

This final version incorporates some minor changes made during the term.

APPLICATION FOR INDEPENDENT STUDY

Student's name (or students' names) and class year(s):

- Aubryn Kaine (DS'20)
- Tashroom Ashan (DS'20)

Term and year: Term 6, 2022

Course Title: Differential Equations

Sponsor: Brian Hill

Pass/Fail, or graded: Graded

Credits (see section 5 of the Academic Policy): 4

Please answer the following questions and attach.

1. Attach a Long Course Description (model provided in "Curriculum and Faculty Information"). If the course is expected to earn more than two credits per semester, please attach a detailed syllabus that explains the assignment of credit.
2. What will the learning arrangement be (e.g., how many meetings with the sponsor, how many hours spent by the student(s) on project activities)?
3. How will the study be evaluated?
4. How will the proposed course contribute to the student's intellectual life at Deep Springs and to his long-term academic goals? How will it serve the sponsor's academic or professional interests? Why is this the best time and place for this particular course of study?

Submitted:

Student	Student	Student
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Faculty or Staff Sponsor

Approved:

Academic Dean	Curriculum Committee Chair	Date
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1. Attach a Long Course Description (model provided in “Curriculum and Faculty Information”). If the course is expected to earn more than two credits per semester, please attach a detailed syllabus that explains the assignment of credit [this is spelled out in Section 3 below].

This course will build on skills developed in One Variable Differential Equations, Integral, and Multivariable Calculus (Commonly known as Calc I, II, and III) through investigations of Differential Equations.

Topics covered include:

- First-Order Differential Equations
- Second-Order Linear Equations
- Laplace Transforms
- Linear Systems

The preceding four topics constitute a standard one-semester course in differential equations. If there is time, some material from one of the following three topics will be added:

- Nonlinear Systems
- Computational Methods
- Quantum Mechanics ← this change made late in the course

Readings and problems will come from [*A First Course in Differential Equations, Third Edition*](#) by J. David Logan.

A daily schedule which distributes the first four topics over the first six weeks has been started here: https://brianhill.github.io/differential-equations/daily_schedule.html. The schedule budgets time for a midterm exam and a final exam. The seventh week will be devoted to the final exam and a final special topic, assuming there is time.

Activities: class discussions, eighteen problem sets (half presented, half submitted for grading), and two exams

Credit division: This course is designed to be a semester course fit into a single term. As such we will be meeting 3 times a week for one hour each with our sponsor, and one time a week for 30 minutes to 1 hour with just students, with the expectation that we will spend about 18 hours per week outside of class preparing so that meeting time with the sponsor can be used efficiently.

2. What will the learning arrangement be (e.g., how many meetings with the sponsor, how many hours spent by the student(s) on project activities)?

We will meet with the sponsor three times a week for one hour per meeting. Readings and problems related to recent material will be due every class, which together will require 4-5 hours

of preparation per class. Please consult the previously-mentioned daily schedule for more details: https://brianhill.github.io/differential-equations/daily_schedule.html. The daily schedule contains a precise record of what was covered.

3. How will the study be evaluated?

- Problem sets: 40 % — three per week, except on the first week, the last week, and the two exam weeks, when there will only be one problem set — 18 problem sets in total, 9 presented in class, 9 submitted for grading
- Class participation: 10 %
- Midterm: 25 %
- Final: 25 %

4. How will the proposed course contribute to the students' intellectual life at Deep Springs and to their long-term academic goals? How will it serve the sponsor's academic or professional interests? Why is this the best time and place for this particular course of study?

Aubryn: I have been interested in pursuing higher math at Deep Springs since I heard that we were getting a physicist as our Natural Sciences chair. Special Relativity and Math Analysis were both very informative and contributed to my understanding of mathematical problem solving, however as I come to the end of my time at Deep Springs I would like to get back into a calculus-based subject. As this is my last term at Deep Springs, this would be my last chance to take a calculus-based subject with Brian in a uniquely low student-teacher ratio where I'm actually participating in a math course as an undergraduate, rather than being lectured to. This course will also set me up well for pursuing engineering courses at my next institution, since a number of programs I'm planning on applying to require differential equations to graduate.

Tashroom: I love math, I love learning math, and I've been deprived of that by the courses offered here. Unfortunately, Deep Springs's current curricular structure doesn't lend itself well to advanced math courses. These courses were some of my favorite courses in high school (multivariable calculus, complex systems, graph theory, etc.) I really hope to get back into math, particularly problem-solving. This will also help me when I transfer as I will seek to pursue chemistry—differential equations are a huge part of physical chemistry and knowing this will greatly help me in my future studies. I hope to learn these skills here, working closely with faculty with great support. I see this course as transitional from Deep Springsy-closeness to the STEM studies that I'll do at my next institution. Hence the particular timeliness of doing this course in my last term here.

Brian (sponsor): Differential equations are used routinely in almost every area of physics. Nonetheless, I have to some degree forgotten how mathematicians develop the subject. This

independent study gives me a chance to refresh my memory on that. As others have noted, we have few-to-no calculus-based courses at Deep Springs. This is also a chance for me to teach something that requires calculus with a few students who have the required background. Finally, although I have been very busy in Terms 4 and 5, I have few duties in Term 6, and so it is a good time to do an independent study at an intensive pace.