



**Faculty of Science**

Office of the Dean  
St. John's, NL Canada A1B 3X7  
Tel: 709 864 8154 Fax: 709 864 3316  
deansci@mun.ca [www.mun.ca/science](http://www.mun.ca/science)

**MEETING OF THE FACULTY COUNCIL OF THE FACULTY OF SCIENCE**

A regular meeting of the Faculty Council of the Faculty of Science will be held on Wednesday, May 20, 2020, at 1:00 p.m. by Webex.

**AGENDA**

- 1. Regrets**
- 2. Adoption of the Minutes of April 15, 2020**
- 3. Business Arising from the Minutes**
- 4. Correspondence: None**
- 5. Reports of Standing Committees:**
  - A. Undergraduate Studies Committee:**
    - a.** Department of Biology, BIOL 4914, Special Topics in Marine Mammal Acoustics, approved by the committee and presented to Faculty Council for information only (Paper 5.A.a., pages 6-9)
    - b.** Department of Biology, BIOL 4915, Special Topics in Social Insects, approved by the committee and presented to Faculty Council for information only (Paper 5.A.b., pages 10-15)
  - B. Graduate Studies Committee:**
    - a.** Departments of Mathematics and Statistics and Physics and Physical Oceanography, cross-listed course MATH 6252/PHYS 6852, Quantum Information and Computing, (Paper 5.B.a., pages 16-19)
  - C. Library Committee: No business**
- 6. Reports of Delegates from Other Councils**
- 7. Report of the Dean**
- 8. Question Period**
- 9. Adjournment**

A handwritten signature in black ink, appearing to read "Travis Fridgen".

Travis Fridgen, Ph.D.  
Acting Dean of Science



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**FACULTY OF SCIENCE  
FACULTY COUNCIL OF SCIENCE  
MINUTES OF MEETING OF APRIL 15, 2020**

A meeting of the Faculty Council of the Faculty of Science was held on Wednesday, April 15, 2020, at 1:00 p.m. using Bluejeans.

**FSC 2738 Present**

**Biochemistry**

M. Berry, R. Bertolo, J. Brunton, S. Harding, M. Mulligan

**Biology**

T. Chapman, S. Dufour, E. Edinger

**Chemistry**

C. Bottaro

**Computer Science**

S. Bungay, Y. Chen

**Earth Sciences**

G. Layne

**Mathematics & Statistics**

R. Haynes, J. Loredano-Osti, S. Mantyka, D. Pike, S. Sullivan, A. Variyath

**Ocean Sciences**

A. Bates, G. Fletcher

**Physics & Physical Oceanography**

S. Curnoe, M. Evstigneev, J. Lagowski, M. Morrow, M. Munroe

**Psychology**

D. Hallett, W. Montevecchi, C. Thorpe, C. Walsh, D. Wilson

**Dean of Science Office**

M. Abrahams, C. Barrett, K. Foss, T. Fridgen, G. Jackson, T. Mackenzie, L. Zedel

**Staff**

C. Deacon, J. Friesen, C. Hyde, B. Power

## **Graduate Students**

A. Alfosool, W. Mao

**FSC 2739**

### **Regrets**

K. Fowler, K. Poduska

**FSC 2740**

### **Adoption of Minutes**

**Moved:** Minutes of the meeting of February 19, 2020, meeting be adopted (Berry/Sullivan). **Carried.**

**FSC 2741**

**Business Arising:** None

**FSC 2742**

**Correspondence:** None

**FSC 2743**

### **Reports of Standing Committees:**

The Graduate Committee presented prior to the Undergraduate Committee.

#### **A. Undergraduate Studies Committee:**

- a) Shannon Sullivan presented a change to the Dean's list criteria, specifically regarding eligibility of work-term students. **(Sullivan/Munroe). Carried.**

Shannon Sullivan presented a second change to the Dean's list criteria for the 2019/20 academic year as a result of the current Public Health Advisory regarding the COVID-19 pandemic and students being awarded a PAS/FAL grade in lieu of a numerical grade. This year a stipulation will be added that students will be eligible for the Dean's List if they have no more than two PAS grades. **(Sullivan/Munroe). One abstention. Carried**

- b) Departments of Ocean Sciences and Biology, OCSC 4922/BIOL 4922, Special Topics in Marine Diversity, approved by the committee and presented to Faculty Council for information only.

#### **B. Graduate Studies Committee:**

Department of Physics and Physical Oceanography, special topics course PHYS 6818, Quantum Field Theory, approved by the committee and presented to Faculty Council for information only.

#### **C. Nominating Committee:** None

#### **D. Library Committee:** None

**FSC 2744**

### **Report of the Dean**

Presented by Mark Abrahams, Dean

1. As you know, this will be my last Science council meeting for some time. I will be moving over to the Provost's office and I greatly appreciate Dr. Travis Fridgen serving as the interim Dean of Science in my absence.
2. The only issue that I have been dealing with since our last Science council is the pandemic. As you know, the university had to make big decisions in a very short period of time, and I want to let you all know how incredibly proud I have been of the Faculty of Science. Faculty, staff, and students have all risen to the challenge. In very short order, you all modified your teaching to accommodate remote learning. Individuals in the Faculty of Science have ensured that unused PPE is made available to Regional Health Authorities. Faculty in Mathematics and Statistics and Computer Science have provided their expertise to Eastern Health to model the local dynamics of this pandemic to determine if and when demand on hospitals may exceed capacity. Molecular geneticists have made their expertise and reagents available to boost the province's testing capacity. I have no doubt that there are many other contributions of which I am not aware.
3. Next week the university will be implementing further restrictions to access campus with different designations for different buildings. All faculty should be able to get access to their office or laboratory, but you will require permission to do so. The reason for doing so is to further ensure the health and safety of the university community, including those that are required to come on campus because their work is considered critical. Once again, I appreciate your cooperation with this. If there are significant problems with this system, please let me know.
4. We would all like to know when we will return to more normal operations and at this point nobody knows. What we do know is that social distancing has been very effective in limiting the spread of Covid-19 so the current situation will likely persist for some time. We hope that by September, we may be able to return to normal operations, but I don't think that is something we can count on. For that reason, we do need to think about how we offer our curriculum in September and the challenge of delivering our laboratories. I am asking department heads to consult with their colleagues nationally and internationally for ideas that they are developing.

## **FSC 2745 Question Period**

Due to COVID-19, it is a good assumption that field work will be prohibited for this summer, but all decisions will be made following advice from the public health authority. If you need to apply for permits, you can do so and the worst case will be that the permits are not used.

A memo will be distributed regarding access to campus. Entry to the Chemistry/Physics building will be not as restrictive as that for other buildings, but those details will be released soon.

We should plan to not be on campus for the Fall semester for now. It may be that only faculty and staff are on campus, but whatever form that return takes, we will not be permitted to have large numbers of students in any classrooms. CITL and ITS are looking

at systems currently being used for course delivery. We also have Webex that can facilitate larger meetings.

**FSC 2746**

**Adjournment**

The meeting adjourned at 1:57p.m.



**Office of the Registrar**

St. John's, NL Canada A1C 5S7  
Tel: 709 864 8260 Fax: 709 864 2337  
[www.mun.ca](http://www.mun.ca)

May 12, 2020

TO: All Members of Faculty Council, Faculty of Science

FROM: Tracey Edmunds, Secretary, Committee on Undergraduate Studies  
Faculty of Science

SUBJECT: **Proposals for Calendar Changes**

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An email poll meeting held on April 17, 2020, the Faculty of Science Committee on Undergraduate Studies approved proposals for two New Special Topics Course from the Department of Biology, and agreed that the following items should be forwarded to Faculty Council for information:

**1. Department of Biology**

- (a) Proposal for a New Special Topics Course: Biology 4914 - Special Topics in Marine Mammal Acoustics
- (b) Proposal for a New Special Topics Course: Biology 4915 - Special Topics in Social Insects

*Tracey Edmunds*

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Tracey Edmunds

# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Cover Page

## LIST OF CHANGES

Indicate the Calendar change(s) being proposed by checking and completing as appropriate:

- New course(s): BIOL 4914 Special Topics in Marine Mammal Acoustics
- Amended or deleted course(s):
- New program(s):
- Amended or deleted program(s):
- New, amended or deleted Glossary of Terms Used in the Calendar entries
- New, amended or deleted Admission/Readmission to the University (Undergraduate) regulations
- New, amended or deleted General Academic Regulations (Undergraduate)
- New, amended or deleted Faculty, School or Departmental regulations
- Other:

## ADMINISTRATIVE AUTHORIZATION

By signing below, you are confirming that the attached Calendar changes have obtained all necessary Faculty/School approvals, and that the costs, if any, associated with these changes can be met from within the existing budget allocation or authorized new funding for the appropriate academic unit.

Signature of Dean/Vice-President: \_\_\_\_\_

Date: \_\_\_\_\_

Date of approval by Faculty/Academic Council: \_\_\_\_\_

# **Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Senate Summary Page for Courses**

## **COURSE NUMBER AND TITLE**

Biology 4914 – Special Topics in Marine Mammal Acoustics

## **ABBREVIATED TITLE**

BIOL 4914 – Spec Top Marine Mamm Acou

## **RATIONALE**

The proposed course is designed to be offered in lieu of BIOL 4912 Biology of Marine Mammals, a 2-week intensive field course offered at the Bonne Bay Marine Station. While this course is being offered in response to the COVID-19 related suspension of on-campus course deliveries, the department will consider offering it in future semesters. The proposed course maintains selected content from BIOL 4912 and replaces field research projects and reports with group presentations and individual projects. It will be offered over the 6-week summer semester (June 29 to August 12 2020).

The pre-requisite for BIOL 4914 will be 30 credit hours in Biology courses. This pre-requisite is in line with the pre-requisite for BIOL 4912.

## **CALENDAR CHANGES**

NA

## **SECONDARY CALENDAR CHANGES**

NA

## **RESOURCE IMPLICATIONS**

This course will be taught by a per course instructor with expertise in marine mammal acoustics who has extensive teaching experience, and has participated in teaching BIOL 4912 Biology of Marine Mammals and BIOL 4630 Mammalogy in the past. There are no additional resource implications.



## **ADDITIONAL INFORMATION REQUIRED FOR NEW COURSE PROPOSALS**

### **Sample Course Outline and Method of Evaluation**

Department of Biology – BIOL 4914: Special Topics in Marine Mammal Acoustics

#### **Lecture Topics**

This course shall introduce students to the concepts of marine mammal acoustics and underwater sound. Topics will include marine mammal species and acoustic signatures, physiology and morphology of how marine mammals create sound, principals of underwater acoustics, methods and technologies used to measure and record bioacoustics and anthropogenic noise.

#### **Laboratory Topics**

Laboratory topics and activities shall include but are not limited to:

- Group presentations on the development and types of underwater technology used to record and monitor marine mammals
- An introduction to acoustic software and its function.
- Individual projects on a marine mammal species and their acoustic signatures
- Processing of acoustic data

#### **Proposed Evaluation Scheme**

Participation: 20%

Quizzes: 30%

Group Presentation: 20%

Individual Project: 30%

#### **Texts**

There is no assigned textbook for this course. Assigned readings will be posted on BrightSpace.

#### **Instructor:**

Ashley Noseworthy, MSc

President/CEO of Edgewise Environmental Ltd.

# Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Cover Page

## LIST OF CHANGES

Indicate the Calendar change(s) being proposed by checking and completing as appropriate:

- New course(s): BIOL 4915 Special Topics in Social Insects
- Amended or deleted course(s):
- New program(s):
- Amended or deleted program(s):
- New, amended or deleted Glossary of Terms Used in the Calendar entries
- New, amended or deleted Admission/Readmission to the University (Undergraduate) regulations
- New, amended or deleted General Academic Regulations (Undergraduate)
- New, amended or deleted Faculty, School or Departmental regulations
- Other:

## ADMINISTRATIVE AUTHORIZATION

By signing below, you are confirming that the attached Calendar changes have obtained all necessary Faculty/School approvals, and that the costs, if any, associated with these changes can be met from within the existing budget allocation or authorized new funding for the appropriate academic unit.

Signature of Dean/Vice-President: \_\_\_\_\_

Date: \_\_\_\_\_

Date of approval by Faculty/Academic Council: \_\_\_\_\_

# **Memorial University of Newfoundland Undergraduate Calendar Change Proposal Form Senate Summary Page for Courses**

## **COURSE NUMBER AND TITLE**

Biology 4915 – Special Topics in Social Insects

## **ABBREVIATED TITLE**

BIOL 4915 – Spec Top Social Insects

## **RATIONALE**

The proposed course is designed to be offer in lieu of the suspended field courses that were to be offered at the Bonne Bay Marine Station this summer. While this course is being offered during the Spring semester in response to the COVID-19 related suspension of on-campus course deliveries, the department will consider offering it in future semesters.

The pre-requisite for BIOL 4915 will be 30 credit hours in Biology courses.

## **CALENDAR CHANGES**

NA

## **SECONDARY CALENDAR CHANGES**

NA

## **RESOURCE IMPLICATIONS**

This course will be taught by a current faculty member with expertise in entomology. There are no resource implications.

## **ADDITIONAL INFORMATION REQUIRED FOR NEW COURSE PROPOSALS**

### **Sample Course Outline and Method of Evaluation**

Department of Biology – BIOL 4915: Special Topics in Social Insects

#### **Lecture Topics**

The evolution of cooperation between individuals represents an increase in biological complexity that rivals that of the emergence of multicellularity. Sociality exhibited by the insects is arguably more complex than that exhibited in our own societies. This course will explore the evolutionary challenge that social insects present to evolutionary theory. Various forms of social organization observed across insect taxa will be explored.

#### **Laboratory (seminar) Topics**

The lab section will consist of seminar presentations in which reviews of current scientific literature of social insects will be presented and discussed.

#### **Proposed Evaluation Scheme**

There will be seven written assignments, associated with the following topics:

- 1) insect morphology and diversity
- 2) variation in social organization
- 3) social evolution's challenge to evolutionary theory
- 4) potential solutions to challenge
- 5) form of social organization in thrips
- 6) form of social organization in honeybees
- 7) phenomenon of colony collapse in honey bees

A lecture and reading will be associated with each topic. Each topic will have a written assignment worth 10% (70% in aggregate) associated with it.

Students will present orally (via BrightSpace) a self study of a social insect group of their choosing. Presentations will be 20 minutes in length, followed by a 10 minute question period. The presentation evaluation by the course instructor will be worth 30%.

#### **Texts**

There is no assigned textbook for this course. Assigned readings will be posted on BrightSpace and/or will be accessible through Memorial online library offerings.

#### **Instructor:**

Dr. Tom Chapman

**From:** [Ambi, Alison](#)  
**To:** [jodyb@mun.ca](mailto:jodyb@mun.ca)  
**Cc:** [Alcock, Erin](#)  
**Subject:** RE: Urgent - Special Topics Course Review  
**Date:** Friday, April 17, 2020 2:58:20 PM

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Hello Jody,

The library's electronic resources will be adequate to support the proposed special topics biology courses (BIOL 4914 and BIOL 4915). In addition to a large collection of ebooks and online journals that can be discovered by searching our catalogue, we provide access to many relevant indexes and article databases (<https://www.library.mun.ca/researchtools/databases/DBSearchResults/?subhead=Biology>). I have cc'd the librarian responsible for Biology (Erin Alcock) and encourage the instructors to get in touch with her for expert recommendations on the best library resources available on these topics.

We would also like to remind the instructors that any materials added to Brightspace will require copyright clearance. Memorial University is now using the library's e-reserves system for copyright clearances for all course-related materials. To start this process instructors will need to submit their syllabus or list of required and/or recommended readings to:

Queen Elizabeth II Library - [qe2circ@mun.ca](mailto:qe2circ@mun.ca)

We will work to acquire permission for uses of material that are not already covered by an existing license, or that exceed Memorial University's Fair Dealing Requirements. We can also purchase items required for e-reserves that fall within our collection development policies.

Sincerely,  
Alison Ambi

Head, Collections Strategies  
Subject Librarian for Computer Science, Earth Sciences, Mathematics & Statistics, Physics,  
Psychology

QEII Library  
Memorial University of Newfoundland  
+1 709 864-7125  
[www.library.mun.ca](http://www.library.mun.ca)

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**From:** Cleyle, Susan <[scleyle@mun.ca](mailto:scleyle@mun.ca)>  
**Sent:** April 17, 2020 12:57 PM  
**To:** Ambi, Alison <[aambi@mun.ca](mailto:aambi@mun.ca)>  
**Cc:** Pitcher-March, Jackie <[jpmarch@mun.ca](mailto:jpmarch@mun.ca)>; Louise Mcgillis ([lmcgillis@grenfell.mun.ca](mailto:lmcgillis@grenfell.mun.ca)) <[lmcgillis@grenfell.mun.ca](mailto:lmcgillis@grenfell.mun.ca)>  
**Subject:** Fw: Urgent - Special Topics Course Review  
**Importance:** High

Alison, this must have slipped through the COVID cracks. Can you respond to Jody-Lynn

please? Thanks, Su

---

**From:** Jody-Lynn Burke  
**Sent:** Friday, April 17, 2020 12:33 PM  
**To:** Library Correspondence  
**Cc:** Cleyle, Susan  
**Subject:** FW: Urgent - Special Topics Course Review

Hello,

At Dr. Fridgen's advice, I'm resending the request for library to provide a report supporting these courses. As mentioned, no additional library resources will be needed.

We hope to have FoSUGS review in the next 24 hours.

**Jody Burke, BSc.(Hons), M.Ed, PGC(QM) – Academic Program Officer**

Department of Biology, Memorial University

Office: (709) 864 8021

E-mail: [jodyb@mun.ca](mailto:jodyb@mun.ca)



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**From:** Jody-Lynn Burke  
**Sent:** Thursday, April 16, 2020 11:41 AM  
**To:** Library Correspondence <[univlib@mun.ca](mailto:univlib@mun.ca)>  
**Subject:** Urgent - Special Topics Course Review  
**Importance:** High

Hello,

I hope everyone at the library is doing well during these unprecedented times.

In light of Covid-19, all Biology Bonne Bay Field courses have been cancelled. To help our students remain on track with their academic program, the department plans like to offer two Special Topics courses; Marine Mammal Acoustics (4914) and Social Insects (4915).

The proposals we intend to present to FoSUGS are attached. No additional library resources will be

required for either course.

Would it be possible for the library to provide a report supporting these courses?

Be well and stay safe!

**Jody Burke, BSc.(Hons), M.Ed, PGC(QM) – Academic Program Officer**

Department of Biology, Memorial University

Office: (709) 864 8021

E-mail: [jodyb@mun.ca](mailto:jodyb@mun.ca)



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## Request for Approval of a Graduate Course

School of Graduate Studies

*Adobe Reader, minimum version 8, is required to complete this form. Download the latest version: <http://get.adobe.com/reader>. (1) Save the form by clicking on the diskette icon on the upper left side of the screen; (2) Ensure that you are saving the file in PDF format; (3) Specify where you would like to save the file, e.g. Desktop; (4) Fill in the required data and save the file; (5) Submit the completed form to:*

School of Graduate Studies; Memorial University of Newfoundland; IIC-2012 (Bruneau Centre for Research and Innovation); St. John's, NL A1C 5S7 Canada Fax: 709.864.4702 eMail: [sgs@mun.ca](mailto:sgs@mun.ca)

To: Dean, School of Graduate Studies  
 From: Faculty/School/Department/Program  
 Subject:  Regular Course     Special/Selected Topics Course

Course No.: MATH 6252 / PHYS 6852

Course Title: Quantum Information and Computing

**I. To be completed for all requests:**

A. Course Type:     Lecture course                       Lecture course with laboratory  
                           Laboratory course                       Undergraduate course<sup>1</sup>  
                           Directed readings                       Other (please specify)

B. Can this course be offered by existing faculty?     Yes     No

C. Will this course require new funding (including payment of instructor, labs, equipment, etc.)?     Yes     No  
 If yes, please specify:

D. Will additional library resources be required (if yes, please contact [munul@mun.ca](mailto:munul@mun.ca) for a resource consultation)?     Yes     No

E. Credit hours for this course: 3

F. Course description (reading list required):  
 The course covers the essentials of quantum information and computing: postulates of quantum theory, quantum registers, entanglement, teleportation, gates, circuits, quantum Fourier transform, quantum algorithms, noise, decoherence, error correction, physical realizations of quantum computers

G. Method of evaluation:	Percentage	
	Written	Oral
Class tests	20	
Assignments	10	
Other (specify):		20 (20)
Final examination:	50	
<b>Total</b>		<b>100</b>

<sup>1</sup> Must specify the additional work at the graduate level



II. To be completed for special/selected topics course requests only

For special/selected topics courses, there is no evidence of:

Instructor's initials

- 1. duplication of thesis work
- 2. double credit
- 3. work that is a faculty research product
- 4. overlap with existing courses

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Recommended for offering in the                      Fall                      Winter                      Spring                      20\_\_

Length of session if less than a semester:

III. This course proposal has been prepared in accordance with General Regulations governing the School of Graduate Studies

Marco Merkli  
Marco Merkli

May 7, 2020

Course instructor

Date

*[Handwritten signature]*

Approval of the head of the academic unit

Date

May 7, 2020

IV. This course proposal was approved by the Faculty/School/Council

Secretary, Faculty/School/Council

Date

**Graduate Course Proposal**  
**Mathematics 6252 / Physics 6852**  
**Quantum Information and Computing**

**Rationale:** Quantum Information Science is an emerging and fast developing subject, connecting mathematics, theoretical and experimental physics and computer science. One of the main goals is to develop quantum computers, which exploit fundamental quantum properties of the microscopic world and are able to outperform dramatically our classical computers in terms of computing speed and complexity limitations. Early versions of quantum computers exist today and certain related products are available and used commercially, in particular in cryptography and key distribution systems. The impact of this new technology is hard to overestimate. It will revolutionize fields pushing the limits of currently available computer power, speed and security. We are in the midst of an intense research effort devoted to the theoretical, experimental and commercial realization of the technology worldwide. The government of Canada has identified Quantum Computing as a Focus Area in their research initiatives.

Memorial University has introduced an undergraduate course on Quantum Information and Computing four years ago (M4252/P4852). Graduate courses in this field are offered routinely at universities in Canada and worldwide. The course proposed here will allow *MUN graduate students* to be exposed to this very significant subject as well. The topic and the course have an interdisciplinary flavour, in the sense that they are accessible to students with mathematical or applied inclinations. According to feedback since the inception of the undergraduate course, many graduate students in both physics and mathematics are very interested in learning about quantum information and computation. With the new course, they would have a suitable venue to explore it.

**Goal of the course:** The students will learn the theoretical principles of quantum information and computing.

**Format of the course:** Regular lecture course with assignments, exams and a project.

**Potential Instructors:** M. Merkli (Math and Stats), S. Curnoe (Physics), J. LeBlanc (Physics)

**Potential texts:**

- M.A. Nielsen, I.L. Chuang: *Quantum Computation and Quantum Information*, Cambridge University Press 2000
- P. Kaye, R. Laflamme, M. Mosca: *An Introduction to Quantum Computing*, Oxford University Press 2007
- J. Watrous' lecture notes (U Waterloo)  
<https://cs.uwaterloo.ca/~watrous/LectureNotes.html>
- J. Preskill's lecture notes (Caltech)  
<http://www.theory.caltech.edu/people/preskill/ph229/>

**Evaluation:** Assignments 10%, midterm test 20%, final exam 50%, project 20%

**Instruction:** 2.5 hours per week

**Proposed Outline:**

*Course objectives.* The students will learn the mathematical setup of the principles of quantum information and quantum computing. They gain an understanding of the physical interpretation of the formalism and will be able to solve concrete theoretical problems in the field. In a project, they will explore in more detail a specific subtopic by reading research literature or some other more advanced text.

*Course content.* The course will begin with a discussion of the postulates of quantum mechanics, which are formulated mathematically using linear algebra. The postulates include the prescription of how to extract the physical content of the theory. We will illustrate this mechanism on the basic building blocks of quantum computing: qubits and qubit registers. Quantum gates will be introduced and it will be explained how they are combined to form quantum circuits. The circuit which implements the quantum Fourier transform will be analyzed. We will discuss quantum algorithms (*e.g.* Deutsch-Josza, Simon, Schor algorithms) and analyze the reasons why they are superior to classical algorithms (parallelism, entanglement). Noise effects will be discussed, including decoherence, and basic aspects of error correction will be explored. An overview of physical realizations of quantum computers will be presented (trapped ions, atoms in optical lattices, quantum dots).

*Instructional method.* Three 50-minute lectures per week, regular assignments during the term, midterm and final exam, plus a project to be delivered at the end of term.

*Course materials.* Textbook: M.A. Nielsen, I.L. Chuang: *Quantum Computation and Quantum Information*, Cambridge University Press 2000

*Course evaluation.* Assignments 10%, midterm test 20%, final exam 50%, project 20%

**Proposed Calendar description:**

**PHYS 6852 / MATH 6252 Quantum Information and Computing** covers mathematical formulation and physical interpretation of quantum theory, pure and mixed states, qubits and quantum registers, entanglement and teleportation, gates, circuits, quantum Fourier transform, quantum algorithms, noise and decoherence, basic error correction, physical realization of quantum computers.