



## Lahore University of Management Sciences

### Critical Thinking, Scientific Writing and Ethics (BIO 403/503)

Fall 2023

Instructor	Khurram Bashir, Muhammad Shoaib
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TA Office Hours	
Course URL (if any)	

<b>Course Teaching Methodology (Please mention the following details in plain text)</b>	
<ul style="list-style-type: none"> <li>Teaching Methodology: Synchronous lectures over zoom/in person with recorded videos to be uploaded on YouTube (optional).</li> <li>Lecture details: 100% live interaction with or without available recordings of the lectures.</li> </ul>	

<b>Course Basics</b>				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2 (WF)	Duration	75 Minutes
Recitation (per week)	Nbr of Rec(s) Per Week	N/A	Duration	N/A
Lab (if any) per week	Nbr of Session(s) Per Week	N/A	Duration	N/A
Tutorial (per week)	Nbr of Tut(s) Per Week	N/A	Duration	N/A

<b>Course Distribution</b>	
Core	Biology elective
Elective	Open to all
Open for Student Category	Anyone can join
Closed for Student Category	NA

<b>COURSE DESCRIPTION</b>
<p>Critical thinking is an integral part of scientific culture. With the development of scientific methods and advances in scientific writing, there is an increasing need to monitor and record scientific experimentation with respect to methodology and reproducibility. Moreover, synchronization of experiments throughout the globe with a particular emphasis on reproducibility and minimizing scientific misconduct is an important factor to compare results from different labs. Scientific writing is continuously evolving, and new ways of presenting data are gaining more and more importance. The current course is designed to equip students to critically analyze a manuscript, differentiate between a study question and a working hypothesis, understand the value of the hypothesis, and differentiate between study objectives, overall goal, and study aims. Be able to differentiate between a scientifically sound and a technically flawed manuscript. At the end of this exercise, the students will be able to better design their experiments and write manuscripts while reducing biases and scientific misconduct. In the first half, students would learn the scientific methodology, principles of critical thinking, scientific writing, and scientific ethics, while in the 2<sup>nd</sup> half, using skills, acquired in the first half of the course, students will be required to critically evaluate current scientific literature.</p>



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COURSE PREREQUISITE(S)	
	Anyone interested in life sciences can join

COURSE OBJECTIVES	
	The main objective of this course is to enable students to think critically and use these skills for project designing and to polish their abilities to strengthen scientific manuscripts/thesis/report writing. Moreover, this course would help students to understand the scientific culture as well as ethical and moral practices in science.

Learning Outcomes	
	After the successful completion of the course, students will <ul style="list-style-type: none"><li>▪ Understand and appreciate the moral and ethical basis of scientific experiments</li><li>▪ Develop a good understanding of scientific writing</li><li>▪ Differentiate between good and bad manuscripts.</li></ul>

Grading Breakup and Policy	
Presentations	20%
In class writing exercise	20 %
Quiz(s), (2-3)	10%
Midterm Examination:	25%
Final Examination:	25%

### Harassment Policy

SSE, LUMS, and particularly this class, is a harassment-free zone. There is zero tolerance for any behavior that is intended, or has the expected result of making anyone uncomfortable and negatively impacts the class environment, or any individual's ability to work to the best of their potential.

In case a differently abled student requires accommodation for fully participating in the course, students are advised to contact the instructor so that they can be facilitated accordingly.

If you think that you may be a victim of harassment, or if you have observed any harassment occurring in the purview of this class, please reach out and speak to me. If you are a victim, I strongly encourage you to reach out to the Office of Accessibility and Inclusion at [oai@lums.edu.pk](mailto:oai@lums.edu.pk) or the sexual harassment inquiry committee at [harassment@lums.edu.pk](mailto:harassment@lums.edu.pk) for any queries, clarifications, or advice. You may choose to file an informal or a formal complaint to put an end to offending behavior. You can find more details regarding the LUMS sexual harassment policy at <https://mgshss.lums.edu.pk/lums-harassment-policy>.

To file a complaint, please write to [harassment@lums.edu.pk](mailto:harassment@lums.edu.pk)

### SSE Council on Equity and Belonging

In addition to LUMS resources, SSE's **Council on Belonging and Equity** is committed to devising ways to provide a safe, inclusive, and respectful learning environment for students, faculty, and staff. To seek counsel related to any issues, please feel free to approach either a member of the council or email at [cbe.sse@lums.edu.pk](mailto:cbe.sse@lums.edu.pk)

### Rights and Code of Conduct for Online Teaching



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Misuse of online modes of communication is unacceptable. TAs and Faculty will seek consent before the recording of live online lectures or tutorials. Please ensure that you do not wish to be recorded during a session to inform the faculty member. Please also ensure that you prioritize formal means of communication (email, LMS) over informal means to communicate with course staff.

### Academic Honesty

A student-teacher relationship is purely based on honesty, integrity, and inspiration. Where the teacher's role is to make every effort possible to inspire his students about the subject and develop independent thinking and a problem-solving attitude about every concept, students are required to uphold values of truth and honesty, and eagerness to learn. In this whole learning process honesty, integrity, and commitment by students play a major role in their long-term success. It means a student performs all academic work, assignments, exams, and quizzes and never gets involved in any unfair activity falling under academic dishonesty like cheating, unauthorized aid of any kind, plagiarism etc. Students are expected to demonstrate an extremely high level of integrity and honesty throughout this course.

Any instances of academic dishonesty in this course (intentional or unintentional) will be dealt with swiftly and severely. Potential penalties include receiving an "F" grade on the assignment in question or in the course overall. For further information, students should make themselves familiar with the relevant section of the LUMS student handbook.

### Examination Detail

<b>Midterm Exam</b>	Yes/No: Yes	Combine Separate: Combine	Duration: 3 hours	Preferred Date:	Exam Specifications: Requires extra sheets.
<b>Final Exam</b>	Yes/No: Yes	Combine Separate: Combine	Duration: 3 hours	Preferred Date:	Exam Specifications: Requires extra sheets.

### COURSE OVERVIEW

Week/ Lecture/ Module	Topics	Recommended Readings	Objectives/ Application
<b>Module 1: Critical thinking</b>			
Week 1 KB	<b>Introduction to Scientific Writing</b>		Students will learn the fundamentals of scientific writing
Week 2 MS	<b>Lecture 3</b> <ul style="list-style-type: none"> <li>The scientific method</li> <li>Hypothesis testing</li> <li>Falsifiability</li> </ul>		Students will learn the fundamentals of scientific methodology and identify associated anomalies. Emphasis will be placed on practical exercises where students will attempt to derive hypotheses



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	<p><b>Lecture 4</b></p> <ul style="list-style-type: none"> <li>• Science vs pseudoscience</li> <li>• Law vs Theory</li> <li>• Arguments and Reasoning</li> <li>• Deductive &amp; Inductive Reasoning</li> </ul>		<p>for a given observation and question. Students will be able to differentiate between science and pseudoscience and understand the breakup of an argument and the types of reasoning used in an argument.</p>
<p>Week 3 <b>MS</b></p>	<p><b>Lecture 5</b></p> <ul style="list-style-type: none"> <li>• Logical fallacies</li> <li>• Types (Formal and Informal)</li> <li>• Examples of selected logical fallacies</li> </ul> <p><b>Lecture 6</b></p> <ul style="list-style-type: none"> <li>• Critical thinking</li> <li>• Definitions and Components of critical thinking</li> <li>• Spectrum of certainty</li> <li>• Burden of proof – Bayes Theorem</li> </ul>		<p>Students will learn how to identify logical fallacies in an argument. They will be given class exercises &amp; assignments to help them spot logical fallacies in scientific texts.</p> <p>Students will learn the basics of critical thinking and will be introduced to the spectrum of certainty. They will learn how to employ Bayes Theorem for calculating the burden of proof.</p>
<p>Week 4 <b>MS</b></p>	<p><b>Lecture 7 &amp; 8</b></p> <ul style="list-style-type: none"> <li>• Principles of critical thinking</li> <li>• Designing experiments based on principles of critical thinking</li> <li>• Personal biasness</li> <li>• Correlations vs causation</li> <li>• Biological replication</li> <li>• Experimental reproducibility</li> <li>• Choosing the right controls</li> <li>• Alternative interpretations</li> <li>• Understanding/interpreting data</li> </ul>		<p>Students will learn how to apply the basics of critical thinking to the design and execution of experiments based on previous data/hypotheses. They would learn how to employ the principles of critical thinking to deduce logical conclusions. They will be taught various aspects of hypothesis-driven research vs secondary data-driven analysis.</p>
<p>Week 5</p>	<p><b>Lecture 8 &amp; 9</b> Importance of Statistics in life sciences research (very briefly)</p> <ul style="list-style-type: none"> <li>• Variability and its sources</li> <li>• Sample and sampling methods</li> <li>• Central tendency</li> <li>• Types of data</li> <li>• Probability</li> <li>• Bernouli process</li> <li>• Binomial and Poisson distribution</li> </ul> <p><b>Quiz</b></p>		<p>Students will learn why statistics are needed in biological research, different sources of variation in life sciences research, and how to choose the appropriate statistical measures to mitigate them. They will be introduced to the concept of probability and will learn Bernouli process and its implications.</p>



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<b>Module 2: Scientific writing and Ethics</b>			
Week 6 KB	<p><b>Lecture 1</b></p> <ul style="list-style-type: none"> <li>• What’s a scientific paper and how it is composed and organized (its components).</li> <li>• How to start writing a paper</li> <li>• Results and presentation of data</li> </ul> <p><b>Lecture 2</b></p> <ul style="list-style-type: none"> <li>• Discussion</li> <li>• How to organize the discussion, DOs, and Do Nots. Justifying scientific claims,</li> <li>• Title of the manuscript</li> <li>• Abbreviations</li> <li>• Keywords</li> </ul>		<p>Students would be able to understand the basics of scientific writing, the Dos and DO NOTs of scientific writing; how to stay away from Scientific Jargons.</p> <p>They would be able to discriminate between good and bad forms of data presentations and shape results into a structured outline.</p> <p>Students would be able to Understand the basics of writing scientific discussion, justifying claims, and selecting appropriate literature for discussions.</p> <p>Moreover, they will learn to shape manuscript titles, define abbreviations, and select keywords.</p>
Week 7 KB	<p><b>Lecture 3</b></p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Methods</li> <li>• Writing Statements</li> </ul> <p><b>Lecture 4</b></p> <ul style="list-style-type: none"> <li>• Statements continued</li> <li>• Types of articles</li> <li>• Prepublications, merits, and concerns</li> <li>• Press release for scientific articles</li> </ul>		<p>Students would learn the basics of writing the different components of scientific papers such as the introduction and methods section.</p> <p>Points to consider while writing statements</p> <p>Data deposition</p> <p>Authorship (author position and author contributions)</p> <p>Acknowledgments</p> <p>Students would learn about conflict of interests and writing the funding statements.</p> <p>Moreover, they would be able to differentiate between different types of scientific manuscripts such as;</p> <p>Short communications</p> <p>Methods/Technical advances</p> <p>Opinion papers</p> <p>Prepublications</p>



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			Press release for scientific articles
Week 8 KB	<p><b>Lecture 5</b></p> <ul style="list-style-type: none"> <li>• Choosing journals</li> <li>• Impact factor vs repute, indexing</li> <li>• Publication modules</li> <li>• Good and bad of the open access system</li> <li>• Reviewers and review systems</li> <li>• Chief editors, editors, responsibilities of the editorial staff</li> </ul> <p><b>Lecture 6</b></p> <ul style="list-style-type: none"> <li>• Predatory Journals</li> <li>• Predatory conferences</li> <li>• Examples and practical problems</li> </ul>		<p>Students would learn how to choose suitable journals</p> <p>Impact factor vs repute</p> <p>Cutting across disciplines</p> <p>Choosing editors</p> <p>Choosing reviewers</p> <p>Duties of reviewers</p> <p>Differences between good and predatory journals/publishers</p> <p>Merits/concerns</p> <p>Predatory conferences</p>
Week 9 KB	<p><b>Scientific misconduct</b></p> <p><b>Lecture 7</b></p> <ul style="list-style-type: none"> <li>• Guest lecture for clinical studies</li> </ul> <p><b>Lecture 8</b></p> <ul style="list-style-type: none"> <li>• Scientific misconduct and problems</li> <li>• Data fabrication</li> <li>• Data falsification</li> <li>• Plagiarism and how to detect plagiarism</li> <li>• Biosafety levels</li> </ul>		<p>Students would learn the points to consider for data and sample collection</p> <p>Managing clinical trials etc</p> <p>Types of scientific misconduct</p> <p>Fabrication</p> <p>Falsification</p> <p>Plagiarism</p> <p>Misuse of funding</p> <p>Biosafety levels and why its important to understand and follow guidelines</p>
	▪ <b>Midterm Exam</b>		
Week 10 KB	<p><b>Lecture 9 &amp; 10</b></p> <ul style="list-style-type: none"> <li>• Retracted papers and reasons for retraction</li> </ul>	<p><b>1:</b> Netherlands Heart Journal, 2009: doi: 10.1007/BF03086211</p> <p><b>2:</b> Nature, 2014. doi:10.1038/nature12968</p> <p><b>3:</b> Nature 2014. doi:10.1038/nature12969</p>	<p>Erratum/Corrigendum</p> <p>Why retraction</p> <p>Voluntary vs forced retractions</p> <p>Retraction for error</p> <p>Retraction for fraud or misconduct.</p> <p>Retraction over data provenance</p> <p>Retraction over public relations issues</p>
	<b>Module 3: Paper presentations</b>		



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Week 11-14	<ul style="list-style-type: none"><li>• Writing assignments</li><li>• Student presentations</li><li>•</li></ul>	The manuscript would be selected from a master list or consultation with the teacher.	Students would be evaluated based on their understanding of scientific writing and data presentation.
<b>Final Exam (Writing skills)</b>			

### Textbook(s)/Supplementary Readings

**Academic Writing for Graduate Students: Essential Tasks and Skills. Third Edition 2012.** John M. Swales, Christine B. Feak. DOI: 10.3998/mpub.2173936.

**Writing Science. How to Write Papers That Get Cited and Proposals That Get Funded. 2011.** Joshua Schimel. ISBN: 9780199760244.

**100 questions (and answers) about research ethics. 2018.** E.E. Anderson, A. Corneli. DOI: 10.4135/9781506348681.

Supplementary readings are to be extracted by students from the web.