Institute of Zoology,
Faculty of Life Sciences
University of the Punjab, Lahore
Course Outline

Programme	BS Zoology	Course Code	ZOOL-413	Credit Hours	1
Course Title	**Bioinformatics**				

Course Introduction
The course will provide:

1. An Introduction to Bioinformatics.
2. To develop awareness about Fundamental Bioinformatics Databases.
3. Information on the tools used to compute solutions to those problems, and the theory upon which those tools are based.

Learning Outcomes
Upon successful completion of the course, the students should be able to:

1. **GAIN** an understanding of the basic concepts of Bioinformatics.
2. **EXPLAIN** the basics of bioinformatics and computational biology.
3. **USE** bioinformatics search tools on the internet for mining data, pairwise and multiple sequence alignments and predict protein structures.

Course Content		Assignments/Readings
Week 1	**Unit 1:** ***Introduction to Bioinformatics*** • Scope of Bioinformatics, useful websites • Aims of Bioinformatics, disciplines related to Bioinformatics, major tasks involved in bioinformatics analysis, bioinformatics tools, Human genome project	

Week 2	**Unit 2:**
	Biological databases
	• Data and types of data, data acquisition
	• Major DNA databases;
	  • GenBank (National Center for Biotechnology Information),
	  • EMBL (European Bioinformatics Institute),
	  • DNA Data Bank of Japan (National Institute of Genetics)
	• Major protein databases in the world,
	  • Protein sequence databases (Uniport),
	  • Protein structure databases (PDB)
	• Specialized databases, genome and organism databases
	• Non-sequence databases, Pubmed, Pubmed health, OMIM	

Week 3	**Unit 3:** **Genome mapping:** Genetic and linkage mapping, Physical mapping	
Week 4	**Unit 4:** Data Retrieval: • Searching sequence databases • FASTA format	

	• Retrieval of Nucleotide Sequence data,	
Week 5	**Unit 5:** Data Retrieval: • Searching Protein databases • FASTA format • Retrieval of Protein sequence and structure data,	
Week 6	**Unit 6:** Gene family: • Introduction, Types, Protein family, • Globin family as an example, Globin genes and chains,	
Week 7	**Unit 7:** • Evolution of globin proteins in human, Combination and types of globin proteins in human.	
Week 8	**Unit 8:** Primer Designing: • Primer and Probe, Qualities of primer, General rules for primer designing • Tools (Online) for primer designing Primer Designing using NCBI	
Week 9	**Unit 9:** • Primer Designing using Primer 3 Plus	
Week 10	**Unit 10:** **BLAST**: Introduction, types, uses, algorithm, BLAST Scores	
Week 11	**Unit 11:** • **BLAST**: Algorithm, BLAST Scores	
Week 12	**Unit 12:** *Sequence Alignment:* • Importance and significance of alignment, methods for sequence alignment • Local and global alignment, Pair-wise local alignment	
Week 13	**Unit 13:** **Multiple Sequence Alignment:** Introduction, tools for MSA, uses and importance	
Week 14	*Unit 14:* *Phylogenetic analysis: Introduction, interpretation, rooted and unrooted tree.*	
Week 15	*Unit 15:* *Phylogenetic methods, tree terminology, comparison of methods, software*	
Week 16	*Unit 16:* Microarrays	
Textbooks and Reading Material		

Textbooks.
1. Lesk A., 2019. Introduction to Bioinformatics. 5th edition Oxford University Press, ISBN-10: 0198794142; ISBN-13 : 978-0198794141

Suggested Readings
1. Jiang R., Zhang X. & Zhang, M. (2013). Basics of Bioinformatics: Lecture Notes of the Graduate Summer School on Bioinformatics of China.
https://link.springer.com/book/10.1007/978-3-642-38951-1
2. Primerose, S.B. (2004) Genomics: Applications in Human Biology. Edition 1st. Willey-

Blackwell.
3. Brown T.A. 2023. Genome 5. Edition 5th, Boca Raton, FL, USA. ISBN 9781003133162 https://doi.org/10.1201/9781003133162,
4. Kabacoff, R. I. (2015). R in Action (2nd ed.). Manning Publications. https://www.manning.com/books/r-in-action

Online resources:
1. https://www.mendeley.com/search/
2. https://www.ncbi.nlm.nih.gov
3. https://www.uniprot.org
4. https://www.rcsb.org
5. https://www.ncbi.nlm.nih.gov/tools/primer-blast/
6. https://www.primer3plus.com/index.html
7. https://blast.ncbi.nlm.nih.gov/Blast.cgi
1. https://www.ebi.ac.uk/jdispatcher/msa/clustalo

Teaching Learning Strategies

1. Use of Technology resources.
2. Use of Google Classroom management and Tools Resources
3. Provision of Handouts
4. Demonstration of the concepts using animations of cellular processes
5. Group activity of the students for problem solving skills

Assignments: Types and Number with Calendar

1. **Assignment 1 (Theory): Due by 15th week of semester.**
   Instructions:
   i.   Every student will/be select/allocated one gene.
   ii.   The gene for analysis cannot be repeated in the same batch.
   iii. The gene sequence of 20 different **species** will be extracted to perform MSA and construct the phylogenetic tree.
   iv.   The components of the tree will be explained and the most closely and most distantly related species will be figured out.

2. **Lab Manual/Notebook: Due before Final Term Examination**
   Instructions:
   i.   The students will prepare the lab manuals (word document or google doc).
   ii.   The working of each method will be shown in the manual as screen shot (Complete screen; no cropped screen screenshots allowed).
   iii. All other information will be included (written form or if gene sequences, then copy paste) as text in the document.
   iv.   At the end of the semester the lab manual will be printed for presentation at final term lab examination.

Assessment

Sr. No.	Elements	Weightage	Details
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, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing