

2009-112

PROPOSAL SUMMARY AND ROUTING FORM

Proposal Title: Industrial Mathematics concentration

Initiating Unit or Individual: Robert N. McCullough, applied mathematics program coordinator
Contact Person's Name: Robert N. McCullough e-mail: RobertMcCullough@ferris.edu
phone: 591-5876

Date or Term of Proposal Implementation: Fall, 2009

- Group I - A – New degree/major or major, redirection of a current offering, or elimination of a degree, major or minor
- Group I - B – New minors or concentrations
- Group II - A – Minor curriculum clean-up and course changes
- Group II - B – New Course
- Group III - Certificates
- Group IV – Off-Campus Programs

Group/Individual	Signature	Date	Vote/Action *
Program Faculty	<i>Robert N. McCullough</i>	9/10/08	6 Support 0 Support with Concerns 0 Not Support
Department Faculty	<i>Robert N. McCullough</i>	9/16/08	18 Support 0 Support with Concerns 0 Not Support
Department Head	<i>John E. Galt</i>	10/21/08	<input checked="" type="checkbox"/> Support <input type="checkbox"/> Support with Concerns <input type="checkbox"/> Not Support
College Curriculum Committee	<i>Auton</i>	12/9/08	<input checked="" type="checkbox"/> Support <input type="checkbox"/> Support with Concerns <input type="checkbox"/> Not Support
Dean	<i>Mark H. ...</i>	12-10-08	<input checked="" type="checkbox"/> Support <input type="checkbox"/> Support with Concerns <input type="checkbox"/> Not Support
University Curriculum Committee	<i>Shenue</i>	1/27/09	<input checked="" type="checkbox"/> Support 6-0. <input type="checkbox"/> Support with Concerns <input type="checkbox"/> Not Support
Senate	<i>Richard Stiffen</i>	2/3/09	<input checked="" type="checkbox"/> Support <input type="checkbox"/> Support with Concerns <input type="checkbox"/> Not Support
Academic Affairs	<i>David Fleck</i>	2/4/09	<input checked="" type="checkbox"/> Support <input type="checkbox"/> Hold <input type="checkbox"/> Not Support

* Support with Concerns or Not Support must include a list of specific concerns. Votes must be shown for faculty groups. Administrators check appropriate action taken.

To be completed by Academic Affairs	<u>3-20-09</u>	<u>4-17-09</u>
President (Date Approved)	Board of Trustees (Date Approved)	President's Council (Date Approved)

REC'D FEB 04 2009

1. Proposal Summary

This proposal seeks to add a new concentration, Industrial Mathematics, within the Applied Mathematics B.S. degree. In addition to the normal General Education requirements, students must complete the following requirements:

Applied Mathematics Core – 19 credit hours required

1. MATH 220 Analytical Geometry & Calculus 1	5 credits
2. MATH 230 Analytical Geometry & Calculus 2	5 credits
3. MATH 251 Statistics for the Life Sciences	3 credits
4. MATH 320 Analytical Geometry & Calculus 3	3 credits
5. MATH 322 Linear Algebra	3 credits

Concentration Requirements - 25 credit hours required

1. CPSC 200 Object Oriented Programming	4 credits
2. MATH 330 Differential Equations	3 credits
3. MATH 340 Numerical Analysis	3 credits
4. MATH 360 Operations Research	3 credits
5. MATH 414 Mathematical Statistics	3 credits
6. CPSC/MATH 300/400 elective	3 credits
7. CPSC/MATH 300/400 elective	3 credits
8. ECON 221 Principals of Economics	3 credits

This is comparable to the other concentrations in total credits (44) and in the number of mathematics/computer science electives (two).

Rationale:

1. Industrial mathematics is a rapidly growing field of applied mathematics. It prepares students to be successful in working in industry.
2. **No university in the state of Michigan currently has an undergraduate degree program in industrial mathematics.**
3. Clarion University in Pennsylvania recently began a similar degree program to, in the words of Dr. Jon Beal, program coordinator: "represent the natural evolution of the classical applied mathematical program."
4. The employment market is good and should get better in the future, according to the US Department of Labor, Bureau of Labor Statistics.
5. It gives students another option within the applied mathematics program. This may make our program more attractive to a larger pool of students.

A more complete description of the proposal, including expanded rationale information, appears under the heading "Proposed Revision" later in this document.

2. Summary of All Course Action Required*

a. **Newly Created Courses to FSU:**

Prefix	Number	Title
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None

b. **Courses to be Deleted From FSU Catalog:**

Prefix	Number	Title
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None

c. **Existing Course(s) to be Modified:**

Prefix	Number	Title
--------	--------	-------

None

d. **Addition of existing FSU courses to program**

Prefix	Number	Title
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CPSC	200	Object Oriented Programming
ECON	221	Principles of Economics
MATH	220	Analytical Geometry & Calculus 1
MATH	230	Analytical Geometry & Calculus 2
MATH	251	Statistics for the Life Sciences
MATH	320	Analytical Geometry & Calculus 3
MATH	322	Linear Algebra
MATH	330	Differential Equations
MATH	340	Numerical Analysis
MATH	360	Operations Research
MATH	414	Mathematical Statistics 1
MATH/CPSC	300/400	Elective
MATH/CPSC	300/400	Elective

e. **Removal of existing FSU courses from program**

Prefix	Number	Title
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None

*Contact Senate Secretary or UCC Chair if spaces for additional courses are needed.

Outcomes Statement and Assessment Plan

The Industrial Mathematics concentration is one of the concentrations within the Applied Mathematics B.S. degree program. The program outcomes and assessment plans follow:

Applied Mathematics B.S. Degree Program Outcomes

A graduate of this program will be able to:

1. apply the mathematical principles, theory, and concepts in analytical geometry, calculus, linear algebra, statistics and computer programming.
2. solve applied problems in their specific concentration of mathematics.
3. analyze real-world problems and appropriately communicate the results.

Applied Mathematics B.S. Degree Program – Assessment Plan

To assess our program outcomes, we will:

1. administer comprehensive final exams in key courses in the program.
2. assign large special projects in select courses testing mastery of key concepts.
3. analyze the results of alumni, employer, student, faculty and advisory board surveys.
4. conduct an exit interview/questionnaire for students graduating from the program.
5. evaluate student responses from terminal course questionnaires to be given in key courses in the concentration.

The specific outcomes and assessment plans for the Industrial Mathematics concentration are as follows.

Industrial Mathematics Concentration – Student Learning Outcomes

A graduate of this concentration will be able to:

1. solve a wide-variety of applied problems in fields related to industrial mathematics, including operations research, statistics, differential equations and numerical analysis

Industrial Mathematics Concentration – Assessment Plan

To assess our concentration outcomes, we will:

1. administer comprehensive final exams in key courses in the concentration.
2. assign large special projects in select courses, including Math 360 Operations Research, testing mastery of key concepts.
3. evaluate student responses from terminal course questionnaires to be given in Math 414 Mathematical Statistics 1 and Math 360 Operations Research.

Proposed Revision

This proposal seeks to add a new concentration, Industrial Mathematics, within the Applied Mathematics B.S. degree.

Several years ago I attended a mathematics conference at CMU. One of the speakers was the head of the MS Industrial Mathematics program at MSU. After his talk I asked him what he considered to be the ideal qualifications for a student entering the MS Industrial Mathematics program at MSU. His response (in order): the calculus sequence, linear algebra, differential equations, numerical analysis, operations research, a computer science course, economics, physics, advanced calculus and analysis.

In addition to the normal General Education requirements, students must complete the following requirements:

Applied Mathematics Core – 19 credit hours required

- | | |
|--|-----------|
| 1. MATH 220 Analytical Geometry & Calculus 1 | 5 credits |
| 2. MATH 230 Analytical Geometry & Calculus 2 | 5 credits |
| 3. MATH 251 Statistics for the Life Sciences | 3 credits |
| 4. MATH 320 Analytical Geometry & Calculus 3 | 3 credits |
| 5. MATH 322 Linear Algebra | 3 credits |

Concentration Requirements - 25 credit hours required

- | | |
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| 1. CPSC 200 Object Oriented Programming | 4 credits |
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| 5. MATH 414 Mathematical Statistics | 3 credits |
| 6. CPSC/MATH 300/400 elective | 3 credits |
| 7. CPSC/MATH 300/400 elective | 3 credits |
| 8. ECON 221 Principals of Economics | 3 credits |

This is comparable to the other concentrations in total credits (44) and in the number of mathematics/computer science electives (two). This is the only concentration we offer that combines mathematical statistics (Math 414) with operations research (Math 360). It is also the only concentration we offer that combines mathematical statistics (Math 414) with differential equations (Math 330).

Rationale:

1. Industrial mathematics is a rapidly growing field of applied mathematics. It prepares students to be successful in working in industry. Recent advances in technology have increased the demand for professionals capable of modeling and simulating these technologies. Modeling, analysis and computations performed by mathematicians can provide technical advantages and cost savings, important for a company's future. Applications of industrial mathematics are wide ranging, including areas from aircraft and automobile design to software development, computer security, and weather modeling. In recent years the field has expanded to include non-industrial topics such as supply, distribution, transportation, communication and information handling, medical care and safety.
2. **No university in the state of Michigan currently has an undergraduate degree program in industrial mathematics.** This will also allow Ferris in the future to develop our own master's degrees in industrial mathematics, if so desired.
3. Clarion University in Pennsylvania recently began a similar degree program. Dr. Jon Beal, program coordinator, said: "This new program represents the natural evolution of the classical applied mathematical program under the influence of new technologies and social issues and addresses needs and issues outlined in the previous reports. The starting of the Bachelor of Science in Industrial Mathematics program at Clarion University will provide an opportunity for Clarion University to become a leader in this area at the undergraduate level. The industrial mathematics program will provide these students an Opportunity to enter the technological workforce." I hope that this program will make Ferris State University also a leader in this emerging field of applied mathematics.
4. The employment market is good and should get better in the future. Here is a quote dealing with this subject from the US Department of Labor, Bureau of Labor Statistics: "Employment of mathematicians is expected to increase by 10 percent during the 2006–16 decade ...Advancements in technology usually leads to expanding applications of mathematics, and more workers with knowledge of mathematics will be required in the future... some of the fastest growing job categories will require substantial mathematics preparation." <http://www.bls.gov/oco/ocos043>.
5. It gives students another option within the applied mathematics program. This may make our program more attractive to a larger pool of students. Our students are interested in how mathematics is related to solving real-world problems. Math 360 Operations Research is a very popular course for our students and is the course most closely related to industrial mathematics. After a drop in the 1990s, trends indicate a slight increase in the number of students nationally taking advanced courses in mathematics: <http://www.nsf.gov/statistics/seind04/c2/tt02-03.htm>

Program Information: Catalog Description

Industrial mathematics is a rapidly growing field of applied mathematics. It prepares students to be successful in working in industry. Recent advances in technology have increased the demand for professionals capable of modeling and simulating these technologies. Modeling, analysis and computations performed by mathematicians can provide technical advantages and cost savings, important for a company's future. Applications of industrial mathematics are wide ranging, including areas from aircraft and automobile design to software development, computer security, and weather modeling, as well as many non-industrial topics such as supply, distribution, communication, transportation, and information handling.

Employment of mathematicians is expected to increase by 10 percent during the next decade, according to the US Department of Labor. Advancements in technology will lead to increasing applications of mathematics, and more people with knowledge of applied mathematics will be needed in the future. Some of the fastest growing jobs will require considerable mathematics preparation.

Course requirements for the industrial mathematics specialty are structured so the student has maximum flexibility in designing an individualized program with the approval of a faculty advisor.

First year student eligibility requirements are a minimum 2.0 high school GPA and a minimum ACT math subtest score of 19. Eligibility requirements for transfer students are a minimum 2.0 college GPA and a "C" or better grade in math preparatory for MATH 115.

Graduation requires a minimum 2.0 overall GPA, a minimum of 120 credits including electives and completion of all general education requirements as outlined in the general education section of the FSU catalog. Additionally, a 2.5 GPA for all mathematics and computer science coursework is required.

Revised Program Admission Criteria

Not applicable

**A proposal to add a new concentration in
Industrial Mathematics to the Applied
Mathematics B.S. degree program**

**Initiator: Robert N. McCullough
Applied Mathematics Coordinator
Department of Mathematics
Ferris State University
October 21, 2008**

Table of Contents

Topic	Page
Title page	1
Table of Contents	2
FORM A	3
Outcome Statement and Assessment Form	6
Proposed Revision	8
Program Information: Catalog Description Revised Program Admission Criteria	10
FORM B	11
FORM B – UGPC FORM C	12
FORM D Term-by-Term Plan	13
FORM E FORM F FORM G Expected Implementation Date Revised Articulation Revised Licensure Certification Need for Proposed Revision	15
Expected Change in the Number of Majors Changes in Support Resources Faculty and/or Staff Changes in Facilities Changes in Library Resources Changes in Equipment and Computers Budget Implications	16

CURRICULUM CONSULTATION FORM

To be completed by each department affected by the proposed change, new degree, new program, new minor, or new course. Potential duplication of coursework is reason for consultation.

1. This completed form must be forwarded with the proposal to the chair/head of the department to be consulted.
2. The department must respond within 20 calendar days of receipt of this form to insure inclusion in the final proposal. The completed form is returned to the initiator and inserted into the proposal.

Failure to respond is interpreted as support for the proposal.

3. The Proposing Department must address any concerns raised by the department. This response will be in writing and be included in the proposal following the consultation form.

RE: Proposal Title: Industrial Mathematics concentration

Initiator(s): Robert N. McCullough

Proposal Contact: Robert N. McCullough **Date Sent:** 9/25/08

Department: Mathematics
(Please print)

Campus Address: ASC 2042

Responding Department: MBMT

Chair/Head/Coordinator: _____ Date Returned: 10-2-08



Based upon department faculty review on 10-2-08 (date), we

- Support the above proposal.
- Support the above proposal with the modifications and concerns listed below.
- Do not support the proposal for the reasons listed below.

Comment regarding the impact this proposal has on scheduling, room assignments, faculty load, and prerequisites for your department. Use additional pages, if necessary.

Form B – UGPC Curriculum Consultation Form to University Graduate and Professional Council

(for proposals affecting graduate and professional curricula)

Not applicable

Form C – Library & Instructional Service Consultation Form

(if new or revised courses are part of the process)

Not applicable

GENERAL EDUCATION REQUIREMENTS

Courses which qualify in the Scientific Understanding (Z), Cultural Enrichment (C) and Social Awareness (S) categories are delineated in the General Education section of the FSU electronic catalog:

<http://www.ferris.edu/htmls/academics/gened/courses.html>

I. GENERAL EDUCATION REQUIREMENTS		
A. COMMUNICATION COMPETENCE		12 Sem Credits
Course	Grade	Credit
ENGL 150		3
ENGL 250		3
ENGL 311 or 321 or 323 or 325		3
COMM 105 or 121		3
TOTAL		
B. SCIENTIFIC UNDERSTANDING		7 Sem Credits
Only approved "Z" courses may count toward this category (one must be a lab course).		
Course	Grade	Credit
Lab		
TOTAL		
C. QUANTITATIVE SKILLS		
This requirement is satisfied through the program requirements area.		
D. CULTURAL ENRICHMENT		9 Sem Credits
Only approved "C" courses may count toward this category. Requirements: 1) one course must be 200+ level, 2) maximum 5 credit hours of music and/or theater activities may apply		
Course	Grade	Credit
200+ level		
TOTAL		

E. SOCIAL AWARENESS		9 Sem Credits
Only approved "S" courses may count toward this category. Requirements: 1) two different subject areas including at least one "foundation" course, 2) one 200+ level course		
Course	Grade	Credit
Foundation		
200+ level		
TOTAL		
F. GLOBAL CONSCIOUSNESS		
Each student must complete one course from the list of qualifying courses presented in the FSU catalog. This course may also count toward fulfilling the Cultural Enrichment or Social Awareness requirement.		
Course:		
G. RACE/ETHNICITY/GENDER		
Each student must complete one course from the list of qualifying courses presented in the FSU catalog. This course may also count toward fulfilling the Cultural Enrichment or Social Awareness requirement.		
Course:		

SAMPLE COURSE SEQUENCE: The following chart depicts one method to begin the course work requirements. In order to complete this program in four years, students must average 15 credit hours per semester. This concentration involves some courses that are only offered every two years, so students **MUST** consult their faculty advisor to develop a course sequence plan appropriate to their academic development and educational plans after the first year.

FIRST YEAR Fall Semester

MATH by placement	3-4
ENGL 150 English I	3
Cultural Enrichment elective	3-4
Social Awareness elective	3
CPSC 200 or 244	3
	15-17

FIRST YEAR Winter Semester

Choose one: COMM 105 or COMM 121	3
MATH by placement	3-4
Scientific Understanding elective	3-5
Social Awareness	3
Cultural Enrich.	3
	15-17

NOTICE REGARDING WITHDRAWAL, RE-ADMISSION AND INTERRUPTION OF STUDIES

Students who return to the university after an interrupted enrollment (not including summer semester) must normally meet the requirements of the curriculum which are in effect at the time of their return, not the requirements which were in effect when they were originally admitted.

Specifications of Required Courses in the Concentration That Are Being Revised

Form E – New Course Information Form

Not applicable. There are no new courses in this new concentration.

Form F – Course Data Entry Form

Not applicable. There are no modified or deleted courses in this new concentration.

Form G – General Education Approval Form

Not applicable. We are not requesting any General Education designation.

Expected Implementation Date:

Fall, 2009

Revised Articulation

Not applicable

Revised Licensure/Certification

Not applicable

Need for the Proposed Revisions to the Degree Major/Minor Program

Relationship to Current University Programs

From a low of 7 students in 1996, before revision of the applied mathematics BS degree program into concentrations, the enrollment in applied mathematics has risen steadily to achieve a steady enrollment of between 30 and 35 majors over the past three years. We hope that the uniqueness of this new concentration, the only one of its kind in Michigan, will attract more students into the applied mathematics program. Students currently in pre-pharmacy, pre-optometry or ore-engineering programs may also be attracted to this concentration. The only closely-related programs to this new concentration in the university are the other concentrations within the applied mathematics program.

Summarize Results from Form B Consultation Forms

The only department affected by this new concentration is the management department, since we are requiring their Economics 221 Principles of Economics course for our students. The corresponding Form B from the management department, indicating their approval, is included earlier in this proposal.

Expected Change in the number of Majors/Minors Following Revision

Based on the interest our students showed in the other concentrations when they were first introduced, we hope to attract 5 new students in the first year and as many as 15 new students in three years to five years. This should lead to the graduation of around 5 students a year from this concentration once the program gets well-established, which should take about five years.

Changes in Support Resources Required for Revision

None anticipated

Faculty and/or Staff

No new additional faculty members are needed for this concentration. The current tenured/tenure track faculty of the mathematics department is well-qualified to teach the courses in this concentration.

Changes in Facilities

No changes in facilities are anticipated for the next five years due to this new concentration.

Changes in Library Resources

None anticipated

Changes in Equipment and Computers

None anticipated

Budget Implications of Curriculum Revision

None anticipated. All of the courses in the new program already exist, the facilities are adequate and the current faculty have the expertise to teach the courses.