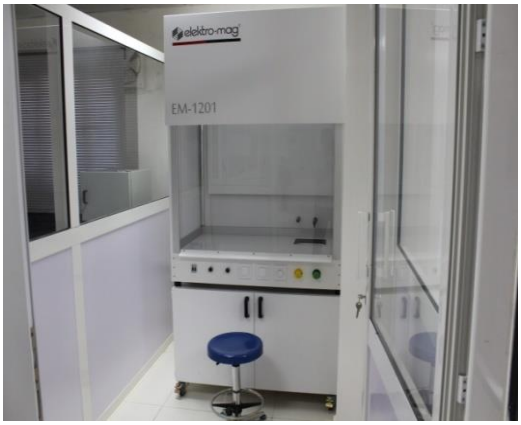
National University – Sudan

Faculty of Graduate Studies and Scientific Research

National University Research Institute

(NURI)



M.Sc. Bioinformatics

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Introduction

Bio-Informatics is where computer science and biology join to address and solve basic problems associated with human health, environment and agriculture. Recent developments in the sciences have produced a wealth of experimental data of sequences and three-dimensional structures of biological macromolecules. With the advances of computer and information science, a variety of databases are made available to the public on the Internet. This master program provides knowledge of Bioinformatics for interpretation of the rapidly expanding biological information. It will empower the students with Bioinformatics tools for reviewing the major scientific databases needed to cater for research problems in biology.

General objectives

Provide:

- Apt Bioinformatics knowledge for interpretation of the rapidly expanding biological information.
- Basic concepts of bioinformatics to identify, seek, establish, maintain and exchange research information in biology.

Specific objectives

Equip the students with:

- Requisite background in modern biology, biochemistry, cell biology, genetics and molecular biology.
- Familiarity in computational methods to address problems in molecular biology.
- Knowledge on storage, retrieval, sharing and use of biological information in core areas of Bioinformatics: multiple sequence alignment, phylogenetic trees, genomics, proteomics etc...
- Skills in applied Bioinformatics: immunoinformatics, Drug designing and discovery.

Learning outcomes

Upon successful completion of the program, the successful candidates should be able to:

- Identify strategies and apply appropriate tools in Bioinformatics.
- identify topical problems drawn from ongoing research and their applications
- Interpret data related to sequences of nucleotides and amino acids, protein domains, and protein structures**.**

- Develop and implement efficient tools to access and manage data

Admission requirements

- Applicants must satisfy the general regulations set by the faculty of graduate studies and scientific research of the National University-Sudan for registration for master degrees.
- Eligible candidates are holders of B.Sc. Honors from a recognized university in: Sciences, Agriculture, Medicine, Veterinary Sciences, Pharmacy and Computer Sciences.

Study program*:*

Semester: One

Code	Course	Credit hours	Contact hours/week	
			Theory	Practical
BIO-611	Basic Molecular Biology	3(2+1)	2	2
BIO-612	Introduction to Proteomics	3(3+0)	3	0
BIO-613	Object Oriented Programming	3(2+1)	2	2
BIO-614	Database Management System	2(1+1)	1	2
BIO-615	Fundamentals of Algorithm	2(1+1)	1	2

Semester: Two

Code	Course	Credit hours	Contact hours/week	
			Theory	Practical
BIO-621	Fundamental of Bioinformatics	3(1+2)	1	4
BIO-622	Structural Biology	4(2+2)	2	4
BIO-623	Alignment and Sequence Analysis	3(2+1)	2	2
BIO-624	Data Mining and Machine Learning	4(2+2)	2	4
BIO-625	Biostatistics	3(2+1)	2	2

Semester: Three

Code	Course	Credit hours	Contact hours/week	
			Theory	Practical
BIO-631	Immunoinformatics	4(2+2)	2	4
BIO-632	Molecular Modeling and Drug Design	4(2+2)	2	4
BIO-633	Research Methodology	3(3+0)	3	0
BIO-634	Research paper	4(0+8)	0	8

Courses contents

BIO-611: Basic Molecular Biology

Genome organization; DNA structure; Replication; Repair and recombination; Prokaryotic and eukaryotic transcription; Post transcriptional modifications; Translation and transport; Mutations; Oncogenes and tumor suppressor genes; DNA extraction methods; RNA extraction; Polymerase chain reaction; Real time PCR; RFLP; Gel electrophoresis; DNA sequencing.

BIO-612: Introduction to Proteomics

Protein biology; Advanced proteomics: Proteins structure and function; Protein analysis for cellular function; Protein folding and unfolding; Protein-protein interaction.

BIO-613: Object Oriented Programming

Java Basics; Multithreading and communication AWT and Event Handling; BioJava; Introduction to scripting with python; Writing python scripting; Making plot with matplotlib; Scientific computing with python; searching and sorting; data clustering and classification.

BIO-614: Database Management System

Introduction; Data models; Structured query language; Relational database and storage; Concurrency control techniques; Information retrieval

BIO-615: Fundamentals of Algorithm

Computing algorithms: sorting, searching and strings Matching; Graphs; Trees; Algorithm design and analysis

BIO-621: Fundamental of Bioinformatics

Introduction to Bioinformatics; Bioinformatics resources; Open access bibliographic resources and literature databases; Databases; Bioinformatics software and tools; Sequence file formats; Protein and nucleic acid sequence; Submitting DNA sequence to the Database; Taxonomy and phylogeny; Sequence patterns and profiles.

BIO-622: Structural Biology

Prediction of genes; Primer design; Proteomics; X-ray crystallography; Predicting protein structure and function from sequence; Structure prediction strategies; Secondary structure; prediction; Protein modeling; Classification and comparison of protein 3D structures; Protein/protein Interaction; Basic concepts of identification of disease genes (SNP).

BIO-623: Alignment and Sequences Analysis

Sequence analysis; Scoring matrices; Pair wise sequence alignments; Multiple sequence alignments (MSA); Comparative genomics; Sequence patterns and profiles; Algorithms for derivation and searching sequence patterns; Taxonomy and phylogeny.

BIO-624: Data Mining and Machine Learning

Introduction; Primitives and system architectures; Concept description and association rules; Classification and prediction

BIO-625: Biostatistics

Introduction to biostatistics: significance and basic concepts; Descriptive statistics: measures of central tendency and dispersion; Probability theory: definitions, probability types, probability rules and random variables; Life table; Distribution theory: the normal distribution, standard normal distribution and t-distribution; Sampling distribution and central limit theorem; Estimation; Hypothesis testing.

BIO-631: Immunoinformatics

Introduction to immunology; Antigens and antibodies; Major histocompatability Complex; Disorders of human immune system; Introduction to immunoinformatics and Immunological database; Computational vaccinology.

BIO-632: Molecular Modeling and Drug Design

Atomic and molecular structure; Chemical bonds; Symmetry and Principles; Introduction to organic chemistry; Stereochemistry; Heteroaromatics; Molecular modeling and drug design; Introduction to drug design and development; Drug targets; Lead identification and modification; Computer-aided drug design; Drug delivery; Pre-clinical and Clinical Testing**.**

BIO-633: Research Methodology

Foundations of research methodology; Introduction to quantitative and qualitative research; Mixed Research Methods

BIO-634: Research Paper

Research skills in bioinformatics: design of experiments, data collection and analysis, scientific writing; Oral presentations; Guided research on specific topics in bioinformatics.

Human resources and facilities

Teaching staff: One professor
Three associate professors
Three assistant professors
Two lecturers

Facilities: Five lecture rooms: 70 seats each
Eight seminar rooms: 50 seats each
Computer laboratory: 250 seats
National University main library: 400 seats
E. Library: 250 seats

Duration of the program: Three semesters 16 weeks each.

Teaching modules

Lectures, tutorials, presentations, seminars, assignments and practical sessions.

Teaching language: English

Examinations regulations

- Abide by the examinations rules of the general regulations of the graduate studies of the National University-Sudan
- A student failing any supplementary examination should repeat the course.
- A student scoring less than 60% in the theoretical and / or the practical component of a specialization subject should sit for a supplementary examination.
- Each student shall conduct a supervised piece of research and submit a paper.
- All students shall sit for oral examination at the end of semester three.

Assessment: Continuous assessment 30%
Final examination 70%

Grading system: A^+ (≥ 85) A(80 – 84) B^+ (70 – 79) B (65 – 69) C (60-64) F (<٦٠)

Award of the degree

The Scientific Council of the National University, based on the of recommendation of the board of the Faculty of Graduate Studies and Scientific Research, shall award
the successful candidate

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