

**Institute of Microbiology and Molecular Genetics**  
**Faculty of Life Sciences**  
**University of the Punjab, Lahore**  
**Course Outline**



Programme	BS	Course Code	MMG412	Credit Hours	3(2+1)
Course Title	<b>ARTIFICIAL INTELLIGENCE IN MICROBIOLOGY AND MOLECULAR GENETICS</b>				
<b>COURSE INTRODUCTION</b>					
<p>Artificial Intelligence (AI), a combination of computer science and robust datasets, to enable problem-solving, has revolutionized all fields of life and has opened new horizons in analyzing and interpreting complex data. In the field of microbiology and molecular genetics, AI is playing an increasingly important role, driving innovative research and breakthroughs. AI has become an essential skill for a microbiologist or molecular geneticist. This course will cover an introduction to the key concepts of AI, providing an understanding of different tools or platforms available for proper analysis and interpretation of experimental results of microbiological or molecular data (DNA, RNA, Proteins). The skills learnt in this course will be used in future research projects and in daily life.</p>					
<b>LEARNING OUTCOMES</b>					
<p>On the completion of the course, the students will:</p> <ol style="list-style-type: none"> <li>1. be able to understand basic concepts of AI and its potential applications in microbiology</li> <li>2. be able to understand potential applications of AI in molecular genetics</li> <li>3. be able to recognize possible ways in which AI can be used to analyze microbiological/ molecular data</li> <li>4. able to explore and use AI tools/platforms to analyze microbiological/ molecular data</li> <li>5. able to apply proper AI tools/platforms to analyze given microbiological/ molecular data and interpret it</li> </ol>					
<b>COURSE CONTENT</b>					
<p>Introduction to Artificial Intelligence (AI) &amp; Deep Learning and its scope in Microbiology and Molecular Genetics. Applications of AI in microbiology: Understanding microbes using AI; Phenotypic identifications of microbes using AI; Molecular identification of microbes by AI; AI in Predictive diagnostics and computer-aided diagnosis (CADx); AI in Infectious Disease Management. AI assisted drug designing: Predictive Analytics; High-throughput Screening; Structure-based Drug Design. Applications of AI in Molecular Genetics: AI in DNA sequence analysis; Genome sequencing by AI; AI in gene prediction; AI in Proteomics: AI in protein prediction; AI in protein structure prediction; genome-wide association studies (GWAS) using AI; Disease prediction from sequence analysis. Current advancements/breakthroughs of AI in Microbiology and Molecular Genetics. Limitations and Ethical Considerations of AI.</p>					

<b>PRACTICALS</b>			
<ol style="list-style-type: none"> <li>1. Students will explore various online platforms and freely available tools</li> <li>2. Students will analyze given Microbiological/DNA/RNA/Protein data using the online platforms/tools</li> </ol>			
<b>TEXTBOOKS AND READING MATERIAL</b>			
<ol style="list-style-type: none"> <li>1. Heifetz, A. (2022). <i>Artificial Intelligence in Drug Design</i>. Humana Press.</li> <li>2. Juhas, M. (2023). <i>Brief Lessons in Microbiology: From the Origin of Life to Artificial Intelligence</i>. Springer.</li> <li>3. Krittanawong, C. (2024). <i>Artificial Intelligence in Clinical Practice: How AI Technologies Impact Medical Research and Clinics</i> (First edition). Elsevier Inc.</li> <li>4. Pathak, Y., Saikia, S., Pathak, S., Patel, J. K., and Prajapati, B. (2023). <i>Artificial Intelligence in Bioinformatics and Chemoinformatics</i> (First edition). CRC Press.</li> <li>5. Razmi, R. M. (2024). <i>AI Doctor: The Rise of Artificial Intelligence in Healthcare: A Guide for Users, Buyers, Builders, and Investors</i>. John Wiley &amp; Sons, Inc.</li> <li>6. Srivastava, A., and Mishra, V. (2024). <i>Artificial Intelligence in Microbiology</i>. Elsevier Science &amp; Technology.</li> </ol>			
<b>ASSESSMENT</b>			
<b>Sr. No.</b>	<b>Elements</b>	<b>Weightage</b>	<b>Details</b>
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on activities, short tests, projects, practicals, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It will be in the form of a test to assess the student's understanding of basic statistical concepts and their application in real situation.