# Department of Microbiology

## Syllabus & Scheme of Examination

# Ph.D Course Work
# Microbiology



# MaharshiDayanand University
# Rohtak 124001

## Examination scheme of Ph.D Course work Microbiology
## w.e.f. the academic session  Jan 2017 to Dec 2017

| 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 & Computer Sciences | 80 | 20* | -- | 100 |
| 17MCBPC4 | Review writing & Presentation/Seminar | 50 | -- | 50** | 100 |
| **Grand Total** | | | | | **400** |

*Internal Assessment:

Two assignments of 10 marks each.

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

**Pass percentage will be 50% in each paper**.
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**Note:** The candidate shall be required to present seminar related to the topic of researchproblem 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.

**Paper: 17MCBPC1 Advances in Fermentation and Enzyme Technology  MM: 80**

**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**  **MM: 80**

**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

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    MM: 80**

**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.