



BSc Degree in Information Technology

End Semester Examination 2023 (III)

IT 257 Bioinformatics

Time: Two Hours

Date: 22nd December 2023

Time: 9.00 a.m. – 11.00 a.m.

Answer **Question 01(Compulsory) AND Any Two (2)** Questions.

(This paper contains 4 questions.)

1.

- 1.1. In a few sentences, explain why bioinformatics is such an important discipline for understanding gene structure and function.
- 1.2. What are biological databases? Explain briefly with classification of biological databases based on data type, maintainer status, data access, data source, database design and organism.
- 1.3. Write short notes for the following.
 - a) Resources for Bioinformatics provided by NCBI
 - b) DNA fingerprinting for inventing new medicines
 - c) Sequencing Techniques
- 1.4. Sequence alignment is used widely in biological computation.
 - a) What are the basic computational methods for sequence alignment? Explain briefly with examples.
 - b) Let $S_1 = \text{ATTCCGCG}$ & $S_2 = \text{TATTCGCC}$
 - 1.4.b.1. Build the complete dynamic programming table for these strings
 - 1.4.b.2. List two optimal global alignment between S_1 & S_2
- 1.5. Python is the most commonly used programming language for biological computation.
 - a) Write down a python code to compare two strings (You may use “ATCGTTCGAT” and “AATTCGATCC” as your inputs).
 - b) Create a python code to compute the GC content as a percentage for the following DNA segment.

AGCAATGCTTTTTTATAATGCCAACTTTGTACAAAAAAGCAGGCTCGGTCAT

(30 Marks)

2.

- 2.1. What is BLAST? Give the different categories into which BLAST tools can be categorized. What are the different parameters you observe after running any BLAST exercise?
- 2.2. Sequence alignment is a technique used for many applications in bioinformatics.
 - a) Briefly explain the application areas of sequence alignment with examples.
 - b) Explain the steps of Smith-Waterman algorithm for sequence alignment.
- 2.3. What are molecular markers? Briefly explain with the three different types of DNA variations used as molecular markers.
- 2.4. Explain the importance of molecular markers in Genetics briefly.

(15 Marks)

3. “Genes are like the story, and DNA is the language that the story is written in.”-Sam Kean

- 3.1. Briefly explain the structure of DNA with diagrams where applicable. Explain the importance of DNA sequencing in genomics.
- 3.2. What is sequence assembly? Give three (3) most commonly used sequence assembly technologies in biotechnology industry and explain the basic differences of them in brief.
- 3.3. Briefly explain the difference between structural & functional genomics.
- 3.4. What is a genetic disorder? Briefly explain how genomics helps to identify a genetic disorder.

(15 Marks)

4. Bioinformatics is the study of Proteomics, Metagenomics and Transcriptomics (The study of Protein, DNA and RNA respectively).

- 4.1. Briefly explain the protein generation process from DNA with any protein/enzyme of your interest. (Eg: Hemoglobin/Amylase/Insulin)
- 4.2. What is PCR? Briefly explain how PCR test helps to identify a rare species (ex: *Crinia zeylanica*/ Pandu Karanda tree in Sinhalese).
- 4.3. Analysis of a genetic code is a basic skill for every bioinformatician. Write down python codes to get the basic measures for the following DNA segment.

“AAATGATAATAGCCAAGTCCGT”

- a) Sequence length
- b) GC content
- c) Reverse complement

(15 Marks)