Syllabus

SCIE 4701 & 4702: Science and Technology Innovation, Commercialization, and Entrepreneurship

Fall term, 2020

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Instructor

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Teaching Assistants

TBD

Course Logistical Support

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Contents:

Recognition of Mi'kmaq Territory

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit the Indigenous Student Centre or contact the programs at elders@dal.ca.

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness. For more information please see here.

Course Description

Capstone course providing an introduction to the processes and mindsets around innovation and commercialization of science and technology, including entrepreneurship. Experiential learning format; teams work to develop and pitch a viable business model for a scientific solution to a real-world problem. Complemented by lectures, case studies, and guest presentations.

Prerequisites

Registration is by permission of the instructor only. There are no specific prerequisite classes; however, undergraduates should have completed at least three full years (90 credit hours) of university study. As well, students are strongly encouraged to participate in workshops and weekend events offered by the SURGE Sandbox, or have other exposure to innovation and entrepreneurship, before committing to this full-year class. Because this class is based around team projects, it is valuable to have some exposure to the topics before committing to a full-year class. SCIE 4701 and SCIE 4702 must be taken in the same year, and a grade will be given for SCIE 4701 only after SCIE 4702 is completed.

Prospective students should email the instructor for permission. Admission decisions will be made by the instructor.

Background and Rationale

This class departs from traditional science training by emphasizing the processes of innovation and commercialization: identifying problems that represent real needs in society and/or the world, and creating novel solutions that not only work, but are supported by a viable business model. Students will develop an understanding of how to design solutions that meet a real need, and have the potential to be commercialized or otherwise make it into the hands of people who can benefit from the solutions.

Students will find that the core principles taught in the class can be applied in a wide range of scientific and technological applications. This class will provide a unique perspective and new skills that are not typically offered in undergraduate or graduate programs in science or engineering.

Learning Objectives

At the end of this course, you should be able to do the following:

Innovation & Entrepreneurship

- Understand and explain the differences between discovery-based research and commercialization/translation-focused research and development
- Identify real-world problems in need of innovative solutions
- Engage in processes including **human-centred design** and **customer discovery** (qualitative research) to define problems and identify a range of possible solutions
- Use the **Value Proposition Canvas** to test alignment between needs and solutions
- Use the **Business Model Canvas** (or related canvases such as the Mission Model Canvas) to develop, justify, and pitch a business model for an innovative solution to a real-world problem
- Constructively evaluate and critique business model canvasses developed by others
- Plan and develop **prototypes** over varying complexity levels, and articulate the value of prototyping in assessing the feasibility of a solution

- Explain technology readiness levels (TRL) and be able to assess products in terms of TRL
- Define and explain core principles of **intellectual property** and how it can be protected, including patents and trademarks in the Canadian, U.S., and other systems, and how intellectual property may be licensed
- Identify multiple options for funding commercial and not-for-profit ventures, and characterize these in terms of appropriate stages of enterprise growth, as well as benefits and costs of different options
- Explain roles and responsibilities of senior organizational leadership, and strategies for allocating rewards (compensation and ownership) to founders and executives
- Apply course material to analyze business cases

Soft Skills

- Stand up in front of strangers and present an idea clearly and concisely with or without visual aids
- Accept and respond constructively to criticism of your ideas in a public setting
- Conduct interviews with strangers to gain insight into a problem they experience, and how well a proposed solution addresses their needs
- Work productively in multidisciplinary teams
- Be effective and productive in a remote working environment

Class Format

This course uses an experiential, team-based format and relies heavily on a *flipped classroom* approach in which students assume responsibility for learning material (via readings and videos) and conducting activities outside of class time. Class time is then productively spent in discussing and interpreting content from the readings, presenting updates on project progress, and receiving feedback form other students and the instructor and mentors on these progress reports.

Online Learning Platforms

For 2020-21, this course is being run as a a synchronous **online course**, using Microsoft Teams. You will be added to the Teams site and notified of how to access it, prior to the start of the term. Although it is being run online, the nature of the experiential learning process, and team-based activities, requires that students all participate synchronously in real time during the scheduled class time. To minimize "Zoom fatigue", class times will be broken into relatively short and varied segments, with scheduled break times.

Course Structure and Outline

This pair of courses operates over two terms. Across both terms, students will build their understanding of the processes of innovation, commercialization, and entrepreneurship through team-based development of an innovative solution to a real problem, developing a business model for this innovation, and pitching their ideas to various audiences.

Fall Term (SCIE 4701)

The term starts with an overview of innovation and entrepreneurship, but the bulk of the term is focused on:

- Learning the processes of *design thinking* through experiential practice. This will involve a variety of in-class activities, as well as a multi-week team project, the design sprint.
- *Developing productive working relationships with classmates* through a variety of activities inside and outside of class time. It is important to get to know all of your classmates, and explore different working styles. Activities will "mix and match" students in small groups to facilitate this process.

- Learning about innovation and entrepreneurship through analysis of business *case studies*. Cases will be analyzed in class discussions in which everyone is expected to participate.

Winter Term (SCIE 4701)

The Winter term is devoted primarily to work on a single major project. These projects are conducted in teams, and involve engaging in *customer discovery* and *design thinking* to:

- identify, define, and validate a specific unmet need (problem)
- develop a range of possible solutions to this need
- select a candidate solution based on its suitability, viability, and desirability
- develop a business model to describe the process and viability of developing and implementing the proposed solution, using the business model canvas (or a related canvas, such as the social enterprise or mission model canvas)

The culmination of these efforts will be a final **lessons learned** presentation in which each team describes the process they went through, the conclusions they arrived at (in particular, whether their solution is ultimately feasible), and what they learned along the way.

Class time during the Winter term will be 50% devoted to teams presenting weekly updates on the development of their projects. The other half of class time will involve presentations by *guests from the innovation and entrepreneurship community*, and additional *case discussions*.

Workload

This is an intensive, honours-level course. Expectations are high. It may be the most demanding course you have ever taken, in its own ways. Unlike many lower-level courses, this course does not emphasize your ability to read, memorize, and regurgitate information. Instead, it focuses on higher-level skills like combining information from multiple sources (including prior courses, life experience, and self-directed reading and research), analyzing information, and applying this information to solve problems. Importantly, these problems do not have pre-defined answers that the instructor expects you to reproduce; rather, you are graded on your ability to understand and explain a problem, and design and defend a viable model to solve that problem.

Students have reported upwards of 10 hours of work each per week on this course, outside of class time. In addition to the required readings (and viewings), getting out of the classroom and collecting data — in the form of interviews and independent research — is an important part of the class in both terms. In the second term, and parts of the first term, teams are expected to have completed at least 5 in-person interviews each week (likely virtual) to better understand the problem.

Radical Candour

This class employs a method of giving feedback known as **radical candour**. This is a method of providing **direct, frank, and unapologetic feedback** to students, particularly during the weekly business model updates. The two principles of radical candour are **care personally** and **challenge directly**. The goal of radical candour is to improve the quality of your solutions and business model — and ultimately, your critical thinking abilities — through honest and constructive feedback.

Most people find radical candour unsettling at first, because it dispenses with norms of politeness, to the extent that these interfere with getting a point across clearly and effectively. With this said, radical candour is *not* intended to be aggressive or hurtful, or to criticize you as a person. If you have concerns about the feedback you are being given, please raise these with the instructor and/or TAs. Please also remember that radical candour is meant to work both ways — you should feel free to raise issues about the instructor(s) directly to them, in a way that is clear and direct but without criticizing them. The instructor and TAs will not penalize you for raising issues about your instruction.

This class pushes many people past their comfort zone. If receiving critiques that may feel abrupt and brusque in front of your peers — weekly — embarrasses you, you should be prepared to work through your discomfort. It's not personal, but it is by design a part of the class to emulate the pace, uncertainty, and pressures of a startup. In return, we also expect you to question us, challenge our point of view if you disagree, and engage in a real dialog with the teaching team.

Please note: *this is not intended to present a barrier to anyone on the basis of personality or background*. If you find the radical candour approach uncomfortable, but want to try it out anyway, then we will support you 100% and will be happy to talk with you privately or publicly about how to make it work for you.

Team work

Much of the work in this class, and correspondingly the assessments, is done in teams. The start of the Fall term will involved many short team activities in which team composition is determined by the instructor and varied each time. In this way, you will have the opportunity to work with all the other students in the class. As well, you will be rewarded for doing short, one-on-one virtual "meet and greets" with classmates, to help you get to know each other a little bit — since casual classroom interactions can't occur as naturally and spontaneously online. Through these activities you should be able to make informed decision when choosing teams for the Fall term design project, and the Winter term major project.

Although team work has its challenges, it is central to this class — including the learning outcomes, activities, and assessments — for important reasons. First and foremost, this course is focused on how to approach solving significant problems, and implementing those solutions through an *organization* — an entity larger than one person. Whether this organization is a startup, social enterprise, nonprofit, or a team inside a larger organization (such as a company or university), the scope of the work to be done is beyond the time and talents of any one individual. As such, making things happen depends on effective team work. This course will provide experience and insights in team work and organizations that will serve you well regardless of where your future takes you.

Course Materials

Required Readings

- Osterwalder, A. (2010). *Business model generation: A handbook for visionaries, game changers, and challengers*. John Wiley and Sons.
- Constable, G. (2014). *Talking to Humans*. Free ebook: https://www.talkingtohumans.com/
- Steve Blank's *How to Build a Startup* course on Udacity (free signup required)
- A course pack of case studies and readings from Harvard Business publishing (link will be provided to registered students)
- Additional material may be posted on the course web site and will be announced there.

Optional Readings

These are not required but students may find them useful in the context of the class, and certainly if they pursue the topics of this class in the future.

- Blank, S., & Dorf, B. (2012). *The startup owner's manual: The step-by-step guide for building a great company*. K & S Ranch.
- Ingle, B. R. (2013). *Introduction to design thinking*. doi:10.1007/978-1-4302-6182-7_1
- Keeley, L., Pikkel, R., Quinn, B., and Walters, H.. (2013). *Ten types of innovation: The discipline of building breakthroughs.* Hoboken, NJ: Wiley.
- Kelley, T. (2001). *The Art of Innovation: Lessons in creativity from IDEO, America's leading design firm*. New York.
- Maurya, A. (2012). *Running Lean*. Sebastapol, CA: O'Reilly Media.

- Osterwalder, A., Pigneuro, Y., Bernarda, G., and Smith, A., (2014). *Value Proposition Design*. Hoboken, NJ: Wiley.
- Ries, E. (2011). *The Lean Startup*. Crown Business.
- Wasserman, N. (2013). *The Founder's Dilemmas: Anticipating and Avoiding the Pitfalls That Can Sink a Startup*. Princeton University Press.
- Zenios, S., Makower, J., & Brinton, T. J. (2015). *Biodesign: The process of innovating medical technologies*, 2nd edition. Cambridge University Press.

Assessment and Evaluation

Evaluation of performance in this class is not based on how well you can memorize material. Rather, it is focused on how well you can apply the principles you learn in the lectures and workshops to a real-world problem. As well, you will be assessed on how well you are able to communicate your ideas orally, including your ability to defend decisions you have made and explain the processes by which you came to make critical decisions in designing your business model. You will also be evaluated on how effectively you work as part of a team. Grading is a combination of *formative assessments* - relatively low-value items whose purpose is to provide you with feedback and guidance in your learning — and *summative evaluation*, which are relatively high-value items used to evaluate the outcomes of your learning and work.

Grading

Grading will be according to the Dalhousie University standard grading scale. A grade will be given for SCIE 4701 only after SCIE 4702 is completed. However, a grade will be assigned separately for each class, based on performance in that term.

4701 (Fall term)

Component	% of final grade
Attendance	5
TA Meetings	10
Self-Assessments	10
Peer Assessment	10
Meet and Greets	5
Case Discussions	30
Design Sprint Project	30

4702 (Winter term)

Component	% of final grade
Attendance	5
TA Meetings	10
Self-Assessments	5

Component	% of final grade
Peer Assessment	10
Case Discussions	10
Guest Discussions	10
Weekly Update Presentations	25
Feedback on other Team Presentations	5
Final Lessons Learned Presentation	20

Details

Attendance

Attendance at all class meetings is mandatory. Attendance will be taken at the start of each class; if you log on after attendance is taken, you will get half points for attendance for that day. Your attendance grade will be calculated as the proportion of classes that you attended (e.g., if you attend 95% of class meetings you will get 95% of the possible attendance points). **If you are unable to attend all or part of a class**, please submit a Student Declaration of Absence (SDA) form to the instructor via a direct message on Teams. **You may submit up to 2 SDAs per term.**

TA Meetings

During team projects, each team will be assigned to a teaching assistant, and will be required to meet as a team with the TA once per week for approximately 30 min. These meetings allow your team to receive more personalized coaching and feedback, and allow you to progress in between classes. The TA will connect with you to schedule these meetings. Grades are assigned by the TA based on the presence, preparedness, and engagement of each team member, using the TA Team Meeting Rubric.

Self-Assessments

You will submit regular written assessments of your own learning progress over the term. Each should be 150-500 words in length. Grading is pass/fail based on submitting something appropriate to the questions, or not. **Late work will be penalized 2% per hour**, with the clock starting the minute after the deadline has elapsed. This is because self-assessments are only helpful if they're done regularly, and in this class they are timed to synch up with your work in other aspects of the course. The teaching team will review, and often comment, on your self-evaluations so they provide an opportunity for individualized coaching and feedback, if you choose to take this opportunity.

Peer Assessments

Effective teamwork depends on effective teams. The teaching team can only have limited insight into the inner workings of a team, based on what we see in class and TA meetings. Effective teams will likely perform well in public, but the contributions of individual members to that effort may not always be balanced. Peer assessments are a mechanism to identify and reward the differences between strong leadership, effective contribution, and poor or unhelpful performance. Peer assessments will be due at the end of the design sprint project in Fall term, and at the end of the Winter term major project (i.e., at the end of term). Evaluations will employ the Team Peer Review Rubric.

Meet and Greets

You will earn bonus points by participating in short (5-10 min) online one-on-one meetings with other class members. These are scheduled by students at your mutual convenience, and can take the form of a text-based chat or a video chat. The purpose of these is to allow for the kinds of casual interactions you might normally have with others in a face-to-face class, and allow you to get to know people as potential team members for projects. To protect everyone's safety, all students have the ability to block others anonymously, and may discontinue a meeting at any time without penalty. All students are expected to abide by Dalhousie University's Code of Student Conduct, and violations will be addressed through the procedures described there. Please report any inappropriate behaviour to the instructor immediately. You will be heard, and you will be respected.

Five meet 'n greets are required, but you are encouraged to do more. The required meet 'n greets should be completed by the end of the third week of the term. Grading is pass/fail, based on both participants in the meeting submitting a report that it occurred, via an online form.

Case Discussions

We will discuss a range of case studies focused on different topics relevant to the course. These serve both to teach material, and allow for analysis and synthesis of course content. Each student is expected to be able to make productive and substantive contributions to every discussion. It is recognized that not everyone is equally comfortable speaking in class, and the instructor(s) will call on or otherwise encourage those who seem to need it. Feel free to raise any concerns with the instructor about this. Grading will be based on the Case Discussion Rubric.

Guest Discussions

We will aim to bring in a guest from the entrepreneurship community approximately every 2 weeks. These guests will normally make a short presentation, followed by time for discussion. As with case discussions, students are expected to actively contribute to these discussions in every class. Grading will be based on the Guest Presenter Rubric.

Design Sprint Project

The major project for Fall term is a "design sprint". This is a structured process for developing and evaluating a novel solution to a problem over several weeks. This is completed in a team, and involves a number of in-class, facilitated activities, as well as work outside of class time. Outside of class, each team will be required to do a certain number of interviews with people whose problem your team is trying to solve. Each team will make a final presentation, which will be graded according to the Design Sprint Rubric.

Weekly Update Presentations

Winter term is primarily focused on a single-term long team project, building a business model around a proposed solution to a problem. Each week, students will engage in "customer discovery" interviews and focus on developing one cell of the business model canvas. Each class will begin with 10 minute update presentations from each team, followed by a question period that includes feedback from the teaching team. Each presentation will be graded according to the Weekly Update Rubric.

Feedback on Other Team Presentations

You are required to provide written feedback to other teams each week during their presentations in Winter term. The mechanism for doing this will be described in class.

Lessons Learned Presentation

At the end of the Winter term, each team will describe their final business model and summarize the lessons they have learned along the way. This is not a pitch – it is recognized that not every effort will result in a viable business model. Rather, you will be graded on how deeply and thoroughly you pursued the development of the model, and how you reflect on all of the learning that has occurred

throughout the course. This will occur publicly in a 15 minute team presentation. Grading will be according to the Lessons Learned Rubric.

Late Work

For all assessment and evaluation components with due dates and times listed on Teams, **late work will be penalized 2% per hour**, with the clock starting the minute after the deadline has elapsed.

Schedule

Click here to see the schedule.

Policies

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate.

Attendance

The course format is synchronous online, and attendance for the full duration of all scheduled class times is required as noted above under grading. **If you are unable to attend all or part of a class**, please submit a Student Declaration of Absence (SDA) form to the instructor via a direct message on Teams. **You may submit up to 2 SDAs per term.** If circumstances arise that necessitate your missing more than two classes per term, please contact the instructor to discuss the matter.

Academic Freedom

Freedom of speech and of thought are cornerstones of academic institutions such as Dalhousie. Our goal in science is to observe and characterize the world accurately and objectively. However, we must realize that our perceptions of reality are often coloured by our beliefs and assumptions, some of which we may not be aware of. Academic freedom includes not only the freedom to think as you please, but others' freedom to express their beliefs as well. Please do not hesitate to express your ideas, but do so in a way that is respectful of others. This is the only avenue for the free expression and exchange of ideas.

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. For more details please see: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).
Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Code of Student Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. For more information please see https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/student-lifepolicies/code-of-student-conduct.html

Important Dates in the Academic Year (including add/drop dates)

https://www.dal.ca/academics/important_dates.html

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Missed or Late Academic Requirements due to Student Absence (policy)

https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academicrequirements-due-to-student-absence.html

Learning and Support Resources

Advising

General Advising: https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: https://www.dal.ca/faculty/science/current-students/academic-advising.html

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: https://libraries.dal.ca

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: https://libraries.dal.ca/services/copyright-office.html

Fair Dealing Guidelines: https://libraries.dal.ca/services/copyright-office/fair-dealing.html

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness/servicessupport/student-health-and-wellness.html

Student Advocacy: https://dsu.ca/dsas

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Biosafety: https://www.dal.ca/dept/safety/programs-services/biosafety.html

Chemical Safety: https://www.dal.ca/dept/safety/programs-services/chemical-safety.html

Radiation Safety: https://www.dal.ca/dept/safety/programs-services/radiation-safety.html

Scent-Free Program: https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html