnology: The Biological Principles*, Tata McGraw-Hill, New Delhi, India.
- Casida L E, Jr. (1968). *Industrial Microbiology*, Wiley Eastern Ltd, New Delhi, India
- Madigan, M. T., Martinko, J. M., & Parker, J. *Brock Biology of Microorganisms*. Upper Saddle River, NJ: Prentice Hall/Pearson Education.
- Constantine J. Alexopoulos, Charles W. Mims, Meredith M. Blackwell, *Introductory Mycology*, John Wiley & Sons Inc., New York,
- William Hayes *The Genetics of Bacteria and Their Viruses*, John Wiley & Sons.
- Watson, James D. Benjamin, W. A., Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R. M. *Molecular Biology of the Gene*.
- Larry Snyder and Wendy Champness *Molecular Genetics of Bacteria*. Washington (DC): ASM Press.
- Jocelyn E Krebs; Benjamin Lewin; Stephen T Kilpatrick; Elliott S Goldstein *Lewin's genes XI*, Burlington, Mass: Jones & Bartlett Learning

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Unit-1: Research Methodology & Scientific Writing

- ❖ Research methodology: An Introduction: Meaning, objectives and types of research, significance of research. Definition and identification of a research problem, justification, theory of hypothesis, Ethics in research.
- ❖ Research Design: Features of a good design, concepts of variables, experimental and control groups. Hypothesis testing.
- ❖ Report Writing: Significance of report writing, steps in report writing and types of reports, writing of research proposal.

Unit-2: Advanced Analytical Techniques

- ❖ Spectroscopy: FTIR, NMR, MS, MALDI-TOF
- ❖ Chromatography: GLC, GC-MS, HPLC, HPTLC, FPLC
- ❖ Separation Techniques: Types of Centrifugation & Electrophoresis

Unit-3: Molecular Biology and Immunotechniques and Microscopy

- ❖ Tracer based techniques: RIA, IRMA, ELISA, Autoradiography, PCR and its variations
- ❖ Blotting techniques, RFLP, RAPD, AFLP, ISSR, SSR, FISH and GISH
- ❖ PET, CAT, Micro CT, MRI
- ❖ Phase Contrast Microscopy, DIC, Fluorescence Microscopy, Confocal Microscopy
- ❖ TEM, SEM, STEM, Special Techniques
- ❖ Specimen preparation for Light and Electron Microscopy
- ❖ Flow cytometry and its applications.

UNIT-IV Biostatistics and Bioinformatics

- ❖ Probability distributions- Binomial, Poisson and Normal distributions
- ❖ Collection, classification and tabulation of data
- ❖ Measures of Central Tendency- Mean, Median and Mode
- ❖ Measures of dispersion- Range, Standard deviation, Standard Error
- ❖ Skewness and Kurtosis
- ❖ Correlation and Regression
- ❖ Student's t-distribution
- ❖ Analytical approaches in Bioinformatics
- ❖ Biological databases

References and suggested readings:

- Roig M. (2006). Avoiding plagiarism, self- plagiarism, and other questionable writing practices: A guide to ethical writing.

C.R. Kothari *Research Methodology: Methods and Techniques*. Second Revised Edition: New Age International Publishers: 2004.

Paul G. Chapin *Research Projects and Research Proposals (A Guide for Research Scientist, Fellow seeking Funds)* 2004: Cambridge, U.K.

Michael Jaykatz *From Research to Manuscript (A Guide to Scientific Writing)*: U.S.A. Springer: 2006.

Judith F. Olson *Writing Skills (Success in 20 minutes a Day: Learning Express Skill Builders)*: New York: 1998) By.

Panneerselvam, R. *Research Methodology*, Prentice Hall of India, New Delhi, 2004.

Skoog D.A. *Instrumental methods of analysis*.

Plummer *An introduction to practical Biochemistry*.

Chatwal and Anand *Instrumentation: Spectroscopy*.

Boyer *Modern experimental Biology*.

Riott I .M. 1998 *Essentials of Immunology*. ELBS, Blackwell Scientific Publishers, London.

Kuby J. 1994 *Immunology* 2 nd Edition. W.H. Freeman and Co. New York.

Claus D. Elgert. 1996 *Immunology - Understanding of Immune System* Wiley - Liss, New York.

William Paul *Fundamentals of Immunology*.

Abbas *Cellular and Molecular Immunology*. 3rd Edition.

Travers *Immunobiology: The Immune System in Health and Disease*. 3rd Edition

Benjamin, *Immunology- A short Course*. 2 nd Edition

Noel R. Rose, Chief Editor: Robert G. Hamilton and Barbara Detrick (Eds.) *Manual of Clinical Laboratory and Immunology* 6th Edition. 2002 ASM Publications.

Patrick R. Murray *Pocket Guide to Clinical Microbiology*. 2 nd Edition. 1998 ASM Publications.

G. Nageswara Rao, *Statistics for Agricultural Sciences*, Oxford and IBH Publishing Co., New Delhi

Zar, Jerrold H. (1998). *Biostatistical Analysis*. Prentice Hall, N.J.

Dr. S. B. Bhise, Dr. R. J. Dias, K. K. Mali and P. H. Ghanwat *Textbook of Computer applications and biostatistics*- ebook, , Trinity publishing house, Satara

N. Nirmala Khandan *Modeling Tools for Environmental Engineers and Scientists*, CRC PRESS

Sokal, Robert and James Rohlf (1997). *Biometry*, Freeman Press, N.Y.

Walpole, R. and R. Myers (1993). *Statistics for Engineers and Scientists*, 5th edn. MacMillan, N.Y.

Wayne, R. Ott (1995). *Environmental Statistics and Data Analysis*, CRC Press.

Manly (2001) *Statistics for environmental science and management*, Chapman and Hall / CRC.

Ramsay and Schafer (1997). *The Statistical Sleuth*, Duxbury Press.