S.23-150

SFU GRADUATE STUDIES

Simon Fraser University
Maggie Benston Centre 1100
8888 University Drive
Burnaby, BC V5A 1S6

TEL 778.782.3042
FAX 778.782.3080

gradstudies@sfu.ca
www.sfu.ca/grad

MEMORANDUM

ATTENTION Senate

DATE **November 16, 2023**

FROM Mary O'Brien,
Chair of Senate Graduate Studies Committee (SGSC)

RE: New Courses

For information: At its meetings on November 7th, 2023, the SGSC approved the following New Courses, effective **SUMMER 2024**:

Faculty of Science
Department of Mathematics
New Courses:
MATH 768 Topics in Biomathematics
MATH 769 Topics in Graphs and Trees in Biomathematics

SFU

MEMO

Faculty of Science

ATTENTION: Senate Graduate Studies Committee

FROM: Vance Williams, Associate Dean Graduate Studies, Faculty of Science

RE: Proposed Course Changes and Additions from Faculty of Science

DATE: August 9, 2023

Dear SGSC,

The following curriculum changes have been approved by the Faculty of Science and are being submitted to the Senate Graduate Studies committee for approval.

~~The following *course deletion* has been proposed~~:
~~**CHEM 864** Quantum Chemistry~~

~~The following *course change* has been proposed~~:
~~**PHYS 846** Nonlinear Physics~~

The following *new courses* are being proposed:
MATH 768 Topics in Biomathematics
MATH 769 Topics in Graphs and Trees in Biomathematics

Enclosed are the documents in support of these changes.

Sincerely,

Vance Williams
Associate Dean Graduate Studies, Faculty of Science

To: Dr. Vance Williams, Associate Dean, Graduate Studies, Faculty of Science, SFU
From: Dr. Ben Adcock, Professor & Graduate Chair, Department of Mathematics, SFU
Re: New courses MATH 768, MATH 769
Date: July 31, 2023

The following new courses have been approved by the Department of Mathematics and are forwarded to the Faculty of Science for approval. These curriculum items should be effective for Summer 2024. Please include them on the next SGSC agenda.

Both courses are cross-listed with corresponding undergraduate courses (MATH 468, MATH 469) that already exist in SFU Calendar. Extra requirements for students registered in the proposed graduate courses are listed in the forms.

Department of Mathematics

New courses: MATH 468, MATH 469

Dr. Ben Adcock

SFU GRADUATE AND POSTDOCTORAL STUDIES

New Graduate Course Proposal

Course Subject (eg. PSYC) Math	Number (eg. 810) 768	Units (eg. 4) 3

Course title (max. 100 characters)
Topics in Biomathematics

Short title (for enrollment/transcript - max. 30 characters) Topics in Biomathematics

Course description for SFU Calendar (course descriptions should be brief and should never begin with phrases such as "This course will..." or "The purpose of this course is..." If the grading basis is satisfactory/unsatisfactory include this in the description - max. 50 words)
Advanced methods and applications of mathematical models in biology, focusing on understanding, analyzing, and applying scientific literature using models and integrating real data. Topics may include parameter estimation in biological models, stochastic simulation of disease outbreaks, age structured population models, and others. Course may be repeated for credit under different topic.

Rationale for introduction of this course
In the past four years the math department has significantly expanded the biomathematics faculty. New graduate courses in this sub-field are necessary to support the accompanying expansion of graduate students in this area.

Term of initial offering (eg. Fall 2019) Summer 2024	Course delivery (eg. 3 hrs/week for 13 weeks) 3 hours/week for 13 weeks
Frequency of offerings/year once every two years	Estimated enrollment per offering 5-10

Equivalent courses (courses that replicates the content of this course to such an extent that students should not receive credit for both courses) Students with credit for MATH 468 may not take this course for further credit

Prerequisite and/or Corequisite None

Criminal record check required? ☐ Yes if yes is selected, add this as prerequisite

Additional course fees? ☐ Yes ☑ No

Campus where course will be taught ☑ Burnaby ☐ Surrey ☐ Vancouver ☐ Great Northern Way ☐ Off campus

Course Components * ☑ Lecture ☐ Seminar ☐ Lab ☐ Independent ☐ Capstone ☐ _____

Grading Basis ☑ Letter grades ☐ Satisfactory/ Unsatisfactory ☐ In Progress / Complete

Repeat for credit? ☐ Yes ☑ No	Total repeats allowed? NA	Repeat within a term? ☐ Yes ☑ No
Required course? ☐ Yes ☑ No	Final exam required? ☐ Yes ☑ No	Capstone course? ☐ Yes ☑ No

Combined with a undergrad course? ☑ Yes ☐ No If yes, identify which undergraduate course and the additional course requirements for graduate students: Math 468. Students will complete additional coursework, which may include a combination of additional homework problems, a project or extra exam questions.

* See important definitions on the curriculum website.

RESOURCES

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

Faculty member(s) who will normally teach this course
Caroline Colijn, Paul Tupper, Cedric Chauve, Ailene MacPherson, Ben Ashby, Jessica Stockdale
Additional faculty members, space, and/or specialized equipment required in order to offer this course

CONTACT PERSON

Academic Unit / Program	Name (typically, Graduate Program Chair)	Email
Mathematics	Ben Adcock	ben_adcock@sfu.ca

ACADEMIC UNIT APPROVAL

A course outline must be included.

Non-departmentalized faculties need not sign –

Graduate Program Committee Ben Adcock	Signature	Date July 25, 2023
Department Chair Paul Tupper	Signature	Date July 25th, 2023

FACULTY APPROVAL

The course form and outline must be sent by FGSC to the chairs of each FGSC (fgsc-list@sfu.ca) to check for an overlap in content

Overlap check done? ☑ YES

This approval indicates that all the necessary course content and overlap concerns have been resolved. The Faculty/Academic Unit commits to providing the necessary resources.

Faculty Graduate Studies Committee Vance Williams	Signature	Date August 9, 2023

A library review will be conducted. If additional funds are necessary, DGS will contact the academic unit prior to SGSC.

SENATE GRADUATE STUDIES COMMITTEE APPROVAL

Senate Graduate Studies Committee Mary O'Brien	Signature	Date November 16, 2023

ADMINISTRATIVE SECTION (for DGS office only)

Library Check: _____
Course Attribute: _____
Course Attribute Value: _____
Instruction Mode: _____
Attendance Type: _____

If different from regular units:
Academic Progress Units: _____
Financial Aid Progress Units: _____

Department of Mathematics, Simon Fraser University

Math 768: Topics in Biomathematics

Grading Scheme:
Assignments 30%, Midterm 20%, Presentation 10%, and Final Project 40%.

Calendar Description:
A survey of contemporary methods and applications of mathematical models in biology, with a focus on how to build, analyze and interpret models. Students will learn and apply the recent scientific literature, and integrate real data. Course may be repeated for credit under different topics.

Course Details: Subject to change at the instructor's discretion. Topics may include:

- Biological preliminaries: introduction to models in epidemiology, ecology, and/or evolution
- Mathematical Preliminaries: Equilibrium and stability analyses, stochastic processes, likelihood inference
- Formulation and analysis of structured population models
- Parameter estimation in biological models
- Stochastic simulation of disease outbreaks, population dynamics, and/or genetic diversity.
- Models for forecasting and prediction

Texts:

Optional: Keeling and Rohani 2008 (ISBN: 978-1-40-084103-5), Diekmann, Hesterbeck, & Britton 2013 (ISBN: 978-0-69-115539-5), Otto and Day 2007 (ISBN: 978-0-69-112344-8), Kot 2001 (ISBN: 978-0-52-180213-0)

Topics in Biomathematics

MATH 468/768

Instructor Info

Ailene MacPherson

Office Hrs: Tu&Fr 12:30-1:30

SCK9523

ailenem@sfu.ca

Course Info

https://amacp.github.io/PopGen/

Math 360 or equiv

Math 346 or Stat 380 or equiv

MWF

12:30-1:20

Overview*

The natural world is inherently random. Describing, understanding, and predicting phenomena in Ecology, Evolution, and Epidemiology therefore requires the use of mathematical models that explicitly include this randomness. In this course we will cover methods and applications of probability, stochastic processes, and computer simulation to these three fields.

*This is for the Spring 2024 offering. Content may vary.

Course Objectives

- Mastery of the principals of probability and stochastic processes.
- Learn to develop and analyze probabilistic and stochastic models for applications in Ecology, Evolution, and Epidemiology.
- Use computational methods to simulate and analyze random events and processes in biology.
- Develop and sharpen your ability to formulate scientific questions and address those questions with mathematics.
- Gain skills in scientific writing, this involves the formulation and communication of perspectives and the expression scientific findings in a clear and concise manner.

Selected Texts

The following texts will be used in this course but are not required.

- Otto, Sarah P. & Day, Troy. *A Biologists Guide to Mathematical Modelling in Ecology and Evolution.* 2007.
- Durrett, Rick. *Essentials of Stochastic Processes.* 1999. ISBN: 0-387-98836-X
- Karlin, Samuel & Taylor, Howard. *A Second Course in Stochastic Processes.* 1981. ISBN 0-12-398650-8.

Grading Scheme

Component	Weight
Bi-Weekly Homework[1] x 6	30% (5% each)
Midterm[2]	20%
Presentation	10%
Final Project	40%

[1] 768 will include an additional challenge question
[2] 768 will include an additional take-home portion

SGSC19

Final Project

Length Requirement: 10pg max, ≥1 figure

Section	Description	Grade
Proposal[1]	A 1pg summary outlining proposed project.	15%
Title & Abstract	A short summary (200 word max) of the project that clearly states aims and focal conclusions.	5%
Intro.	Provides background, context, and motivation. Must include a thesis statement (e.g., "This works evaluates...").	20%
Methods[2] & Results	Summarize what methods you used. Why are these methods were appropriate. Explain what you found.	30%
Discussion	What are the implications of what you found? What are the limitations of your work?	15%
Figure	Figure(s)/tables(s) that support(s) the content of the methods or results	10%
References[3]	Reference list of additional literature	5%

[1] 768 proposal must include 3 references
[2] 768 required to have an appendix with a key derivation
[3] 468(768) required to have at least 1(5) references.

Diversity and Inclusivity Statement

In this course you will treat others and be treated with respect. We welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, orientations, national origins, abilities, and other visible and non-visible differences. All members of this course are expected to contribute respectfully and in return each contribution will be appreciated and treated with respect.

Academic Integrity

"All members of the university are expected to uphold the values of academic integrity: honesty, trust, fairness, respect, responsibility, and courage. SFU considers any act of falsification, misrepresentation or deception to be destructive because it is unfair to students who pursue their studies honestly, it compromises the worth of other's work, and ultimately prevents students from meaningfully reaching their own scholarly potential.

Being an SFU student means you belong to a scholarly community where you will develop the critical thinking and research skills to not only be job ready but life ready. The satisfaction of a degree earned through hard work and persistence is a prize that is profoundly meaningful and universally respected." `https://www.sfu.ca/students/academicintegrity.html`

Class Schedule

Week	Topic	Assignments etc.
Week 1-2	Probability	HW 1
Week 3-4	Discrete-time Discrete-space Markov Chains	HW 2
Week 5	Poisson Processes	HW3 & Midterm
Week 6-7	Continuous-time Discrete-space Markov Chains	HW 4
Week 8	Stochastic Differential Equs.	Proposal[1]
Week 9	Individual (Agent)-Based Simulations	HW 5
Week 10-11	Model Fitting	HW 6
Week 12-13	Presentation & Writing Workshop	

[1] Project proposal due (1pg)

SFU GRADUATE AND POSTDOCTORAL STUDIES

New Graduate Course Proposal

Course Subject (eg. PSYC) Math	Number (eg. 810) 769	Units (eg. 4) 3

Course title (max. 100 characters)
Topics in Graphs and Trees in Biomathematics

Short title (for enrollment/transcript - max. 30 characters) Graphs and Trees in Biomath

Course description for SFU Calendar (course descriptions should be brief and should never begin with phrases such as "This course will..." or "The purpose of this course is..." If the grading basis is satisfactory/unsatisfactory include this in the description - max. 50 words)
A survey of contemporary methods and applications of discrete mathematical models focusing on graphs, networks, and trees in evolutionary biology, ecology, and epidemiology. Using discrete models and integrating real data, students will focus on understanding, analyzing, and applying recent scientific literature. Course may be repeated for credit under different topic.

Rationale for introduction of this course
In the past four years the math department has significantly expanded the biomathematics faculty. New graduate courses in this sub-field are necessary to support the accompanying expansion of graduate students in this area.

Term of initial offering (eg. Fall 2019) Summer 2024	Course delivery (eg. 3 hrs/week for 13 weeks) 3hrs/week for 13 weeks
Frequency of offerings/year Once every two years	Estimated enrollment per offering 5-10

Equivalent courses (courses that replicates the content of this course to such an extent that students should not receive credit for both courses) Students with credit for MATH 469 may not take this course for further credit

Prerequisite and/or Corequisite None

Criminal record check required? ☐ Yes if yes is selected, add this as prerequisite

Additional course fees? ☐ Yes ☑ No

Campus where course will be taught ☑ Burnaby ☐ Surrey ☐ Vancouver ☐ Great Northern Way ☐ Off campus

Course Components * ☑ Lecture ☐ Seminar ☐ Lab ☐ Independent ☐ Capstone ☐ _____

Grading Basis ☑ Letter grades ☐ Satisfactory/ Unsatisfactory ☐ In Progress / Complete

Repeat for credit? ☐ Yes ☑ No	Total repeats allowed? NA	Repeat within a term? ☐ Yes ☑ No
Required course? ☐ Yes ☑ No	Final exam required? ☐ Yes ☑ No	Capstone course? ☐ Yes ☑ No

Combined with a undergrad course? ☑ Yes ☐ No If yes, identify which undergraduate course and the additional course requirements for graduate students: Math 469. Students will complete additional coursework, which may include a combination of additional homework problems, a project or extra exam questions.

* See important definitions on the curriculum website.

RESOURCES

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

Faculty member(s) who will normally teach this course
Caroline Colijn, Paul Tupper, Cedric Chauve, Ailene MacPherson, Ben Ashby, Jessica Stockdale
Additional faculty members, space, and/or specialized equipment required in order to offer this course

CONTACT PERSON

Academic Unit / Program	Name (typically, Graduate Program Chair)	Email
Math	Ben Adcock	ben_adcock@sfu.ca

ACADEMIC UNIT APPROVAL

A course outline must be included.

Non-departmentalized faculties need not sign

Graduate Program Committee Ben Adcock	Signature	Date July 25, 2023
Department Chair Paul Tupper (acting chair for M. Trummer)	Signature	Date July 25th, 2023

FACULTY APPROVAL

The course form and outline must be sent by FGSC to the chairs of each FGSC (fgsc-list@sfu.ca) to check for an overlap in content

Overlap check done? ☑ YES

This approval indicates that all the necessary course content and overlap concerns have been resolved. The Faculty/Academic Unit commits to providing the necessary resources.

Faculty Graduate Studies Committee	Signature	Date
Vance Williams		August 9, 2023

A library review will be conducted. If additional funds are necessary, DGS will contact the academic unit prior to SGSC.

SENATE GRADUATE STUDIES COMMITTEE APPROVAL

Senate Graduate Studies Committee	Signature	Date
Mary O'Brien		November 16, 2023

ADMINISTRATIVE SECTION (for DGS office only)
Library Check: _____
Course Attribute: _____
Course Attribute Value: _____
Instruction Mode: _____
Attendance Type: _____

If different from regular units:
Academic Progress Units: _____
Financial Aid Progress Units: _____

Department of Mathematics, Simon Fraser University

Math 769: Topics in Graphs and Trees in Biomathematics

Grading Scheme:
Assignments 30%, Midterm 20%, Presentation 10%, and Final Project 40%.

Calendar Description:
A survey of contemporary methods and applications of discrete mathematical models focusing on graphs, networks, and trees in evolutionary biology, ecology, and epidemiology. Using discrete models and integrating real data, students will focus on understanding, analyzing, and applying recent scientific literature. Course may be repeated for credit under different topics.

Course Details: Subject to change at the instructor's discretion. Topics may include:

- Mathematical preliminaries: probability, stochastic processes, and graph theory.
- Biological preliminaries: Population genetics, Phylogenetics, and Epidemiology
- Disease transmission networks: pair-approximations, simulation of transmission, and analysis.
- Coalescent theory: population genetic derivation, probability distributions of coalescent times and accompanying genomic statistics, simulation, and ancestral recombination graphs
- Phylogenetics: trait simulation, comparative analysis, diversification analysis, application of phylogenetic trees to macro-evolution and epidemiology, and phylogenetic networks

Texts:

Optional: Robeva 2015 (ISBN: 978-0-12-801213-0), Wakeley 2008 (ISBN: 978-0-97-470775-4)

Graphs & Trees in Biology

MATH 469/769

Instructor Info

TBD

Office Hrs: TBD

NA

TBD

Course Info

TBD

MACM 201

R/Python/Etc. Coding

MWF

TBD

Overview*

From genetics to epidemiology, biological processes and data often create, are visualized, and analyzed in the form of mathematical graphs. Examples include disease transmission networks, phylogenetic trees, and genome and pangenome graphs. This course will introduce the principals of graph theory and discrete mathematics central to applications in biology.

*This is a tentative syllabus, content may vary.

Course Objectives

- Learn to represent and analyze biological data with graph structures and graph algorithms.
- Use computational methods to simulate biological processes on graphs.
- Develop and sharpen the ability to formulate scientific questions and address those questions with discrete mathematics.
- Gain skills in scientific writing. This involves the formulation and communication of perspectives and the expression scientific findings in a clear and concise manner.

Selected Texts

The following texts will be used in this course but are not required.

- Robeva, Rena. *Algebraic and Discrete Mathematical Methods for Modern Biology* 2015. ISBN: 978-0-12-801213-0
- Wakeley, John. *Coalescent Thoery.* 2006. ISBN: 978–0-9747977-5-4

Grading Scheme

Component	Weight
Bi-Weekly Homework[1] x 6	30% (5% each)
Midterm[2]	20%
Presentation	10%
Final Project	40%

[1] 769 will include an additional challenge question
[2] 769 will include an additional take-home portion

SGSC25

Final Project

Length Requirement: 10pg max, ≥1 figure

Section	Description	Grade
Proposal[1]	A 1pg summary outlining proposed project.	15%
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[3] 469(769) required to have at least 1(5) references.

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Class Schedule

Week	Topic	Assignments etc.
Week 1-2	Intro. to Graph Theory	HW 1
Week 3-4	Food Webs	HW 2
Week 5-6	Genome Graphs	HW3 & Midterm
Week 7-8	Transmission Networks	HW 4
Week 8-9	Phylogenies	Proposal[1], HW 5
Week 10-11	Coalescent Genealogies	HW 6
Week 12-13	Presentations & Writing Workshop	

[1] Project proposal due (1pg)