Master of Science in Bioinformatics and Computational Biology

36 semester credit hours minimum

Mathematics Faculty

**Professors:** Larry P. Ammann, Zalman I. Balanov, Pankaj K. Choudhary, Mieczyslaw K. Dabkowski, Vladimir Dragovic, Sam Efroymovich, Yulia Gel, M. Ali Hooshyar, Wieslaw Krawcewicz, Susan E. Minkoff, L. Felipe Pereira, Dmitry Rachinskiy, Viswanath Ramakrishna, Janos Turi, John Zweck

**Professors Emeritus:** Patrick Odell, John W. Van Ness

**Clinical Professors:** Natalia Humphreys, Wenyi (Roy) Lu

**Associate Professors:** Swati Biswas, Yan Cao, Min Chen

**Assistant Professors:** Mohammad Akbar, Maxim Arnold, Carlos Arreche, Bhargab Chattopadhyay, Sy Han (Steven) Chiou, Qingwen Hu, Frank Konjetschke, Yifei Lou, Oleg Makarenkov, Tomoki Oshawa, Sunyoung Shin, Anh Tran, Nathan Williams

**Senior Lecturers:** Mohammad Ahsan, Kelly Aman, Malgorzata Dabkowska, Rabin Dahal, Anatoly Eydelzon, Manjula Foley, Bentley T. Garrett, Farid Khafizov, Yuly Koshevnik, David L. Lewis, Changsong Li, Brady McCary, Derege Mussa, My Linh Nguyen, Jigarkumar Patel, Paul Stanford, Julie Sutton, Tristan Whalen

**UT Dallas Affiliated Faculty:** Hervé Abdi, Titu Andreescu, Alain Bensoussan, Stefano Leonardi, Faruck Morcos, John J. Workowski, Zhenyu Xuan, Hyuntae Yoo, Michael Qiwei Zhang

**Mathematics Faculty With Research Interests in Bioinformatics and Computational Biology:** Swati Biswas, Yan Cao, and Min Chen

Biology Faculty

**Professors:** Lee A. Bulla, Rockford K. Draper, Juan E. González, Lawrence J. Reitzer, Stephen Spiro, Li Zhang, Michael Qiwei Zhang

**Professors Emeritus:** Hans Bremer, Donald M. Gray

**Clinical Professor:** David Murchison

**Associate Professors:** Gail A. M. Breen, John G. Burr, Jeff L. DeJong, Ernest M. Hannig, Tae Hoon Kim, Dennis L. Miller, Zhenyu Xuan

**Assistant Professors:** Zachary Campbell, Nikki Delk, Heng Du, Jung-whan (Jay) Kim, Faruck Morcos, Kelli Palmer, Duane D. Winkler, Hyuntae Yoo
Research Assistant Professors: Lan Guo, Li Liu

Senior Lecturers: Irina Borovkov, Mehmet Candas, Brenna Hill, Wen-Ju Lin, Meenakshi Maitra, Robert C. Marsh, Jing Pan, Elizabeth Pickett, Ruben D. Ramirez, Scott A. Rippel, Ilya Sapozhnikov, Uma Srikanth, Michelle Wilson, Wen-Ho Yu

UT Dallas Affiliated Faculty: Leonidas Bleris, Sheena D'Arcy, Stephen D. Levene, Jonathan E. Ploski, Lucien (Tres) Thompson

Biological Sciences Faculty With Research Interests in Bioinformatics and Computational Biology: Faruck Morcos, Zhenyu Xuan, Hyuntae Yoo, and Michael Q. Zhang

Program Objective

The Master of Science program in Bioinformatics and Computational Biology is an interdisciplinary program offered jointly by the Departments of Mathematical Sciences and Biological Sciences, with the former serving as the administrative unit. By combining coursework from the disciplines of Biology, Computer Science, Mathematics, and Statistics, it caters to the growing demand of a new breed of scientists who have expertise in all these disciplines. In addition to coursework, the program also provides opportunities to gain practical experience by getting involved in research with faculty members.

A successful applicant to the program is expected to have a Bachelor's degree in Biology, Mathematics, Statistics, or in another science/engineering discipline, and must have completed Differential and Integral Calculus courses. Additional coursework in one or more of the disciplines of Biology, Computer Science, Mathematics, and Statistics is desirable but is not required.

Degree Requirements

The University's general degree requirements are discussed on the Graduate Policies and Procedures page.

The MS program in Bioinformatics and Computational Biology requires completion of at least 36 semester credit hours. The program offers a choice between two tracks. Track 1 is designed for students with a general background in science/engineering, whereas Track 2 is designed for students with a strong background in biology. To build further expertise, both tracks offer a choice of three elective groups, namely, Computer Science oriented, Statistics oriented, and Biology oriented elective groups. Both also offer opportunities for research. Students are expected to choose a track and an elective group based on their backgrounds and interests in consultation with the Graduate Advisor for the program.

Track 1 (MS)

I. Core: 15 semester credit hours

BMEN 6374 Genes, Proteins and Cell Biology for Engineers
BIOL 6V00  Topics in Biological Sciences (Computational Molecular Evolution)
CS 5303  Computer Science I
MATH 5390  Topics in Mathematics (Advanced Calculus and Linear Algebra)
STAT 5351  Probability and Statistics I (for Elective Group 2)
  or STAT 5353  Probability and Statistics for Data Science and Bioinformatics (for Elective Groups 1 and 3)

II. Elective Groups (Choose one elective group)

Elective Group 1 (Computer Science Oriented):  15 semester credit hours

CS 5343  Algorithm Analysis and Data Structures¹
MATH 6312  Combinatorics and Graph Theory
MATH 6341  Bioinformatics
  or BIOL 5376  Applied Bioinformatics
MATH 6390  Topics in Mathematics (Medical Image Analysis)

AND one of the following:

CS 6307  Introduction to Big Data Management and Analytics for non-CS Majors
CS 6314  Web Programming Language
CS 6360  Database Design
CS 6375  Machine Learning

Elective Group 2 (Statistics Oriented):  18 semester credit hours

STAT 5352  Probability and Statistics II
STAT 6337  Advanced Statistical Methods I
STAT 6338  Advanced Statistical Methods II
STAT 6340  Statistical and Machine Learning
MATH 6341  Bioinformatics
  or BIOL 5376  Applied Bioinformatics
MATH 6390  Topics in Mathematics (Medical Image Analysis)

Elective Group 3 (Biology oriented):  15 semester credit hours

MATH 6341  Bioinformatics
  or BIOL 5376  Applied Bioinformatics
MATH 6345 Mathematical Methods in Medicine and Biology
MATH 6390 Topics in Mathematics (Medical Image Analysis)
AND two of the following:
BIOL 5375 Genes to Genomes
BIOL 5381 Genomics
BIOL 6315 Epigenetics
BIOL 6373 Proteomics
BIOL 6385 Computational Biology
or BMEN 6389 Computational Biology
or MATH 6343 Computational Biology

III. Research or Elective(s) or a Combination Thereof

• Elective Group 1: 6 semester credit hours
• Elective Group 2: 3 semester credit hours
• Elective Group 3: 6 semester credit hours

Track 2 (MS)

I. Core: 14 semester credit hours

BIOL 5410 Biochemistry
BIOL 5420 Molecular Biology
STAT 5351 Probability and Statistics I (for Elective Group 2)
  or STAT 5353 Probability and Statistics for Data Science and Bioinformatics (for Elective Groups 1 and 3)
MATH 5390 Topics in Mathematics (Advanced Calculus and Linear Algebra)

II. Elective Groups (Choose one elective group)

Elective Group 1 (Computer Science oriented): 18 semester credit hours

CS 5303 Computer Science I
CS 5343 Algorithm Analysis and Data Structures
MATH 6312 Combinatorics and Graph Theory
MATH 6341 Bioinformatics
  or BIOL 5376 Applied Bioinformatics
MATH 6390 Topics in Mathematics (Medical Image Analysis)
AND one of the following:

CS 6307 Introduction to Big Data Management and Analytics for non-CS Majors
CS 6314 Web Programming Language
CS 6360 Database Design
CS 6375 Machine Learning

Elective Group 2 (Statistics oriented): 18 semester credit hours

STAT 5352 Probability and Statistics II
STAT 6337 Advanced Statistical Methods I
STAT 6338 Advanced Statistical Methods II
STAT 6340 Statistical and Machine Learning
MATH 6341 Bioinformatics
  or BIOL 5376 Applied Bioinformatics
MATH 6390 Topics in Mathematics (Medical Image Analysis)

Elective Group 3 (Biology oriented): At least 18 semester credit hours

MATH 6341 Bioinformatics
  or BIOL 5376 Applied Bioinformatics
MATH 6390 Topics in Mathematics (Medical Image Analysis)
MATH 6345 Mathematical Methods in Medicine and Biology
AND two of the following:

BIOL 5375 Genes to Genomes
BIOL 5381 Genomics
BIOL 6315 Epigenetics
BIOL 6373 Proteomics
BIOL 6385 Computational Biology
  or BMEN 6389 Computational Biology
  or MATH 6343 Computational Biology
BIOL 6V00 Topics in Biological Sciences (Computational Molecular Evolution)
III. Research or Elective[s] or a Combination Thereof

All Elective Groups: 4 semester credit hours

Other Requirements

- For a PhD bound student in the Department of Biological Sciences, **BIOL 5440** Cell Biology and **BIOL 5460** Quantitative Biology (or an equivalent) are required. This requirement can be fulfilled by taking these courses as 'electives' in the Bioinformatics and Computational Biology program.

- Electives must be approved by the Graduate Advisor of the program.

- Substitutions for required courses may be made if approved by the Graduate Advisor of the program and the Head of the Mathematical Sciences Department.

- A student may choose to write an MS thesis under the supervision of a faculty member. The thesis project can count for 3 to 6 semester credit hours of electives towards the required 36 hours, in accordance with University policies. The thesis must be approved by the Head of the Mathematical Sciences Department. Once the thesis project is completed, the student must successfully defend it before his/her thesis committee.

1. Students who have not taken the CS 5333 Discrete Structures prerequisite for CS 5343 Algorithm Analysis and Data Structures should consult with their Graduate Advisor from the Mathematical Sciences Department to determine eligibility.