Department of Microbiology

Syllabus & Scheme of Examination

Ph.D Microbiology

Maharshi Dayanand University
Rohtak 124001

Students who obtain degree in Ph.D (Microbiology),

PSO1: Have significant practical knowledge on various research areas of Microbiology.

PSO2: Are well-versed research skills and develop ability to plan and execute experiments as well as to analyze & interpret data.

PSO3: Have a deep understanding of the students especially with regard to the role of microorganisms in industry, health and environment and will gain in depth- knowledge about their area of research.

PSO4: Gain advanced laboratory training in the various aspects of enzymatic microbiology, medical microbiology, plant-microbe interaction, bioremediation, bioprocess technology, with special reference to their respective research areas.

PSO5: Will develop the capability to clearly present and discuss the research both in written and spoken English.

PSO6: Well-acquainted about Intellectual property rights, bioethics, legal and social issues in research.

Examination scheme of Ph.D Microbiology w.e.f. the academic session 2017-18

Paper No.	Nomenclature of the paper	Theory	Internal Assessment	Seminar (if any)	Max. Marks
17MCBPC1	Advances in Fermentation and Enzyme Technology	80	20*	--	100
17MCBPC2	Research Methodology	80	20*	--	100
17MCBPC3	Biostatistics and Computer Sciences	80	20*	--	100
17MCBPC4	Review writing and Presentation/Seminar	50	--	50**	100
Grand Total					**400**

***Internal Assessment:**

Two assignments of 10 marks each.

**Seminar
Division of Marks:
Participation : 10
Seminar report : 10
Presentation : 15
Discussion : 15
Total : 50

Pass percentage will be 50% in each paper.

Paper: 17MCBPC1 - Advances in Fermentation and Enzyme Technology

Theory Marks: 80
Internal assessment: 20
Time: 3 hours

Course Outcomes
After completing this course students will be able to:
CO1: Understand development of process for microbial fermentations.
CO2: Learn the basic principles involved in the purification of various useful products of industrial importance.
CO3: Techniques used for the applicability of free- and immobilized-enzymes/biocatalysts.
CO4: Learns production of industrially and medically important enzymes

Note: The total eight questions will be set selecting two questions from each unit. The students will have to attempt total four questions selecting one question from each Unit.

Unit I

Fermentation: Submerged and solid state fermentations, Types of fermenters, Design and operation of Fermenters, Concepts for selection of a reactor. Growth and product formation kinetics: Monod growth kinetics, Kinetics of colony formation and pellet growth. Concepts for calculation of yield coefficient, specific growth rate, specific productivity, maintenance coefficient. Biomass and substrate balance calculations for chemostat, chemostat with recycles, multistage chemostat systems and fed-batch systems.

Unit II

Stoichiometry of cell growth: Elemental balance, Electron balance, Theoretical calculation of oxygen demand, Upper limit of yield and energy changes occurring due to growth and product formation. Sterilization: Kinetics of cell death and nutrient degradation during heat killing ; Batch and continuous sterilization; Scale up of sterilization. Brief account of Downstream processing: Downstream process economics, Cost cutting strategies in downstream processing industry.

Unit III

Enzymes: commercial applications; Production of industrially important enzymes such as Amylases, Proteases, Lipases, Enzymes used for analytical purpose: Glucose oxidase, cholesterol oxidase; Medicinal enzymes: L-Asparaginase.

Unit IV

Techniques of enzyme immobilization; Kinetic Parameters for soluble and Immobilized Enzyme Systems, Reactors for Enzyme Catalyzed Reactions. Idealized Enzyme Reactor Performance, Mass transfer limitations in immobilized enzyme reactors.

Paper: 17MCBPC2 - Research Methodology

Theory Marks: 80
Internal assessment: 20
Time: 3 hours

Course Outcomes
After completing the course on Research Methodology, students will learn:
CO1: Ways and means to isolate and grow micro-organisms
CO2: Understand the use of the tools required to study the microscopic features of the microbes
CO3: Understand the tools available to carry out the molecular characterization of the microorganisms
CO4: Learn the techniques to harvest biomolecules of commercial importance from microbes
CO5: To learn the immunological characterization helpful in diagnosis and treatment of pathogenic micro-organisms

Note: The total eight questions will be set selecting two questions from each unit. The students will have to attempt total four questions selecting one question from each Unit.

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Unit I

Microbiological Techniques: Basic techniques for isolation, cultivation and enumeration of Microorganisms; Staining of microorganisms; Microscopy: bright field microscopy, dark field microscopy, fluorescence microscopy, phase contrast and electron (transmission and scanning) microscopy; Growth limitation and sterilization techniques.

Unit II

Molecular Biology Techniques: PCR and its types, applications of PCR, Real Time PCR, RT-PCR. Gel electrophoresis: Agarose and PAGE, formaldehyde-agarose for RNA, Denaturing gels, native PAGE, SDS-PAGE, Southern, Northern and Western blotting. Library preparation: Genomic DNA, cDNA, EST and reduced representation libraries. DNA microarray, DNA sequencing techniques.

Unit III

Biophysical techniques: Principle & application of gel filtration, Ion exchange & hydrophobic interaction chromatography, GC, HPLC, FPLC, Isoelectric-focussing (IEF), 2-D gels, Centrifugation and its types, Spectrophotometry, GC-MS, LCMS, NMR, MALDITOF, X-ray crystallography, Circular Dichroism.

Unit IV

Immunological techniques: ELISA, RIA, immunofluorescence, RAST, RIST, MLR, flow cytometry and fluorescence, FACS and immunoelectron microscopy; Hybridoma technology, monoclonal antibodies and abzymes; Antibody engineering.

Paper: 17MCBPC3 – Biostatistics & Computer Sciences

Theory Marks: 80
Internal assessment: 20
Time: 3 hours

Course Outcomes
After completing the course students will be able to:
CO1: Learn the Basic and advanced techniques in bioinformatics and biostatistics
CO2: Get deep insight on various aspects of scientific research including writing of research proposal and review writing
CO3: Understand and get knowledge about IPR and bioethics, legal and social issues in research

Note: The total eight questions will be set selecting two questions from each unit. The students will have to attempt total four questions selecting one question from each Unit.

Unit I

Biostatics: Data presentation, Measures of central tendency; Measure of disparity: Mean deviation, Standard deviation, Standard error, Coefficient of variation; Correlation and regression. Probability theory and distributions: Binomial, Poisson, and Normal distributions. Statistical inference- Hypothesis testing (t test, Z test, Chi square test), ANOVA for one way and two way classified data.

Unit II

Bioinformatics basics; Databases: Sequence databases, Structural databases (e.g. PDB, MMDB, FSSP, SCOP, BRENDA); Data mining tools; Data submission tools; Data analysis tools (BLAST & FASTA); Gene prediction tools; Tools for Phylogenetic prediction. Sequence Analysis, Sequence alignment, Primer Designing, Mass Spectrometry based proteomics tools, Protein structure & functions prediction tools: Modeling: 2D and 3D protein modeling. System Biology approach to understand microbial enzyme machinery.

Unit III

Introduction to Scientific Research: Meaning of Scientific Research, Purpose, Characteristics, Type of research; Motivation of research; Process of research: Identification of the problem, formulation of objectives, research plan and its components. Documentation and Scientific writing: Writing of Research proposal, Preparation of Research paper and Review articles, Thesis writing and Bibliography compilation.

Unit IV

Intellectual Property Rights: Patentable subject matter and patent types, Deposit of microorganisms for the purposes of Patent; Biosafety issues, Ethical, legal and social issues in Scientific research.

Paper: 17MCBPC4 – Review writing & Presentation/Seminar

Total Marks: 50+50=100

Course Outcomes

On the completion of this course students will be able to learn the following:

CO1: In-depth knowledge assigned topic of current research

CO2: The capability to clearly present and discuss the research both in written and spoken English.

CO3: Writing Journal Articles: Word choice and style, References, Plagiarism

Review writing & Presentation/Seminar

The candidate shall be required to prepare a review on the related to the topic of research problem under the guidance of the Faculty in the Department. The evaluation will be based on the presentation of the seminar jointly by the faculty members of the
department.