

MEMO

Dean of  
Graduate Studies

## STREET ADDRESS

Maggie Benston Student Services  
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8888 University Drive  
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TO: Senate

TEL

FROM Wade Parkhouse, Dean, Graduate Studies



RE Faculty of Science

[GS2011.18]

CC Peter Ruben

DATE October 4, 2011

**For information**

Acting under delegated authority at its meeting of 3 October 2011, the SGSC approved the following curriculum revisions:

**Effective Date is May 2012****Faculty of Science**

[GS2011.18]

**b. Department of Mathematics****i) M.Sc Stream and PhD Stream:**

Addition of Operations Research stream (O.R.)

Calendar changes to identify core courses

Addition of new courses:

MATH 804-4 Operations Research: Selected Topics

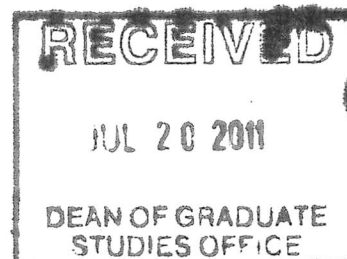
MATH 808-4 Advanced Linear Programming

MATH 888-0 PhD Comprehensive Exam: Operations Research

Senators wishing to consult a more detailed report of curriculum revisions may do so by going to Docushare:

<https://docushare.sfu.ca/dsweb/View/Collection-12682>

If you are unable to access the information, please call [778-782-3168](tel:778-782-3168) or email [shelley\\_gair@sfu.ca](mailto:shelley_gair@sfu.ca).



**TO:** W. Parkhouse  
Dean of Graduate Studies

**FROM:** D. Bingham, Chair  
Faculty of Science Graduate Studies  
Committee

**RE:** Mathematics Program Change

**DATE:** July 11, 2011

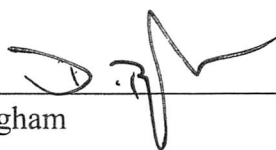
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The following has been approved by the Faculty of Science and is forwarded for approval by the Senate Graduate Studies Committee. Please include this on the next SGSC agenda.

Mathematics

Changes to the Mathematics Graduate Program as described in the attached documentation and new course proposals for MATH 804-4, MATH 808-4 and MATH 888-0.

The proposal is to add an Operations Research stream to the Mathematics graduate program.

  
\_\_\_\_\_  
D. Bingham

Enclosure

c. C. Cupples



# MEMO

DEPARTMENT OF MATHEMATICS

**ATTENTION SGSC**

**From:** Graduate Studies Committee  
 Mathematics Department  
 Local 23059  
 mathgsec@sfu.ca

**RE:** Mathematics Major Graduate Program Change  
 "Proposal for Operations Research M.Sc. and Ph.D. Streams"

**Date:** June 30, 2011

Attached please find a document from the Department of Mathematics, entitled "Proposal for Operations Research M.Sc. and Ph.D. Streams". This program change is an addition to our current program and will be offered at the Surrey Campus but maintained at the Burnaby Campus.

## 1. Proposed Program Change

This is a proposal to add an Operations Research (O.R.) stream to the Mathematics graduate program at SFU. Currently there are two streams, Applied and Computational Mathematics (APMA) and Mathematics. Each consists of a set of requirements that lead to the M.Sc. or Ph.D. degrees in Mathematics. The key features of the requirements for O.R. are three core courses, one of which will be new to the calendar, and an O.R. focused comprehensive exam for Ph.D. students.

Course Title: MATH 804-4 Operations Research: Selected Topics

Units: 4.00

Subject: Mathematics

Description: Topics vary depending on faculty availability and student interests.

Possible topics include: Applied and Computational Optimization, Approximation Algorithms, Convex Programming, Discrete Convexity and Optimization Methods in Finance.

Course Title: MATH 808-4 Advanced Linear Programming

Units: 4.00

Subject: Mathematics

Description: Convex geometry, the simplex method and duality, pivot rules, degeneracy, decomposition and column generation methods, the complexity of linear programming and the ellipsoid algorithm, interior point methods for linear programming.

Course Title: MATH 888-0 Ph.D. Comprehensive Exam: Operations Research

Units: 0.00

Subject: Mathematics

Description: A written examination covering a broad range of senior undergraduate and graduate

## **2. How This Change Will Affect the Existing Program**

No changes to the existing Math and APMA programs. The new proposed program is in addition to these.

The proposed regulations for the O.R. M.Sc. program will be the same as the Mathematics M.Sc., but with the requirement that the course work include the O.R. core courses, namely:

1. MATH 708-3 Discrete Optimization
2. MATH 808-4 Advanced Linear Programming
3. APMA 923-4 Numerical Methods in Continuous Optimization

MATH 808 is new to the calendar, but has already been taught as topics course. Also, the explicit requirement for taking courses from different areas of mathematics will be removed. A possible outline for Math 808 is included in Appendix A.

As with the APMA and Mathematics Ph.D. programs, the O.R. Ph.D. program requires the completion of the requirements for the M.Sc. program plus additional course and research requirements. The main research requirements are the same as in these two programs, namely an oral candidacy exam and a thesis that embodies a significant contribution to mathematical knowledge.

Where it differs is in the initial general education requirements. These are considered to be partly satisfied by the core course requirements. In addition, the candidate will submit to a written examination on the mathematics of operations research. Students taking the exam will be registered in the course Math 888.

We remark that the required courses have fairly modest mathematical prerequisites. A student coming from our undergraduate program would cover much of the relevant background already upon completion of MACM 201, MATH 242 and MATH 308; additional courses would help for mathematical maturity. We believe that a good student will also be able to succeed in the program with the mathematical background acquired in a good undergraduate engineering degree.

Finally, we propose the addition of a course number for selected topics in O.R. to parallel those for Applied Mathematics and Mathematics.

Admissions requirements remain unchanged.

## **3. Justification for Change**

The Department of Mathematics is developing a research group in O.R. as part of SFU's expansion into Surrey. The O.R. group consists of three research faculty (Z. Lu, A. Punnen and T. Stephen), two senior lecturers (N. Kouzniak and R. Pyke) and about 10 graduate students, and there is hope that it will grow. Last year the undergraduate Industrial Mathematics (O.R. option) was renamed and substantially revised to an undergraduate program in O.R. We see several benefits to having a graduate stream in Operations Research.

The most important benefit is to recruit and serve students who are not mathematics majors or even have undergraduate backgrounds other than mathematics. In fact, we already have two strong Ph.D. students whose background is in Engineering: one is a mature student who has worked as an operations researcher for over 20 years, and the other transferred from the Engineering Science program. Such students may not be well served either by the Mathematics graduate program, which requires a comprehensive exam that has a wide coverage of topics in pure mathematics, or by the APMA stream, which includes required courses in areas that may be far from the research topic of an O.R. student.

We also expect that having the O.R. graduate program as a section in the calendar will be excellent advertising for SFU's O.R. program. This is particularly true for the type of non-traditional mathematics student mentioned above, but we believe it will also appeal to some traditional students and raise the profile of O.R. within the Department and the University.

O.R. techniques figure prominently in interdisciplinary collaborations, for instance in computational biology and health care, where Mathematics faculty are active. Some students in these areas, but outside the O.R. group, may fit better with the new program than with either of the two existing programs.

Finally, while the degrees will remain Mathematics degrees, students can advertise themselves as O.R. specialists on the job market. O.R. maintains a distinct identity in industry. In the U.S., jobs requiring graduate degrees in O.R. are often filled by graduates of Industrial Engineering departments. Locally, Operations Research is well established in the health care industry, with many such positions filled by graduates of the Operations and

Logistics division of UBC's Business School. Featuring O.R. in our program description can help SFU students compete in this market. Of the five Surrey-based students who have graduated with an M.Sc. in Mathematics or plan to graduate this term, three have jobs as operations researchers (with Research in Motion, Analysis Works and Mintec); the other two are pursuing further degrees.

#### **4. Current Calendar Language** (No Changes)

See attached scanned copies of the SFU Mathematics Graduate Course Requirements in the current SFU Calendar. There are no changes.

#### **5. Proposed Calendar Language**

The following text is to be inserted at the end of the SFU Mathematics graduate course requirements:

##### **Operations Research**

##### **MSc Program Requirements**

MSc candidates normally complete at least 18 graduate units beyond courses completed for the bachelor's degree. Of these, at least 12 should be numbered 800 or above, and must include the Operations Research core courses, which are as follows:

MATH 708-3 Discrete Optimization

MATH 808-4 Advanced Linear Programming

APMA 923-4 Numerical Methods in Continuous Optimization

The additional courses may be graduate courses from the Mathematics Department and will frequently include relevant courses from related disciplines such as business, engineering or statistics, subject to approval by the student's supervisory committee. At least one course is from an area of mathematics or operations research outside the O.R. core courses. The candidate also submits a satisfactory thesis and defends it at an oral exam based on the thesis and related topics (MATH 898). See "Graduate General Regulations" on page xxx for regulations.

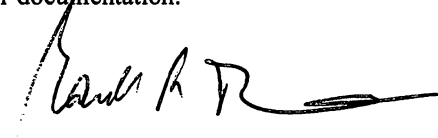
##### **PhD Program Requirements**

A PhD candidate is normally required to complete the MSc requirements and at least 12 further graduate units. Of these, at least eight units must be from courses numbered 800 or above. Subject to the approval of the department's graduate studies committee, a PhD candidate with a MSc is deemed to have completed the MSc requirements for the purpose of the PhD program requirements. Candidates normally pass a two stage general exam. The first stage consists of successful completion of a comprehensive exam (MATH 888). In the second, students present to their supervisory committee a written thesis proposal and then defend it at an open oral defence (MATH 879). The supervisory committee evaluates the thesis proposal and defence, and passes or fails the student. A candidate cannot attempt either general exam stage more than twice. Both stages must be completed within six full-time terms of initial enrollment in the program. Students must submit and successfully defend a thesis which embodies a significant contribution to mathematical knowledge (MATH 899). See "Graduate General Regulations" on page xxx for further information.

Please contact Diane, if you require further documentation.

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Razvan Fetecau  
Co-chair  
Graduate Studies Committee  
Department of Mathematics

M. TRUHNER  
CHAIR, MATHEMATICS

dp

# Proposal for Operations Research M.Sc. and Ph.D. streams

June 30, 2011

## 1 Preamble

This is a proposal to add an Operations Research (O.R.) stream to the Mathematics graduate program at SFU. Currently there are two streams, Applied and Computational Mathematics (APMA) and Mathematics. Each consists of a set of requirements that lead to the M.Sc. or Ph.D. degrees in Mathematics. The key features of the requirements for O.R. are three core courses, one of which will be new to the calendar, and an O.R. focused comprehensive exam for Ph.D. students.

## 2 Motivation

The Department of Mathematics is developing a research group in O.R. as part of SFU's expansion into Surrey. The O.R. group consists of three research faculty (Z. Lu, A. Punnen and T. Stephen), two senior lecturers (N. Kouzniak and R. Pyke) and about 10 graduate students, and there is hope that it will grow. Last year the undergraduate Industrial Mathematics (O.R. option) was renamed and substantially revised to an undergraduate program in O.R. We see several benefits to having a graduate stream in Operations Research.

The most important benefit is to recruit and serve students who are not mathematics majors or even have undergraduate backgrounds other than mathematics. In fact, we already have two strong Ph.D. students whose background is in Engineering: one is a mature student who has worked as an operations researcher for over 20 years, and the other transferred from the Engineering Science program. Such students may not be well served either by the Mathematics graduate program, which requires a comprehensive exam that has a wide coverage of topics in pure mathematics, or by the APMA stream, which includes required courses in areas that may be far from the research topic of an O.R. student. We also expect that having the O.R. graduate program as a section in the calendar will be excellent advertising for SFU's O.R. program. This is particularly true for the type of non-traditional mathematics student mentioned above, but we believe it will also appeal to some traditional students and raise the profile of O.R. within the Department and the University.

O.R. techniques figure prominently in interdisciplinary collaborations, for instance in computational biology and health care, where Mathematics faculty are active. Some students in these areas, but outside the O.R. group, may fit better with the new program than with either of the two existing programs. Finally, while the degrees will remain Mathematics degrees, students can advertise themselves as O.R. specialists on the job market. O.R. maintains a distinct identity in industry. In the U.S., jobs requiring graduate degrees in O.R. are often filled by graduates of Industrial Engineering departments. Locally, Operations Research is well established in the health care industry, with many such positions filled by graduates of the Operations and Logistics division of UBC's Business School. Featuring O.R. in our program description can help SFU students compete in this market. Of the five Surrey-based students

who have graduated with an M.Sc. in Mathematics or plan to graduate this term, three have jobs as operations researchers (with Research in Motion, AnalysisWorks and Mintec); the other two are pursuing further degrees.

### **3 Summary of the changes**

The proposed regulations for the O.R. M.Sc. program will be the same as the Mathematics M.Sc., but with the requirement that the course work include the O.R. core courses, namely:

1. MATH 708-3 Discrete Optimization
2. MATH 808-4 Advanced Linear Programming
3. APMA 923-4 Methods of Continuous Optimization

MATH 808 is new to the calendar, but has already been taught as topics course. Also, the explicit requirement for taking courses from different areas of mathematics will be removed. A course outline for Math 808 is attached and included in Appendix A.

As with the APMA and Mathematics Ph.D. programs, the O.R. Ph.D. program requires the completion of the requirements for the M.Sc. program plus additional course and research requirements. The main research requirements are the same as in these two programs, namely an oral candidacy exam and a thesis that embodies a significant contribution to mathematical knowledge.

Where it differs is in the initial general education requirements. These are considered to be partly satisfied by the core course requirements. In addition, the candidate will submit to a written examination on the mathematics of operations research. Students taking the exam will be registered in the course Math 888.

We remark that the required courses have fairly modest mathematical prerequisites. A student coming from our undergraduate program would cover much of the relevant background already upon completion of MACM 201, MATH 242 and MATH 308, additional courses would help for mathematical maturity. We believe that a good student will also be able to succeed in the program with the mathematical background acquired in a good undergraduate engineering degree.

Finally, we propose the addition of a course number for selected topics in O.R. to parallel those for Applied Mathematics and Mathematics.

Admissions requirements remain unchanged.

#### **3.1 Resource requirements**

We do not anticipate that this stream will require additional resources. In fact, we are already offering the program under the Mathematics M.Sc. and Ph.D. option - the proposal is more about a new identity for the program, rather than a new program in itself. In the academic years 2008-9 to 2010-11, we offered Continuous Optimization and Discrete Optimization twice each, Advanced Linear Programming once, an additional cross-listed graduate course on Network Flows (Math 748) and a graduate topics course on Approximation Algorithms (Math 800). We expect that it will be possible to maintain a similar level of offerings, given that the cross-listed courses benefit from undergraduate enrollment, and the courses, most notably Continuous Optimization, are attracting students from other departments such as Engineering Science. Faculty are aware that occasionally these courses may have to be offered as reading courses.

Typical enrollments in our graduate classes are around 15 (combined undergrad and grad) for the 700-level courses and 10 for the 800-level grad-only courses. We expect these to grow modestly as the program becomes established. A typical annual intake for the O.R. group is four M.Sc. students and one Ph.D. student, the number of students in the program may be slightly higher if the program is occasionally used by students outside the O.R. group. The number of M.Sc. students is relatively high for the size of the group since an M.Sc. in O.R. is more appealing as a terminal degree oriented towards the non-academic job market.

The Ph.D. comprehensive exam will require some additional faculty time, both in the formulation of a list of questions for the test and in grading. The problems in the comprehensive exam will come from a set list of questions, which will be reviewed by an O.R. researcher from outside SFU. The faculty are aware of this commitment and agreeable to taking it on.

## **3.2 Proposed calendar description**

The following text is to be inserted at the end of the SFU Mathematics graduate course requirements:

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### **Operations Research**

#### **MSc Program Requirements**

MSc candidates normally complete at least 18 graduate units beyond courses completed for the bachelor's degree. Of these, at least 12 should be numbered 800 or above, and must include the Operations Research core courses, which are as follows:

MATH 708-3 Discrete Optimization

MATH 808-4 Advanced Linear Programming

APMA 923-4 Methods of Continuous Optimization

The additional courses may be graduate courses from the Mathematics Department and will frequently include relevant courses from related disciplines such as business, engineering or statistics, subject to approval by the student's supervisory committee. The candidate also submits a satisfactory thesis and defends it at an oral exam based on the thesis and related topics (MATH 898). See "Graduate General Regulations" on page xxx for regulations.

#### **PhD Program Requirements**

A PhD candidate is normally required to complete the MSc requirements and at least 12 further graduate units. Of these, at least eight units should be from courses numbered 800 or above. Subject to the approval of the department's graduate studies committee, a PhD candidate with a MSc is deemed to have completed the MSc requirements for the purpose of the PhD program requirements.

Candidates normally pass a two stage general exam. The first stage consists of successful completion of a comprehensive exam (MATH 888). In the second, students present to their supervisory committee a written thesis proposal and then defend it at an open oral defence (MATH 879). The supervisory committee evaluates the thesis proposal and defence, and passes or fails the student. A candidate cannot complete either general exam stage more than twice. Both stages must be completed within six full-time terms of initial enrollment in the program.

Students must submit and successfully defend a thesis which embodies a significant contribution to mathematical knowledge (MATH 899).

See "Graduate General Regulations" on page xxx for further information.

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Calendar course descriptions:

|                     |                                                                                                                                                                                                                                         |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title</b> | MATH 804-4 Operations Research: Selected Topics                                                                                                                                                                                         |
| <b>Units</b>        | 4.00                                                                                                                                                                                                                                    |
| <b>Subject</b>      | Mathematics                                                                                                                                                                                                                             |
| <hr/>               |                                                                                                                                                                                                                                         |
| <b>Course Title</b> | MATH 808-4 Advanced Linear Programming                                                                                                                                                                                                  |
| <b>Units</b>        | 4.00                                                                                                                                                                                                                                    |
| <b>Subject</b>      | Mathematics                                                                                                                                                                                                                             |
| <b>Description</b>  | Convex geometry, the simplex method and duality, pivot rules, degeneracy, decomposition and column generation methods, the complexity of linear programming and the ellipsoid algorithm, interior point methods for linear programming. |
| <hr/>               |                                                                                                                                                                                                                                         |
| <b>Course Title</b> | MATH 888-0 Ph.D. Preliminary Exam: Operations Research                                                                                                                                                                                  |
| <b>Units</b>        | 0.00                                                                                                                                                                                                                                    |
| <b>Subject</b>      | Mathematics                                                                                                                                                                                                                             |
| <b>Description</b>  | A written examination covering a broad range of senior undergraduate and graduate mathematical material commonly used in Operations Research.                                                                                           |
| <hr/>               |                                                                                                                                                                                                                                         |

## A Course outline for Math 808

### MATH 808 - 4 Advanced Linear Programming

**Description:** Convex geometry, the simplex method and duality, pivot rules, degeneracy, large-scale optimization decomposition and column generation methods, the complexity of linear programming and the ellipsoid algorithm, interior point methods for linear programming.

**Textbook:** Bertsimas and Tsitsiklis, *Introduction to Linear Optimization*, Athena Scientific (2007) or Schrijver, *Theory of Linear and Integer Programming*, Wiley (1998).

**Possible Instructors:** Z. Lu, A. Punnen, T. Stephen

## **B Additional Information**

There are many graduate programs in O.R. in Canada, in the U.S. and around the World, see for instance the directory at:

<http://www.informs.org/Build-Your-Career/INFORMS-Student-Union/ORMS-Educational-Programs>

These vary considerably in audience and structure, examples are described below.

The only current graduate programs in B.C. advertised as O.R. are through UBC's Sauder School of Business. They offer a Master's of Management (MM) in O.R. and an M.Sc. and a Ph.D. in Management Science. The MM is a short professional program (16 months) built around an industrial project and is quite different from what we propose. The M.Sc. and Ph.D. are academic programs with course work covering mathematical optimization, stochastic methods and research methods. All of these courses are taught by Management School professors: UBC is in the somewhat unusual situation of having top-rate mathematicians in their Business School, but their programs necessarily skew less towards math and more towards business compared to this proposal. Most of the theory of optimization (linear, continuous and discrete) is covered in a single course.

An excellent O.R. graduate program is offered by the University of Waterloo's Department of Combinatorics and Optimization. Their M.Sc. in O.R. (thesis option) requires four courses: Combinatorial Optimization, Continuous Optimization and two more courses taken from a list of related topics courses. The Ph.D. in Combinatorics and Optimization requires four additional courses and a comprehensive exam before proceeding to an oral examination and the thesis.

The three required courses that we propose are similar to core courses in the O.R. graduate programs of mathematically oriented engineering schools in the U.S., such as Cornell and Georgia Tech.

SIMON FRASER UNIVERSITY

NEW GRADUATE COURSE PROPOSAL FORM

When a department proposes a new course it must first be sent to the chairs of each faculty graduate program committee where there might be an overlap in course content. The chairs will indicate that overlap concerns have been dealt with by signing the appropriate space or via a separate memo or e-mail (attach). The new course proposal must also be sent to the Library for a report.

Once overlap concerns have been dealt with, signatures indicate approval by the department, home faculty and Senate Graduate Studies Committee.

Department or School: Mathematics

Proposed course number and title: Math 804-4 Operations Research: Selected Topics

Other Faculties:

Other Faculties approval indicates that the Dean(s) or designate of other Faculties affected by the proposed new course support(s) the approval of the new course.

|                       |                 |            |
|-----------------------|-----------------|------------|
| Name of Faculty _____ | Signature _____ | Date _____ |
| Name of Faculty _____ | Signature _____ | Date _____ |
| Name of Faculty _____ | Signature _____ | Date _____ |
| Name of Faculty _____ | Signature _____ | Date _____ |
| Name of Faculty _____ | Signature _____ | Date _____ |

Departmental approval (non-departmentalized faculties need not sign)

Department Graduate Program Committee

Signature [Signature] Date June 21, 2011

Department Chair

Signature [Signature] Date June 22 2011

Faculty approval

Faculty approval indicates that all the necessary course content and overlap concerns have been resolved, and that the Faculty/Department commits to providing the required Library funds and any other necessary resources

Faculty Graduate Program Committee

Signature [Signature] Date July 18/11

SGSC approval

Signature [Signature] Date Sept 13/11

SGSC approval indicates that the Library report has been seen, and all resource issues dealt with. Once approved, new course proposals are sent to Senate for information.

NEW GRADUATE COURSE PROPOSAL FORM

**Subject:** Mathematics (max. 4 chars) **Catalog Number:** 804

**Course Title:** Operations Research: Selected Topics (max. 80 char.)

**Short Title** (appears on transcripts etc.) ST-Operations Research (max. 25 char.)

**Course Description for Calendar:** (append a course outline as a separate document)

Topics vary depending on faculty availability and student interests. Possible topics include: Applied and Computational Optimization, Approximation Algorithms, Convex Programming, Discrete Convexity and Optimization Methods in Finance.

**Units:** 4

**Available Course Components:** (select all that apply)

☒ Lecture

☐ Seminar

☐ Laboratory

☐ Practicum

**Prerequisites:** (if any)

N/A

**Campus at which course will be offered:** Surrey

**Estimated Enrolment:** 10 **The term course will first be offered:** Fall 2012

**Frequency of course offering:** maybe once every 2 yrs

**Grading Basis:** ☒ Graded

☐ Satisfactory/Unsatisfactory

☐ In Progress/Complete

**Justification:**

To supplement the core courses on OR topics. Both the current MATH and APMA options have a selected topic numbered course and the newly proposed OR Program should have its own selected topic offering.

**Resources:**

**Faculty member(s) who will normally teach this course:**

(append information about their competency to teach the course)

Zhaosong Lu, Abraham Punnen, and Tamon Stephen

**Number of additional faculty members required in order to offer this course:** 0

**Additional space required in order to offer this course:** (append details) 0

**Additional specialized equipment required in order to offer this course:** (append details)

0

**Additional Library resources required:** (append details) **Annually \$** 0 **One-time \$** 0

If additional resources are required to offer this course, the department proposing the course should be prepared to provide information on the source(s) of those additional resources.

Upon approval of the course proposal, the Dean of Graduate Studies office will consult with the department or school regarding other course attributes that may be required to enable the proper entry of the new course in the student record system.

# Course Outline

|                                  |                                                                                                                                                                                                                                                                                                                          |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title:</b>             | MATH 804 - 4 Operations Research: Selected Topics                                                                                                                                                                                                                                                                        |
| <b>Section:</b>                  | G100                                                                                                                                                                                                                                                                                                                     |
| <b>Term:</b>                     | TBA                                                                                                                                                                                                                                                                                                                      |
| <b>Instructor:</b>               | Possible Instructors: Zhaosong Lu, Abraham Punnen, Tamon Stephen<br>Surrey Campus                                                                                                                                                                                                                                        |
| <b>Description Topics:</b>       | Topics vary depending on faculty availability and student interests. Possible topics include: Applied and Computational Optimization, Approximation Algorithms, Convex Programming, Discrete Convexity and Optimization Methods in Finance.                                                                              |
| <b>Grading:</b>                  | TBD                                                                                                                                                                                                                                                                                                                      |
| <b>Required Texts:</b>           | TBD (Depends on Topic)                                                                                                                                                                                                                                                                                                   |
| <b>Recommended Texts:</b>        |                                                                                                                                                                                                                                                                                                                          |
| <b>Materials/Supplies:</b>       |                                                                                                                                                                                                                                                                                                                          |
| <b>Prerequisite/Corequisite:</b> | N/A                                                                                                                                                                                                                                                                                                                      |
| <b>Notes:</b>                    | THE INSTRUCTOR RESERVES THE RIGHT TO CHANGE ANY OF THE ABOVE INFORMATION.<br>Students should be aware that they have certain rights to confidentiality concerning the return of course papers and the posting of marks. Please pay careful attention to the options discussed in class at the beginning of the semester. |

SIMON FRASER UNIVERSITY

NEW GRADUATE COURSE PROPOSAL FORM

When a department proposes a new course it must first be sent to the chairs of each faculty graduate program committee where there might be an overlap in course content. The chairs will indicate that overlap concerns have been dealt with by signing the appropriate space or via a separate memo or e-mail (attach). The new course proposal must also be sent to the Library for a report.

Once overlap concerns have been dealt with, signatures indicate approval by the department, home faculty and Senate Graduate Studies Committee.

Department or School: Mathematics

Proposed course number and title: Math 808-4 Advanced Linear Programming

Other Faculties:

Other Faculties approval indicates that the Dean(s) or designate of other Faculties affected by the proposed new course support(s) the approval of the new course.

|                 |           |      |
|-----------------|-----------|------|
| Name of Faculty | Signature | Date |
| Name of Faculty | Signature | Date |
| Name of Faculty | Signature | Date |
| Name of Faculty | Signature | Date |
| Name of Faculty | Signature | Date |

Departmental approval (non-departmentalized faculties need not sign)

Department Graduate Program Committee

Signature [Signature] Date June 21, 2011

Department Chair

Signature [Signature] Date June 22 2011

Faculty approval

Faculty approval indicates that all the necessary course content and overlap concerns have been resolved, and that the Faculty/Department commits to providing the required Library funds and any other necessary resources

Faculty Graduate Program Committee

Signature [Signature] Date July 18/11

SGSC approval

Signature [Signature] Date Sept 13/11

SGSC approval indicates that the Library report has been seen, and all resource issues dealt with. Once approved, new course proposals are sent to Senate for information.

NEW GRADUATE COURSE PROPOSAL FORM

**Subject:** Mathematics (max. 4 chars) **Catalog Number:** 808

**Course Title:** Advanced Linear Programming (max. 80 char.)

**Short Title** (appears on transcripts etc.) Adv. Linear Programming (max. 25 char.)

**Course Description for Calendar:** (append a course outline as a separate document)

Convex geometry, the simplex method and duality, pivot rules, degeneracy, decomposition and column generation methods, the complexity of linear programming and the ellipsoid algorithm, interior point methods for linear programming.

**Units:** 4

**Available Course Components:** (select all that apply)

☒ Lecture

☐ Seminar

☐ Laboratory

☐ Practicum

**Prerequisites:** (if any)

N/A

**Campus at which course will be offered:** Surrey

**Estimated Enrolment:** 10 **The term course will first be offered:** Fall 2012

**Frequency of course offering:** once every 2 yrs

**Grading Basis:** ☒ Graded

☐ Satisfactory/Unsatisfactory

☐ In Progress/Complete

**Justification:**

The newly proposed program in OR requires students to take this course. The course was taught as a topic course in the past, but now it will have regular offerings.

**Resources:**

**Faculty member(s) who will normally teach this course:**

(append information about their competency to teach the course)

Zhaosong Lu, Abraham Punnen, Tamon Stephen

**Number of additional faculty members required in order to offer this course:** 0

**Additional space required in order to offer this course:** (append details) 0

**Additional specialized equipment required in order to offer this course:** (append details)  
0

**Additional Library resources required:** (append details) **Annually \$** 0 **One-time \$** 0

If additional resources are required to offer this course, the department proposing the course should be prepared to provide information on the source(s) of those additional resources.

Upon approval of the course proposal, the Dean of Graduate Studies office will consult with the department or school regarding other course attributes that may be required to enable the proper entry of the new course in the student record system.

# Course Outline

|                                  |                                                                                                                                                                                                                                                                                                                          |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Title:</b>             | MATH 808 - 4 Advanced Linear Programming                                                                                                                                                                                                                                                                                 |
| <b>Section:</b>                  | G100                                                                                                                                                                                                                                                                                                                     |
| <b>Term:</b>                     | TBD                                                                                                                                                                                                                                                                                                                      |
| <b>Instructor:</b>               | Possible Instructors: Zhaosong Lu, Abraham Punnen, Tamon Stephen<br>Surrey Campus                                                                                                                                                                                                                                        |
| <b>Description Topics:</b>       | Convex geometry, the simplex method and duality, pivot rules, degeneracy, decomposition and column generation methods, the complexity of linear programming and the ellipsoid algorithm, interior point methods for linear programming.                                                                                  |
| <b>Grading:</b>                  | TBD                                                                                                                                                                                                                                                                                                                      |
| <b>Required Texts:</b>           | Bertsimas and Tsitsiklis, Introduction to Linear Optimization, Athena Scientific (2007) or Schrijver, Theory of Linear and Integer Programming, Wiley (1998)                                                                                                                                                             |
| <b>Recommended Texts:</b>        |                                                                                                                                                                                                                                                                                                                          |
| <b>Materials/Supplies:</b>       |                                                                                                                                                                                                                                                                                                                          |
| <b>Prerequisite/Corequisite:</b> | N/A                                                                                                                                                                                                                                                                                                                      |
| <b>Notes:</b>                    | THE INSTRUCTOR RESERVES THE RIGHT TO CHANGE ANY OF THE ABOVE INFORMATION.<br>Students should be aware that they have certain rights to confidentiality concerning the return of course papers and the posting of marks. Please pay careful attention to the options discussed in class at the beginning of the semester. |

SIMON FRASER UNIVERSITY

NEW GRADUATE COURSE PROPOSAL FORM

*When a department proposes a new course it must first be sent to the chairs of each faculty graduate program committee where there might be an overlap in course content. The chairs will indicate that overlap concerns have been dealt with by signing the appropriate space or via a separate memo or e-mail (attach). The new course proposal must also be sent to the Library for a report.*

*Once overlap concerns have been dealt with, signatures indicate approval by the department, home faculty and Senate Graduate Studies Committee.*

Department or School: Mathematics

Proposed course number and title: Math 888-0 Ph.D. Comprehensive Examination: Operations Research

Other Faculties:

*Other Faculties approval indicates that the Dean(s) or designate of other Faculties affected by the proposed new course support(s) the approval of the new course.*

|                       |                 |            |
|-----------------------|-----------------|------------|
| Name of Faculty _____ | Signature _____ | Date _____ |
| Name of Faculty _____ | Signature _____ | Date _____ |
| Name of Faculty _____ | Signature _____ | Date _____ |
| Name of Faculty _____ | Signature _____ | Date _____ |
| Name of Faculty _____ | Signature _____ | Date _____ |

Departmental approval (non-departmentalized faculties need not sign)

Department Graduate Program Committee

Signature [Signature] Date June 21, 2011

Department Chair

Signature [Signature] Date 22 June 2011

Faculty approval

*Faculty approval indicates that all the necessary course content and overlap concerns have been resolved, and that the Faculty/Department commits to providing the required Library funds and any other necessary resources*

Faculty Graduate Program Committee

Signature [Signature] Date July 18/11

SGSC approval

Signature [Signature] Date Oct 4/2011

*SGSC approval indicates that the Library report has been seen, and all resource issues dealt with. Once approved, new course proposals are sent to Senate for information.*

## NEW GRADUATE COURSE PROPOSAL FORM

**Subject:** Mathematics (max. 4 chars) **Catalog Number:** 888

**Course Title:** Ph.D. Comprehensive Exam: Operations Research (max. 80 char.)

**Short Title** (appears on transcripts etc.) Ph.D. Comp. Exam: OR (max. 25 char.)

**Course Description for Calendar:** (append a course outline as a separate document)

A written examination covering a broad range of senior undergraduate and graduate mathematical material commonly used in Operations Research.

**Units:** 0

**Available Course Components:** (select all that apply)

☐ Lecture

☐ Seminar

☐ Laboratory

☐ Practicum

**Prerequisites:** (if any)

N/A

**Campus at which course will be offered:** Surrey

**Estimated Enrolment:** 5 **The term course will first be offered:** Fall 2012

**Frequency of course offering:** as needed

**Grading Basis:** ☐ Graded ☒ Satisfactory/Unsatisfactory ☐ In Progress/Complete

**Justification:**

The newly proposed OR Program will have its own OR-focused Ph.D. Comprehensive Exam, different from that of the MATH Program.

**Resources:**

**Faculty member(s) who will normally teach this course:**

(append information about their competency to teach the course)

Zhaosong Lu, Abraham Punnen, Tamon Stephen

**Number of additional faculty members required in order to offer this course:** 0

**Additional space required in order to offer this course:** (append details) 0

**Additional specialized equipment required in order to offer this course:** (append details)

0

**Additional Library resources required:** (append details) **Annually \$** 0 **One-time \$** 0

*If additional resources are required to offer this course, the department proposing the course should be prepared to provide information on the source(s) of those additional resources.*

*Upon approval of the course proposal, the Dean of Graduate Studies office will consult with the department or school regarding other course attributes that may be required to enable the proper entry of the new course in the student record system.*

SFU Connect

mathgsec@sfu.ca

± Font Size -

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## Fwd: Mathematics New Courses for Library Assessment

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**From :** Leslie Rimmer <lrimmer@sfu.ca>

Thu, Jun 30, 2011 11:42 AM

**Subject :** Fwd: Mathematics New Courses for Library Assessment 3 attachments**To :** Diane Pogue <mathgsec@sfu.ca>**Cc :** Natalie Gick <ngick@sfu.ca>, Annie Jensen <anniej@sfu.ca>, Gwen Bird <gbird@sfu.ca>

Dear Diane,

I have reviewed the course proposals and outlines you sent, and have determined that the library will be able to support these courses with no additional resources from the department. I have therefore added them to the list at <http://www.lib.sfu.ca/collections/course-assessments> to indicate library sign off, as they move through the approval process.

We will likely need to increase our acquisitions in support of Math at the Surrey Library, but we can accommodate this within the existing budget for Math and Surrey.

Best regards,  
Leslie

----- Original Message -----

----- Forwarded Message -----

From: "Diane Pogue" &lt;mathgsec@sfu.ca&gt;

To: gbird@sfu.ca

Sent: Wednesday, June 22, 2011 1:54:04 PM

Subject: Mathematics New Courses for Library Assessment

Hi Gwen,

Please find attached three New Graduate Course Proposal Forms and Outlines for Math 804-4, Math 808-4 and Math 888-0, that are ready for Library Assessment . These three courses will be offered at the Surrey Campus.

The Department of Mathematics is proposing to add an Operations Research stream to the current Mathematics Graduate Program at SFU as part of SFU's expansion into Surrey. Currently there are two streams, Applied and Computational Mathematics (APMA) and Mathematics. Each consists of a set of requirements that lead to the M.Sc. or Ph.D. degrees in Mathematics.

The next Faculty Curriculum Committee Meeting is scheduled for the beginning of July. (~July 5th).

Please contact me when the assessment has been completed or if you require further information.

Thank you,

Diane Pogue  
Graduate Secretary  
Department of Mathematics  
Phone: 778-782-3059  
Fax: 778-782-4947

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Gwen Bird  
Associate University Librarian, Collections Services

Simon Fraser University  
Burnaby, BC V5A 1S6  
ph: 778.782.3263 | fax: 778.782.3023

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Leslie Rimmer  
Collections Librarian  
Liaison Librarian for Biological Sciences

WAC Bennett Library  
Simon Fraser University  
8888 University Drive  
Burnaby, B.C. V5A 1S6 Canada

Email: [lsrimmer@sfu.ca](mailto:lsrimmer@sfu.ca) / Tel: 778-782-4962 / Fax: 778-782-3023  
\*\*I am on campus Tuesdays through Thursdays and alternate Fridays\*\*



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476 KB



**M808Scan.pdf**  
486 KB



**M888Scan.pdf**  
389 KB

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11  
Helleen Toohey

SFU

**TO:** Associate Deans – Arts & Social  
Sciences, Applied Sciences,  
Education, Health, Environment,  
Business Administration,  
Communication, Art & Technology

**FROM:** D. Bingham, Chair  
Faculty of Science Graduate  
Studies Committee

**RE:** New Courses – MATH 808,  
MATH 804 and MATH 888

**DATE:** July 11, 2011

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Please check the enclosed new courses for overlap and/or any other difficulties.

Please indicate your comments, on the cover memo, and return it to Rosemary Hotell  
through campus mail, or by e-mail to [hotell@sfu.ca](mailto:hotell@sfu.ca).

Thanks.

problems  
Helleen Toohey



Craig Jones 12

SFU

**TO:** Associate Deans – Arts & Social  
Sciences, Applied Sciences,  
Education, Health, Environment,  
Business Administration,  
Communication, Art & Technology

**FROM:** D. Bingham, Chair  
Faculty of Science Graduate  
Studies Committee

**RE:** New Courses – MATH 808,  
MATH 804 and MATH 888

**DATE:** July 11, 2011

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Please check the enclosed new courses for overlap and/or any other difficulties.

Please indicate your comments, on the cover memo, and return it to Rosemary Hotell  
through campus mail, or by e-mail to [hotell@sfu.ca](mailto:hotell@sfu.ca).

Thanks.

No concerns,  
Craig Jones  
Faculty of Health Sciences