

Master of Science in Molecular Biology and Bioinformatics.

Advancement of knowledge in Biochemistry has necessitated the development of new disciplines to enable further research and utilization of the vast knowledge now available. One such discipline is Molecular Biology and Bioinformatics.

Bioinformatics can be defined as the use of information systems and computers to study biology. Bioinformatics more properly refers to the creation and advancement of algorithms, computational and statistical techniques, and theory to solve formal and practical problems posed by or inspired from the management and analysis of biological data. It's an interdisciplinary science that encompasses biological sciences, mathematics, and computer science to manage, process, and understand large amounts of biological data, resulting from genome sequencing, proteomics, and gene expression chips. The study of Molecular Biology and Bioinformatics entails development of new computational methods, finding the genes in the DNA sequences of model organisms and predicting structure and function of protein sequences, clustering similar gene and protein sequences and generating phylogenetic trees for studying organization and evolution of genes and genomes, computational approaches to macromolecular structure and dynamics, comparative evolutionary genomics, and prediction and analysis of structure. Bioinformatics uses computer programmes/tools to analyse information stored in biological databases. The primary databases accommodate raw data generated by scientists through wet experiments. Molecular Biology is therefore an important instrument in the enrichment of Biological databases.

The degree program will be carried out in collaboration with other Departments namely: Mathematics, statistics and Institute of Computer Science. The program will provide students with theoretical and practical knowledge of molecular biology. In addition, students will acquire practical and theoretical understanding of biological data, statistical, numerical and computer skills they need to undertake/exploit Bioinformatics.

COURSE OBJECTIVES

1. To provide students with ample knowledge of molecular biology and Bioinformatics
2. To equip the students with theoretical knowledge on emerging molecular biology and Bioinformatics tools
3. To provide students with Computational and Mathematical knowledge and skills required to understand, implement and develop bioinformatics algorithms.

COURSE JUSTIFICATION

A large collection of biological information on biomolecular sequences and structures exist and more are generated daily through research. Most of this information however is stored as primary information resource. Such information has proved to be of little benefit unless stored in automated systems such as databases for access by research, industry and medical communities. With development of World Wide Web, exchange of biological information nationally and internationally, has improved tremendously. More importantly, advanced methods of computer-based information processing for analyzing structures and functions of biologically important molecules have been developed. These tools have played a central role in access to biological information. Competence in computational biology has also been key to success in the areas of functional and structural predictions, comparative proteomics, genomics, phylogenetics and population genetics. The molecular diagnosis of disease and discovery of novel drugs as areas in medicine where knowledge and skills in molecular biology and bioinformatics have been exploited with immense benefits.

Despite the immense robustness of Molecular Biology and Bioinformatics, there are just a few institutions which offer academic degrees in Kenya. The purpose of establishing this course therefore, is to produce trained manpower in molecular biology and Bioinformatics skills. Graduates with these skills will be eligible to work in research institutions, universities and industries with a focus on innovation.

1.0 Entry requirements

- 1.1 The common regulations for all Masters degrees in the University shall apply
- 1.2 The general regulations for all Masters degrees in the Faculty/School shall apply
- 1.3 The following shall be eligible for registration for the Master of Science degree in Molecular Biology and Bioinformatics;

- (i) A holder of at least a second class honours (Upper Division) degree from JKUAT or any other university recognized by JKUAT Senate, having studied Biological sciences, computer Science, mathematics/Statistics. Physical Sciences, Engineering, Medicine, Pharmacy, Veterinary Medicine, Dental sciences, Agriculture and any other relevant science.
- (ii) A holder of a degree accepted as equivalent to one of the degrees mentioned in (i) above from recognized University.
- (iii) A holder of a Second Class Honours (Lower Division) Degree, under exceptional circumstances, may be considered provided he/she produces evidence of having worked for at least **two** years.

1.4 Candidates without a background in computer science and programming will be required to do the following courses:

- (i) ICS 2174 Introduction to Computer Science
- (ii) ICS 2175 Computer Programming I

2.0 Duration of Master of Science Programme

2.1 The Master of Science programme shall normally extend over a period of eighteen months (18 months) for a full time student and twenty four (24) months for a part-time student from the date of registration. However a student who has insufficient background knowledge in some topics in his/her first degree may be required to undertake in addition a bridging course during the first year of study which will include prescribed undergraduate units related to the course of study as directed by the Chairman of the Department and to pass course work and examinations for these units at a satisfactory level, before being allowed to proceed to the second year of postgraduate study.

2.2 No student shall be registered as a full-time student for more than thirty six (36) months or as a part-time student for more than forty eight (48) months, except by permission of the University Senate.

3.0 Pattern of the course

3.1 The programme shall consist of:-

- i) either course work and examination, involving full-time attendance at the University.

- ii) or, coursework, examination and thesis also involving full-time attendance at the University,
and where the entire second year of the programme is devoted to the thesis. However, students undertaking course work exam and thesis must take HBB 3212 – Proteomics and Protein Identification during the first year of study.
 - iii) or, under exceptional circumstances thesis only, which may be taken on full-time or part-time basis. Provided that no candidate shall qualify for the award of a Master of Science by thesis only, unless the Department is satisfied that he/she has necessary background course work and has been in attendance in the Faculty of Science, for such period as specified in 2.1, 2.2.
- 3.2 In any year of study where courses are taught, the programmes shall consist of a minimum of eight (8) and a maximum of ten (10) units or the equivalent. Each unit shall comprise the equivalent of 60 lecture hours.
- 3.3 Subject to the approval of Senate, Faculty/School may require the candidate to attend such a course or courses in the candidate's area of study or to endow the candidate with specialized skills or knowledge to assist him/ her in his/her study or research. Performance in courses offered may be assessed.
- 3.4 On the recommendation of the Faculty/School Board and within the first one year the Senate may permit a candidate to change his/her registration status from part-time student or vice versa once only, in which case regulation 2.2 above shall apply to such a candidate as if he/she had initially been admitted to the status he now seeks.
- 3.5.1 A student who takes course work in the second year of post graduate study will take taught course units as in 3.1 (i)
- 3.5.2 A student who undertakes course work and project during the second year of study shall be required to undertake prescribed study. The student will undertake the project under the direction of one or more supervisors and shall present the project in the form of a typewritten dissertation not later than one month after the date of the last written paper for the units taken by students who have registered for course work to be examined at the

end of the second year of study. The project shall be assessed normally by two supervisors and an external examiner appointed by the University Senate on the recommendation of the department concerned.

- 3.5.3 A student who registers for course work, examination and thesis will be required to submit a written proposal within a period of three months from the date of registration for the second year of study.
- 3.5.4 A student who takes thesis in year 2 will be required to submit a written proposal within three month from the date of completion.
- 3.6 The Department, acting on the recommendation of the supervisors, may at its discretion extend the time for submission of a proposal for thesis research. Such extension of time shall not normally exceed one month. The Board of Postgraduate Studies shall be notified of such extension.

Appointment, termination and/or replacement of Supervisor(s)

- 3.7 The Senate, acting on the recommendation of the Faculty concerned shall appoint, terminate and/or replace the supervisor(s) of projects and thesis as it may deem necessary. There shall normally be two supervisors per candidate.

COURSE DISTRIBUTION

FIRST YEAR

First semester

HBB 3201: Fundamentals of Molecular Biology

HBB 3203: Methods in Molecular Biology

HBB 3204: Genome structure and organization

HBB 3206: Fundamentals of Bioinformatics

SMA 3210: Mathematics for Bioscientists

HBB 3100: Research Methodology

Second semester

HBB 3205: Gene expression and protein structure analysis

HBB 3202: Molecular markers and their applications

HBB 3208: Database Systems

HBB 3209: Research methods in Bioinformatics

HBB 3207: Computing internet Technologies and application

HBB 3212: Proteomics and protein identification

SECOND YEAR

First semester

Core Units

HBB 3211: Algorithm tools and their applications in Bioinformatics

HBB 3222: Project (2 Units)

Elective Units (Students to select two (2) units)

HBB 3219: Management of microbial diseases

HBB 3220: Dynamics of parasitic diseases

HBB 3221: Molecular biology of plant diseases

Second semester

Core units

HBB 3222: Project (2 units)

Elective Units (Students to select three (3) units)

HBB 3213: Computation genomics

HBB 3214: Molecular Modeling and Chemoinformatics

HBB 3215: Data structure and algorithms

HBB 3216: Protein structure models and drug discovery

HBB 3217: Genomic pattern recognition and molecular diagnostics

HBB 3218: Molecular epidemiology and population genetics