S.06-49

SIMON FRASER UNIVERSITY

Senate Committee on University Priorities

Memorandum

TO: Senate

FROM: John Waterhouse
Chair, SCUP
Vice President, Academic

RE: Proposal to revise the Industrial Mathematics Program (Options A, B, and C), Faculty of Sciences (SCUP 06-16)

DATE: March 13, 2006

At its March 8, 2006 meeting SCUP reviewed and approved the proposal from the Faculty of Science for an Industrial Mathematics Program (Options A, B and C).

Motion

That Senate approve and recommend to the Board of Governors, a revision to the Major and Honors Program in Industrial Mathematics to include Option A: Operations Research (Surrey), Option B: Scientific Computing (Burnaby), and Option C: Discrete Mathematics (Burnaby).

Rationale

The proposed changes were designed to make the program more appropriate to changes in technology and the needs of industry, and to take advantage of the expertise of several new faculty members. In particular, the new opportunities at the Surrey campus made it possible to introduce the Operations Research option.

encl.

cc. T. Archibald

SIMON FRASER UNIVERSITY
MEMORANDUM

To: Senate Committee on University Priorities

From: C. MacKenzie, Chair
Senate Committee on Undergraduate Studies

Subject: Faculty of Sciences – Industrial Mathematics program (Options A, B, and C)
(SCUS Reference: SCUS 05-29 e)

Date: February 14, 2006

Action undertaken by the Senate Committee on Undergraduate Studies at its meeting on February 14, 2006 gives rise to the following motion:

Motion:

"that SCUP approve and recommend to Senate the changes to the Industrial Mathematics program to include Option A: Operations Research (Surrey), Option B: Scientific Computing (Burnaby) and Option C: Discrete Mathematics (Burnaby) within Area Requirements."

The relevant documentation is attached for review by SCUP.

Changes to Industrial Mathematics Program

FROM:

Industrial Mathematics Program

Advisors
Dr. M. Monagan, K10547 Shrum Science Centre,
(604) 291-4279, monagan@cecm.sfu.ca
Dr. A. Punnen
Dr. J.F. Williams
This program is an interdisciplinary one which combines a broad education in mathematics with courses in science or engineering and strong computational skills. Industry is looking for mathematicians with a basic training in science or engineering who can communicate effectively with scientists and engineers, and who can tackle industrial problems whose solution requires substantial mathematics and/or statistics. The program aims to meet this need. In addition to the program requirements set out below, general university and faculty of science regulations for a major or honors degree, as the case may be, must be satisfied.

Major Program
Students must complete core requirements, group A requirements, and group B requirements.

Core Requirements
The core requirements, as set out below, are common to all students (see Core Requirements below).

Group A Area Requirements
Students choose one discipline from the following areas: continuous mathematics, discrete mathematics, or industrial statistics.
Curriculum for the group A area requirement is listed below (see Group A Requirements).

Group B Area Requirements
Students choose one of the following areas: biological sciences, chemistry, computing science, earth sciences, engineering science, or physics (see Group B Requirements). With one exception, students will complete a minor in one of the above group B areas. Accordingly, students must be accepted into the minor program of the relevant department or school. The exception is engineering science. For this discipline, students will complete a prescribed curriculum (shown below) instead of completing a minor program, and must meet the same grade point average requirement as that which is required of students in the BASc program in the School of Engineering Science.

Note that admission to the computing science minor program is highly competitive. See "Admission Requirements" on page 127. Group A and B Combinations Students should seek advice about which disciplines from groups A and B suit their career goals. The following area requirement combinations are expected to be the more applicable ones for industry.
- industrial statistics and biology
- continuous mathematics and chemistry
- discrete mathematics and computing science
- discrete mathematics and engineering science
- continuous mathematics and earth sciences
- continuous mathematics and engineering science
- continuous mathematics and physics

Second Bachelor's Degree
If the industrial mathematics major is taken as part of a second bachelor's degree, then the group B requirement may be waived if the student's previous degree contains an approved major. Approvals will be

given on an individual basis and those majors that are approved will not be limited to the five disciplines listed in group B.

Core Requirements
Lower Division Core Requirements
Students must complete one of
CMPT 101-4 Introduction to Computer Programming
CMPT 104-2 Computer Programming

plus all of
CMPT 201-4 Data and Program Abstraction
MACM 101-3 Discrete Mathematics I
MACM 201-3 Discrete Mathematics II
MACM 202-4 Mathematical Modeling and Computation
MATH 151-3 Calculus I
MATH 152-3 Calculus II
MATH 232-3 Elementary Linear Algebra
MATH 251-3 Calculus III
STAT 270-3 Introduction to Probability and Statistics

Upper Division Core Requirements
Students must complete all of
MATH 310-3 Introduction to Differential Equations
MATH 322-3 Complex Variables
MATH 402-4 Industrial Mathematics
STAT 330-3 Introduction to Statistical Inference

plus two of
MATH 314-3 Boundary Value Problems
MATH 343-3 Applied Discrete Mathematics (or 308)
STAT 340-3 Statistical Quality Control (or 380)

plus two of
CMPT 305-3 Computer Simulation and Modeling
CMPT 307-3 Data Structures and Algorithms
MACM 316-3 Numerical Analysis I

Group A Requirements
Students must fulfil the requirements for one of the following three options.

Continuous Mathematics
Students must complete all of
MACM 316-3 Numerical Analysis I
MATH 252-3 Vector Calculus
MATH 314-3 Boundary Value Problems
MATH 418-3 Partial Differential Equations

plus one of
MATH 309-3 Continuous Optimization
MATH 313-3 Differential Geometry
MATH 320-3 Advanced Calculus of One Variable

plus one of
MATH 415-3 Ordinary Differential Equations
MATH 416-3 Numerical Analysis II
MATH 462-3 Fluid Dynamics

MATH 467-3 Vibrations
MATH 470-3 Variational Calculus

Discrete Mathematics
Students must complete all of
CMPT 307-3 Algorithms and Data Structures
MATH 308-3 Linear Programming
MATH 343-3 Applied Discrete Mathematics

plus two of
MATH 443-3 Combinatorial Theory
MATH 445-3 Graph Theory
MATH 447-3 Coding Theory

Industrial Statistics
Students must complete all of
STAT 340-3 Statistical Quality Control
STAT 350-3 Linear Models in Applied Statistics II
STAT 430-3 Statistical Design and Analysis of Experiments

plus one of
STAT 402-3 Generalized Linear and Non-linear Modeling
STAT 410-3 Statistical Analysis of Sample Surveys
STAT 420-3 Non-Parametric Statistics
STAT 450-3 Statistical Theory
STAT 460-3 Bayesian Statistics

It is recommended that students also complete STAT 280.

Group B Requirements
Students must fulfil the requirements for a minor in one of the following areas: •biological sciences
•chemistry
•computing science
•earth sciences
•physics
Refer to the relevant department or school for curriculum requirements.

Engineering Science
An alternative to completing a minor in the above-mentioned areas is to complete the following prescribed curriculum in engineering science.

one of
CMPT 150-3 Introduction to Computer Design
ENSC 150-3 Introduction to Computer Design

plus all of
ENSC 151-2 Digital and Computer Design Laboratory
ENSC 220-3 Electric Circuits I
PHYS 120-3 Modern physics and Mechanics
PHYS 121-3 Optics, Electricity and Magnetism
PHYS 131-2 General Physics Laboratory B

plus two of
ENSC 320-3 Electric Circuits II
ENSC 327-3 Communications Systems
ENSC 380-3 Linear Systems

ENSC 383-4 Feedback Control Systems

plus one of
ENSC 429-4 Discrete-Time Systems
ENSC 483-4 Modern Control Systems
ENSC 488-4 Introduction to Robotics
PHYS 484-3 Nonlinear Physics

plus one more upper division ENSC course.

Students who choose a discipline (e.g. complete a minor program) other than engineering science should seek approval for their minor from the relevant department or school.

If the computing science minor is chosen to satisfy the group B requirement, then CMPT 275, 305, 307 and MACM 316 must be included in the overall program. Further, the upper division courses used for the minor should not overlap with the courses used to satisfy the core requirements set out above.

Honors Program
Students must satisfy the requirements for the major program, and complete additional course work (see below) for a total of 132 credit hours.
•Students must complete at least 48 upper division credit hours in MACM, MATH, and STAT courses (excluding STAT 301, 302, 403)
•Take additional courses to total at least 60 upper division credit hours

Students must also complete all of
CMPT 305-3 Computer Simulation and Modeling
CMPT 307-3 Data Structures and Algorithms
MACM 316-3 Numerical Analysis I
MATH 314-3 Boundary Value Problems
MATH 343-3 Applied Discrete Mathematics (or 308)
STAT 340-3 Statistical Quality Control (or 380)

Co-operative Education
Students in the Industrial Mathematics Program are encouraged to enter co-operative education, a program which integrates work experience with academic study. The advantage of augmenting academic studies with co-op work/study has been strongly endorsed by representatives from industry.

To obtain a co-op designation for the degree, students are required to complete four co-op work terms while completing the academic requirements for the degree.

Students are strongly advised to complete two consecutive work terms after completing 85 credit hours for the major.

For further details, see "Co-operative Education" on page 240.

TO:

Industrial Mathematics Major and Honors Programs.

Advisors

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The Department of Mathematics offers industrial mathematics major and honors programs designed to prepare students for careers in industry. Students enrolling in the industrial mathematics program will choose a program area from either operations research (Surrey campus), scientific computing (Burnaby campus) or discrete mathematics (Burnaby campus). In addition to the program requirements set out below, general university and faculty of science regulations for a major or honors degree, as the case may be, must be satisfied.

Major Program

The program requirements are divided into three parts, a core requirement common for all students, an area requirement, and a minor requirement. The lower division requirements number 31-34 credit hours and the upper division requirements number 34 credit hours. Minor requirement is in addition to those already specified, and is as stipulated by the relevant department or school.

Lower Division Core Requirements

Students must complete

either
CMPT 126-3 Introduction to Computer Science and Programming

or both of
CMPT 120-3 Introdution to Computer Science and Programming I
CMPT 125-3 Introducton to Computer Science and Programming II

and all of
CMPT 225-3 Data Structures and Programming
MACM 101-3 Discrete Mathematics I
MACM 202-4 Mathematical Modeling and Computation.
MATH 151-3 Calculus I
MATH 152-3 Calculus II
MATH 232-3 Elementary Linear Algebra
MATH 251-3 Calculus III
STAT 270-3 Introduction to Probability and Statistics
STAT 285-3 Intermediate Probability and Statistics

Note: With a grade C or better in the relevant course, these substitutions are permitted:

MATH 150, 154, or 157 for 151, and MATH 155 or 158 for MATH 152.

Upper Division Core Requirements

Students must take all of
MACM 316-3 Numerical Analysis I
MATH 308-3 Linear Optimization
MATH 310-3 Introduction to Ordinary Differential Equations
MATH 402-4 Industrial Mathematics Project

Area Requirement

Students must take one option from the following list

Option A: Operations Research (Surrey campus)

Students must take all of
MACM 201-3 Discrete Mathematics II
MATH 309-3 Continuous Optimization
MATH 343-3 Applied Discrete Mathematics
MATH 345-3 Introduction to Graph Theory
MATH 348-3 Probability Models in Operations Research
MATH 408-3 Discrete Optimization
MATH 448-3 Network Flows

plus one additional course from Table 1 below.

Option B: Scientific Computing (Burnaby campus)

Students must take all of
MATH 252-3 Vector Calculus
MATH 314-3 Boundary Value Problems
MATH 418-3 Partial Differential Equations
MACM 409-3 Numerical Linear Algebra and Optimization

plus two of
MATH 309-3 Continuous Optimization
MATH 320-3 Intro to Analysis II
MATH 322-3 Complex Variables
MATH 462-3 Fluid Dynamics
MATH 467-3 Dynamical Systems
MATH 470-3 Variational Calculus
MACM 416-3 Numerical Analysis II

plus two additional courses from Table 1 below.

Option C: Discrete Mathematics (Burnaby campus)

Students must take all of
MACM 201-3 Discrete Mathematics II
MATH 332-3 Introduction to Appied Algebraic Systems
MATH 343-3 Applied Discrete Mathematics
MATH 345-3 Introduction to Graph Theory

plus two of

MATH 408-3 Discrete Optimization
MATH 447-4 Coding Theory
MACM 401-3 Introduction to Computational Algebra
MACM 442-3 Cryptography

plus two additional courses from Table 1 below.

Table 1 - Industrial Mathematics Courses.

CMPT 305-3 Computer Simulation and Modelling
CMPT 307-3 Data Structures and Algorithms
CMPT 361-3 Introduction to Computer Graphics
CMPT 405-3 Design and Analysis of Computing Algorithms
CMPT 461-3 Advanced Computer Graphics

MACM 316-3 Numerical Analysis I
MACM 401-3 Introduction to Computational Algebra
MACM 416-3 Numerical Analysis II
MACM 442-3 Cryptography
MACM 409-3 Numerical Linear Algebra and Optimization

MATH 308-3 Linear Optimization
MATH 309-3 Continuous Optimization
MATH 310-3 Introduction to Ordinary Differential Equations
MATH 314-3 Boundary Value Problems
MATH 320-3 Introduction to Analysis II
MATH 322-3 Complex Variables
MATH 332-3 Introduction to Applied Algebraic Systems
MATH 342-3 Elementary Number Theory
MATH 343-3 Applied Discrete Mathematics
MATH 345-3 Introduction to Graph Theory
MATH 348-3 Probability Models in Operations Research
MATH 402-4 Industrial Mathematics Project
MATH 408-3 Discrete Optimization

MATH 418-3 Partial Differential Equations
MATH 438-3 Linear Algebra
MATH 443-3 Combinatorial Theory
MATH 445-3 Graph Theory
MATH 447-4 Coding Theory
MATH 448-3 Network Flows
MATH 462-3 Fluid Dynamics
MATH 467-3 Dynamical Systems
MATH 470-3 Variational Calculus

PHYS 395-3 Computational Physics

Minor requirement

Students must complete the requirements for either a minor in economics, engineering, or computing science or any minor offered by the faculty of science (e.g. biology, chemistry, earth science, physics, statistics).

Students must be accepted into the minor program of the relevant department or school.

Upper division courses used to satisfy the major requirements cannot be also used to satisfy the minor requirement.

If the industrial mathematics major is taken as part of a second bachelor's degree, then the minor requirement may be waived if the student's previous degree contains an approved major. Approvals will be given on an individual basis and those majors that are approved will not be limited to the disciplines listed in the minor requirement.

Other requirements

Students must complete the Faculty of Science requirements for a major as outlined on page 213. Computing courses taken as part of the industrial mathematics major count towards the 12 credit hour requirement from subjects outside of the Faculty of Science.

Students planning to go on to graduate school in mathematics are advised to also take both of

MATH 242: Introduction to Analysis I
MATH 332: Introduction to Applied Algebraic Systems.

Honors Program

Students must satisfy the requirements for the major program in industrial mathematics, and complete additional course work (see below) for a total of 132 credit hours.

Students must take both of

MATH 242 Introduction to Analysis I
MATH 332 Introduction to Applied Algebraic Systems

and take additional courses from Table 1 to complete a total of at least 48 upper division credit hours, of which at least four courses must be at the 400 level. One upper division MATH course not listed may be substituted for a course in Table 1.

Students must also fulfill the Faculty of Science general requirements for an honors degree as outlined on page 213. Note, the only requirement there which is not already met by the above requirements for the industrial mathematics honors program, which includes a minor requirement, is the minimum GPA requirement.

Co-operative Education

Students in the Industrial Mathematics Program are encouraged to enter co-operative education, a program which integrates work experience with academic study. The advantage of augmenting academic studies with co-op work/study has been strongly endorsed by representatives from industry.

To obtain a co-op designation for the degree, students are required to complete four co-op work terms while completing the academic requirements for the degree.

For further details, see "Co-operative Education" on page 240.

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Rationale for the changes:

The changes were designed to make the program more appropriate to changes in technology and the needs of the industry, and to take advantage of the expertise of several new faculty members. In particular, the new opportunities opened by the creation of the Surrey campus made it possible to introduce the Operations Research option.