Department of Microbiology

Syllabus

Ph.D. Coursework Microbiology

Maharshi Dayanand University
Rohtak 124001

Program Architecture, Duration, and Scheme of Examination, Workload / Week and credits for Ph.D. Coursework in Microbiology (2020-2021)

Program Specific Outcomes (PSO)

PSO1: Enable students to plan, execute experiments and make analysis to interpret research data.

PSO2: Develop an understanding of microbiological research and its role in industry, health and environment sector.

PSO3: Develop the written and oral skills to clearly present the research to the scientific community.

PSO4: Be well-acquainted with Intellectual property rights, bioethics, legal and social issues in research.

Duration: One Semester (Six months)

Total credit requirement: 14 credits

Program Structure: Ph.D. Course-work in Microbiology

SEMESTER 1						
Course Code	**Nomenclature of Course**	**Theory marks (end semester examination)**	**Internal Assessment marks**	**Maximum marks**	**Hours /Week**	**Credits**
20MCBPH11C1	Research Methodology	80	20*	100	4	4
20MPCC1	Research and Publication Ethics	40	10**	50	2	2
20MCBPH11C3	Biostatistics & Computer Sciences	80	20*	100	4	4
20MCBPH11C4	Advances in Fermentation and Enzyme Technology	80	20*	100	4	4
Total marks/Credits				**350**	**14**	**14**

Note: The compulsory course on Research and Publication Ethics will be offered by Ch. Ranbir Singh Institute of Social and Economics for all UTDs/Centers/ Institutes passed with resolution No. 27 of 271 meeting of EC held on 29.9.2020

***Internal Assessment:**

Two assignments of 5 marks each

Two presentations of 5 marks each

****Internal Assessment:**

One assignment of 5 marks

One presentation of 5 marks

COURSE: 20MCBPH11C1 RESEARCH METHODOLOGY

Name of the Program	Ph.D. Coursework	**Program Code**	MCBPH
Name of the Course	Research Methodology	**Course Code**	20MCBPH11C2
Hours/Week	4	**Credits**	4
Max. Marks.	80	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answers from all units. The candidate has to attempt one question each from each unit along with the compulsory question (5 x 16 = 80 marks)

Course Objectives:

1. To study Microbiological techniques to isolate and grow micro-organisms.
2. To study various types of microscopy.
2. To study Molecular Biology Techniques..
3. To study Biophysical techniques.
4. To study immunological techniques.

Course Outcomes:

By the completion of the course, the student can be able to

1. learn ways and means to isolate and grow micro-organisms
2. Understand the use of the tools required to study the microscopic features of the microbes
3. Understand the tools available to carry out the molecular characterization of the microorganisms
3. Learn the techniques to harvest biomolecules of commercial importance from microbes
5. To learn the immunological characterization helpful in the diagnosis and treatment of pathogenic micro-organisms

Unit – I

Microbiological Techniques: Basic techniques for isolation, cultivation, and enumeration of Microorganisms; Staining of microorganisms; Microscopy: bright field microscopy, darkfield 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, MALDI-TOF, 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.

References:

1. Friefelder. D. (1982). Physical Biochemistry, Application to Biochemistry, and Molecular Biology. W.H. Freemen and Company, San Fransisco.
2. Zabriskie, J. (2009). Essential Clinical Immunology Cambridge: Cambridge University Press.
3. William, B. L. and Wilson, K. (1986). A Biologist Guide to Principles and Techniques of Practical Biochemistry. Edward Arnold Publisher, Baltimore, Maryland (USA).
4. Slater, R .J. (1990). Radioisotopes in Biology-A Practical Approach. Oxford UniversityPress, NewYork
5. Brown. T.A. Molecular Biology LabFax, Bios Scientific Ltd.Oxford

Course: 20CCPH11C1 RESEARCH AND PUBLICATION ETHICS

Name of the Program	Ph.D. Coursework	**Program Code**	MCBPH
Name of the Course	Research and Publication ethics	**Course Code**	20MPCC1
Hours/Week	2	**Credits**	2
Max. Marks.	40	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of shorts answer from all units. The candidate has to attempt one question each from each unit along with the compulsory question (5 x 8 = 40 marks)

Course Objectives:

1. To study the philosophy of ethics
2. To study the scientific conduct of research
3. To study the publication ethics
4. To know about various journal citation databases
5. To know the importance of quality publications

Course Outcomes:

By the completion of the course the student is able to

1. Ethics in conduct of scientific research
2. Know the scientific misconducts
3. How to avoid plagiarism and what are the penalties of plagiarism
4. Know the quality of research publications
5. Write research and review articles.

Unit - I

PHILOSOPHY AND ETHICS

1. Introduction to philosophy: definition, nature and scope, concept, branches
2. Ethics: definition, moral philosophy, nature of moral judgments and reactions

SCIENTIFIC CONDUCT

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data

Unit - II

PUBLICATION ETHICS

1. Publication ethics: definition, introduction, and importance
2. Best practices/standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
5. Violation of publication ethics, authorship, and contributor ship
6. Identification of publication misconduct, complaints, and appeals
7. Predatory publishers and journals

Unit - III

DATABASES AND RESEARCH METRICS

(A) Databases

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

(B) Research Metrics

1. Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score
2. Metrics: h-index, g index, i10 index, altmetrics

Unit - IV

Practice

OPEN ACCESS PUBLISHING

1. Open access publications and initiatives
2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
3. Software tool to identify predatory publications developed by SPPU
4. Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.

PUBLICATION MISCONDUCT

(A) Group Discussions

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

(B) Software tools (2 hrs.) :Use of plagiarism software like Tumitin, Urkund and other open source software tools

References:

1. Bird, A. (2006). Philosophy of Science, Routledge
2. P. Chaddah (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarised.
3. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance (2019).
4. Beall, J (2012), Predatory publishers are corrupting open access. Nature, 489(7415), 179.
5. National Academy of Sciences, National Academy of Engineering and Institute of Medicine (2009). On being a Scientist: A guide to Responsible Conduct in Research, Third Edition, national Academic press.

COURSE: 20MCBPH11C3 BIOSTATISTICS & COMPUTER SCIENCES

Name of the Program	Ph.D. Coursework	**Program Code**	MCBPH
Name of the Course	Biostatistics & Computer Sciences	**Course Code**	20MCBPH11C3
Hours/Week	4	**Credits**	4
Max. Marks.	80	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answers from all units. The candidate has to attempt one question each from each unit along with the compulsory question (5 x 16 = 80 marks)

Course Objectives:

1. To study the basics of Biostatistics.
2. To study the basics of Bioinformatics.
3. To study the Research methodology of Science.
4. To study Intellectual property rights.
5. To study Biosafety issues, Ethical, legal, and social issues in scientific research.

Course Outcomes:

By the completion of the course, the student can

1. Have an understanding of summarization, presentation, and analysis of scientific data
2. Have an understanding of various tools and techniques of Bioinformatics.
3. Get deep insight on various aspects of scientific research including the writing of research proposals and review writing.
4. Understand and get knowledge about IPR.
5. Develop an understanding of bioethics, legal, and social issues in scientific research.

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.

References:

1. Gurumani, N. (2014). An Introduction to Biostatistics. Neha Publishers & Distributors
2. Paulson, D.S (2008). Biostatistics and Microbiology. Springer
3. Rosner, B (2010). Fundamentals of Biostatistics. Brooks/Cole, Cengage Learning
4. Baxevanis, A. D and , Ouellette B. F. F(2009).Bioinformatics. Wiley india Pvt. Ltd
5. Lesk, A.M (2013). An Introduction to Bioinformatics. Oxford University Press Inc

COURSE: 20MCBPH11C4 ADVANCES IN FERMENTATION AND ENZYME TECHNOLOGY

Name of the Program	Ph.D. Coursework	**Program Code**	MCBPH
Name of the Course	Advances in Fermentation and Enzyme Technology	**Course Code**	20MCBPH11C4
Hours/Week	4	**Credits**	4
Max. Marks.	80	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answers from all units. The candidate has to attempt one question each from each unit along with the compulsory question (5 x 16 = 80 marks)

Course Objectives:

1. To study Microbial Growth and Product formation Kinetics.
2. To know about the material balance calculations for Batch, fed-batch, and continuous modes of cultivation.
3. To learn about the sterilization process.
4. To study the production of industrial and therapeutic enzymes
5. To know about the enzymatic reactions and their bioprocess considerations

Course Outcomes:

After completing this course students will be able to

1.. Understand the development of the process for microbial fermentations.
2. Learn the basic principles involved in the purification of various useful products of industrial importance.
3. Learn about growth stoichiometry and growth and product formation kinetics.
4. Techniques used for the applicability of free-and immobilized-enzymes/biocatalysts.
5 . Learns the production of industrially and medically important enzymes.

Unit – I

Fermentation: Submerged and solid-state fermentation, 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. A 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 the 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.

References:

1. Stanbury, P. F, Whitaker, A , Hall, S.J (2011).Principles of Fermentation Technology. Elsevier
2. Aiba, S., Humphrey, A.E, Millis, N. F. (1973). Biochemical Engineering. Academic
3. Press Nielson,. J. and Villadsen J. (2003). Bioreaction Engineering Principles. Plenum Press.4.
4. Shuler, M. L. and Kargi F. (2017) Bioprocess Engineering Basic Concepts. by. Prentice Hall.
5. Baily, J.E. and Ollis D.F. (1986) Biochemical Engineering Fundamentals McGraw Hill.