

UNIVERSITY OF MUMBAI



**Revised Syllabus for
Ph.D Entrance Exam (PET)
in
MICROBIOLOGY
Paper I & II**

With effect from the academic year **2020–2021**

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AC _____
Item No. _____

UNIVERSITY OF MUMBAI



Sr. No.	Heading	Particulars
1	Title of the Course	PET (Microbiology)
2	Eligibility for Admission	M.Sc.
3	Passing Marks	40
4	Ordinances / Regulations (if any)	Nil
5	No. of Years / Semesters	NA
6	Level	P.G. (Strike out which is not applicable)
7	Pattern	Semester (Strike out which is not applicable)
8	Status	Revised (Strike out which is not applicable)
9	To be implemented from Academic Year	From Academic Year 2020-21

Date

Dean Science & Technology **Name** Dr Anuradha Majumdar

Chairman, BOS of Microbiology Dr Zarine Bhatena

Signature

Z. P. Bhatena

PREAMBLE

The University of Mumbai offers research programs in different subjects and in interdisciplinary areas under the various faculties leading to the degree of Doctor of Philosophy (Ph.D.). A candidate to qualify for enrollment into this program shall have to enrol for the PET exam and qualify in it to register at a recognized place of research which includes the University Departments, research Institutes and Affiliated Colleges recognized as “Research Centre” by the University.

The PET course work for Ph.D. in Microbiology shall have two courses namely Course-I and course- II. Course I shall be on Research Methodology, research aptitude, logical reasoning, comprehension, communication and general knowledge while course II shall be subject specific

The mode of assessment for the evaluation of coursework would be as follows

- PET shall be of Multiple Choice Questions (MCQ) and of 100 marks.
- Each paper will have 50 questions and the qualifying marks shall be 50% of the aggregate, taking Paper I and II together.
- Relaxation of 5% of marks from 50% to 45% shall be allowed for those belonging to reserved category / Differently/Abled and other categories of candidates as per policies of the Government of Maharashtra prescribed from time to time.

The revision of this syllabi has been undertaken to enable assessment of the research undertaking capabilities of candidate besides evaluating his basic and advanced knowledge .

Dr Anuradha Majumdar (Dean, Science & Technology)

Prof Shivram Garje (Associate Dean , Science)

Dr Z. Bhathena Chairperson , BOS of Microbiology

Dr Bela Nabar Member (BOS)

Dr Nagesh Malik Member (BOS)

Dr Anushree Lokur (Member (BOS)

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Dr Varsha Shukla (Member BOS)

Dr Minal Dukhade (Member BOS)

Dr Vikrant Bhor (Member BOS)

Dr Abhay Shedye (Member BOS)

Dr P Thorat (Member BOS)

Dr Aparna Pharande (Member BOS)

Mumbai University Syllabus for PhD (PET) Entrance Exam :

Microbiology

PAPER 1

Research Methodology

1. Research terminology and fundamentals:

Definition & Objectives of research, scientific thinking, general characteristics of research, classification and types of research, types of research methods, Research methods verses methodology, Criteria of good research ,Identification and formulation of research problem, Study designs.

2. Defining Research problem:

Formulation of a hypothesis, understanding the structure, elements, classification, functions of hypothesis based on scientific laws and principles.

Meaning and nature of hypothesis, Functions of hypothesis, Importance of hypothesis, Kinds of hypothesis, Characteristics of good hypothesis, formulation of hypothesis

3. Research Formulation – Defining and formulating the research problem, selecting the problem, importance & types of literature review in defining a problem. Critical literature review, Primary and secondary sources of literature: reviews, treatise, monographs-patents. Web as a source , searching the web, Identifying gap areas from literature review.

4. Data collection and processing:

Definition, scope and limitations of data collection and processing, Methods and techniques of data collection: types of data, methods of primary data collection (observation/ experimentation/ questionnaire/ interviewing/ case/pilot study, methods), methods of secondary data collection (internal/ external). Representation of data; Its types and its representations, importance of measurement scales, variables & their measurements

5. Sampling and sampling distributions

Sampling frame, importance of probability sampling, simple random sampling, systematic sampling, stratified random sampling, cluster sampling, problems due to unintended sampling, ecological and statistical population in the laboratory.

6. Data analysis and report writing

Experimental data collection and data processing: Processing operations, Problems in processing, elements of analysis in data processing, software for data processing.

Types of research reports, guidelines for writing a report, formats for poster and oral presentations.

General structure of scientific reports: - Different types of scientific documents - journal articles, books, thesis, conference and project reports. Components of a research paper:

Publication process, copyright transfer, Open access, , Formulation of research proposal

Style of referencing (citation styles): Harvard, Vancouver, APA, MLA reference writing,.

7. Statistics in research

Statistical methods for data analysis; Mean, Standard deviation & standard error. Concept of probability and its significance. Measures of central tendency -mean, median, mode, geometric mean, Measures of dispersion- Range, Q.D., M.D., Variance, standard deviation, Correlation and Regression analysis

Hypothesis testing: Null and alternate hypothesis, Type-I & Type-II errors, Level of significance, Power of test, p value. Parametric tests: Large sample Tests, Small sample Tests, t-test, F-test and ANOVA

Books recommended

1. Research Methodology-C R Kothari
2. Research Methodology: An Introduction-Stuart Melville and Wayne
3. Practical Research Methodology-Catherine Dawson
4. Research Methods for Science Michael P Marder
5. Research Methodology: Principle, Methods and Practices-Joshua O.Miluwi and Hina Rashid
6. Research Methodology: A Step By Step Guide for beginners- Ranjeet Kumar
7. How to Write and publish a Research Paper- Seventh Edition-Robert Day And Barbara Gastle
8. Introduction to Bio-statistics and Research Methods- P S S Sunder Rao
9. Research Methodology and Scientific Writings- C George Thomas

References:

- 1) Garg, B. L. Karadia R. Agrawal, F. and Agrawal U. K., 2002. An Introduction to Research Methodology, RBSA Publishers
- 2) Kothati C. R., 1990. Research Methodology: Methods And Techniques New Age International 418p.
- 3) Sinha S. C. and Dhiman A. K., 2002. Research Methodology Ess Ess Publications 2 Columes.
- 4) Trochim W. M. K., 2005. Research Methods: The Concise Knowledge Base Atomic Dog Publishing. 270P

Paper 2: Subject Concerned Syllabus

Microbiology

1. Microscopic techniques in Microbiology

Principle, working Specimen preparation & Applications of

- A. Light microscopy - Bright field microscope, Dark field microscope, Phase-contrast microscope, fluorescence microscope, Confocal microscopy, scanning probe microscopy
- B. Electron microscopy-TEM and SEM , AFM

2. Advanced Spectroscopic and Chromatography Techniques:

Principle, working and applications of

- i UV, IR, Mass Spectroscopy: ESI-MS and MALDI-MS
- ii. NMR: Approach to determine structure of Carbohydrate by NMR
- iii. FTIR, HPTLC, Ion exchange chromatography, Gel filtration chromatography

3. Taxonomy & Identification methods in microbiology

Taxonomy and classification- Phenetic phylogenetic, genotypic and numerical taxonomy. Techniques for determining microbial taxonomy and phylogeny, An overview of Bergey's manual of systematic bacteriology

A. Culture dependent analysis of microbial communities:

- i). phenotypic analysis using VITEK, API 20, FAME and BIOLOG

B. Culture independent methods

- i) Methods for DNA / RNA extraction
- ii) Basic PCR methods with respect to identification of microorganisms
- iii) Gene sequence analysis
 - 1. Amplification of 16S rRNA gene for prokaryotes and SSU, LSU, ITS.
 - 2. Multi-locus sequence typing
 - 3. Genome fingerprinting (Multi gene and whole genome) – Ribotyping

4. Molecular Tools for Genetics & Molecular biology:

- i. Principles and procedures of protein and nucleic acid sequencing: Southern, northern and western blotting, polymerase chain reaction, Reverse transcriptase PCR, real time PCR, , Differential display PCR, Real time Fluorescent PCR, Hot- Start PCR, Multiplex PCR, Nested PCR, Applications.
- ii. Nucleic acid sequencing:Pyrosequencing, RFLP and RAPD, SNP, VNTR analysis, Restriction enzymes, vectors, gene cloning. gene therapy.
- iii Molecular separations: Gel electrophoresis, Two-dimensional gel electrophoresis
- iv. Labelled tracers: Autoradiography, Liquid scintillation counting Nonradioactive tracers
- v. Using in Situ nucleic acid hybridization for locating genes in chromosomes,

5. Fermentation Technology & Industrial microbiology:

Types of Fermentations, bioreactor configurations, stirred tank, bubble column, airlift reactor, stirred and air driven reactors, packed bed, fluidized bed, trickle bed, monitoring and control of bioreactors, Ideal reactor operation: batch, fed-batch, and continuous operation.

Downstream processing: filtration, centrifugation, cell disruption, ideal stage concept, aqueous two-phase liquid extraction, adsorption, chromatography, Solid state fermentation' Major products of industrial microbiology; Antibiotics, Amino acids, Organic acids, probiotics, vitamins, vaccines .

6. Medical Microbiology & Immunology Microbial biofilms :

- i. Virulence, Cell adhesion, New emerging pathogens like MDR TB, dengue, SARS, listeriosis
- ii. Antimicrobial agents and chemotherapy, Genetic Basis of antimicrobial resistance, Mechanistic basis of antimicrobial resistance- modification of antibiotic molecules, decreased penetration and efflux, changes in target sites, Resistance Due to Global Cell Adaptations
- iii. Basic concepts in immunology: Humoral and cellular immunity, Diversity of TCR and BCR, Monoclonal antibodies and their applications.
- iv. Biofilm in health & disease: Structure, properties and formation, Infections on Tissue Surfaces, and associated with Medical Devices and Implants

7. Applied & Environmental Microbiology:

- i. Environmental complex, interaction of ecological factors: light, temperature, precipitation (Rainfall), humidity of air, atmospheric gases and wind; topographical factors,
- ii. Extremophile: anaerobes, halophiles, acidophile, alkalophile, thermophile, barophile,
- iii. Aero microbiology: Microbes of indoor and outdoor environment, pathways, enumeration, control, bioterrorism.
- iv. Water microbiology: Significance of microbes in water quality, Test for potability of water,
- v. Microbial treatment of sewage: application of wastewater in land. Composting of bio solids and domestic solid waste.
- vi. Biodegradation and bioremediation processes by natural communities: stimulating biodegradation-hydrocarbondegradation in water and soils. Phyto remediation and types, Metal bioleaching, Bio augmentation, Microbes as Biosensors, Bio pesticides, biofertilizers .

REFERENCES

- 1) Michael Madigan. John Martinko. Kelly Bender, Daniel Buckley. David stahl. Fourteenth edition. Brock Biology of microorganisms, Pearson publishers.
- 2) Joanne M.Willey, Linda M.Sherwood, Christopher J.Woolverton. Tenth edition. Prescotts microbiology, Mcgraw Hill.
- 3) Stanley R.Maloy, John E cronan, Jr.Davidfreifelder. Second edition. Microbial genetics, Narosa publishing house.

- 4) Gerhard Gottschalk. Second edition. Bacterial Metabolism, Springer Verlag.
- 5) Alexander n Glazer, HiroshiNikaido. Second edition. Microbial Biotechnology: fundamentals of applied microbiology, Cambridge University press.
- 6) Thomas J.kindt, Richard A. Goldsby, Barbara A. Osborne. Sixth edition.
- 7) Kuby Immunology, W.H freeman and company.