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 Efromovich, Yulia Gel, M. Ali Hooshyar, Wieslaw Krawcewicz, Susan E. Minkoff, L. Felipe Pereira, Dmitry Rachinskiy, Viswanath Ramakrishna, Robert Serfling, 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, Bhargab Chattopadhyay, Qingwen Hu, Frank Konieutschke, Yifei Lou, Oleg Makarenkov, Tomoki Oshawa, Qiongxia (Joanne) Song, Anh Tran

**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, John J. Wiorkowski, Zhenyu Xuan, Hyuntae Yoo, Michael Qiwei Zhang

**Adjunct Faculty from the Research for Mathematics of the Mexican Council and Technology:** Jose Gomez-Larranaga, Adolfo (Sanchez) Valenzuela

**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: Monique Duncan, Lan Guo, Li Liu

Senior Lecturers: Irina Borovkov, Mehmet Candas, Brenna Hill, Wen-Ju Lin, 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 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): 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

Elective

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)

**BIOL 6V00** Topics in Biological Sciences (Introduction to Programming for Biological Sciences)

### 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.

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