APSC 174 – INTRODUCTION TO LINEAR ALGEBRA

Course Syllabus – Winter 2025

This is your course syllabus. Please download the file and keep it for future reference.

LAND ACKNOWLEDGEMENT

Queen's University is situated on traditional Anishinaabe and Haudenosaunee Territory. See: http://www.queensu.ca/encyclopedia/t/traditional-territories

INCLUSIVITY STATEMENT

Queen's students, faculty, and staff come from every imaginable background – small towns and suburbs, urban high rises, Indigenous communities, and from more than 100 countries around the world. You belong here: https://www.queensu.ca/inclusive/.

TEACHING TEAM

Course Instructors

Alan Ableson (MECH)

Mike Roth (MATH)

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APSC 174 (W 2.8-0-0.5 3.3)

COURSE DESCRIPTION

Systems of linear equations; real vectors spaces and subspaces; linear combinations and linear spans; linear dependence and linear independence; applications to systems of linear equations and their solution via Gaussian elimination; bases and dimension of real vector spaces; linear transformations, range, kernel and Rank-Nullity theorem; matrix representation of a linear transformation; composition of linear transformations and matrix multiplication; invertible matrices and determinants; eigenvalues and eigenvectors of square matrices. Applications of the course material to engineering systems are illustrated.

(40/0/0/0/0) (Mathematics/Natural Sciences/Complementary Studies/Engineering Science/Engineering Design)

COURSE LEARNING OUTCOMES (CLO)

By the end of this course, students should be able to:

CLO	DESCRIPTION	INDICATOR
CLO 1	State the axioms of real vector spaces and subspaces and determine whether a given subset of a vector space is a vector subspace.	KB-Mathematics
CLO 2	Demonstrate an understanding, through calculations and proofs, of linear combination, linear dependence, linear span, basis and dimension.	KB-Mathematics
CLO 3	Solve systems of linear equations using Gaussian elimination and back substitution by applying elementary row operations on an augmented matrix.	KB-Mathematics
CLO 4	Define a linear mapping between vector spaces and determine if a given mapping is linear, define the kernel and image of a linear mapping, compute them for a given real matrix, and explain how they are related to the column vectors of that matrix.	KB-Mathematics

CLO 5	Perform basic matrix algebraic operations (addition, scaling, multiplication), and compute and utilize properties of the determinant of a real square matrix (including using it to assess whether a matrix is invertible).	KB-Mathematics
CLO 6	Define eigenvalues, eigenspaces and eigenvectors for a given vector space and compute them for a real square matrix.	KB-Mathematics

COURSE EVALUATION

Assessment Weighting

Assessment Tool	Schedule	Weight		Alignment with CLOs
Weekly Assignments (Webwork)	Weekly on Thursdays, 3 PM	10% (best 10 of 12)		1-6
Midterm Test 1	Feb. 11	22.5%	Or best test 22.5% and Exam 67.5%	1,2
Midterm Test 2	Mar. 25	22.5%		3,4
Final Exam	TBA	45%		1-6

Total 100%

Note:

1. We will automatically compute two final marks for each student, either using both (Test 1 and Test 2), or just a student's best test, along with the final exam; see the [22.5%/22.5%/45%] vs [22.5%/67.5%] weights in the table. Each student's final grade will automatically be the **higher** of those two final marks.
2. The expectation is that students will be able to demonstrate competency on all of the course material by having a passing average over all the proctored assessments; **students who would pass by the calculations in the Assessment Weighting table, but who have lower than 50% average on the 90 marks assigned for Test 1, Test 2 and Final Exam (that is, lower than 45/90), will receive an FR final grade.** In this case, students may take the APSC 174 supplemental exam in late July or early August if they meet the eligibility criteria. See: https://smithengineering.queensu.ca/first-year/rewrite-exams

Assessment Descriptions

Exams

Exams will require answers written out in full of all the steps explained. We are more interested in seeing the reasons for your answers and whether you understand the concepts involved than in the numerical answer. Also, if you explain your solutions clearly, we can give part marks where appropriate. We allow all proctored assessments to be written in either pencil or pen.

No resources are allowed during exams (i.e., no calculators, no notes, formulas, textbooks, etc.). See the note on Academic Integrity below.

Previous Exams: Looking at APSC 174 examinations from past years will help you to be prepared for the style of the questions we will ask. See the course OnQ site for old exams, or the central Exam Bank for old exams (https://exambank.library.queensu.ca/).

Weekly Assignments (WeBWorK)

There will be weekly assignments to be submitted online using WeBWorK. A link to WeBWorK can be found from the course OnQ page. The software marks your submissions right away and you may repeatedly attempt the same self-test until you get it correct. You will only be able to access each weekly assignment up until its matching deadline on the Thursday after the week the material was covered.

Grading

All assessments in this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to the established Grade Point Index.

Feedback on Assessments

The teaching team will provide feedback on graded activities.

- For WeBWorK assignments, the feedback will be immediate.
- For the written assessments (midterm and final exams) you can expect your grade and feedback within twenty-one days of the exam date.

Accessing Your Final Grade

Your final grades will show on SOLUS. Official transcripts showing final grades will be available on the Official Grade Release Date. Please note that in official transcripts, a mark of IN (incomplete) is considered a grade, and your transcript is released with this grade.

Course Materials

Required Textbook

APSC 174 Lecture Notes, by Abdol-Reza Mansouri.

Cost: Free and available on OnQ.

Optional Textbook

Linear Algebra, by Stephen H. Friedberg, Arnold J. Insel, and Lawrence E. Spence (4th or 5th Ed).

Cost: $51.95 in paperback and available on Amazon.

Tutorials

Tutorial problems will be posted on OnQ each Monday and their solutions posted a week later.

Other Material

- WeBWorK for weekly assignments is free for students. Accounts will automatically be created for each student.
- This course makes use of Crowdmark software for all grading. Be aware that by logging into the Crowdmark site https://app.crowdmark.com/sign-in/queensu you will be leaving OnQ and accessing Crowdmark's website. You should consult their privacy policy: https://crowdmark.com/privacy/queens.
- All other course material is accessible via OnQ.

Required Calculator

No electronic devices or other aids are allowed on any test or exam.

Suggested Time Commitment

This course represents a study period of one semester spanning 12 weeks. Learners can expect to invest on average 7-9 hours per week in this course. Learners who adhere to a pre-determined study schedule are more likely to successfully complete the course.

PLANNED WEEKLY SCHEDULE

Week	Covered Topics
1	Introduction; languages of sets; functions and maps
2	Definition, examples and properties of vector spaces
3	Subspaces; linear combinations
4	Linear combinations and spans; linear dependence and independence
5	Solutions to systems of linear equations, connection with linear dependence and independence
6	Solving linear systems via Gaussian elimination and row-reduced echelon form; bases and coordinates for vector spaces
7	Dimension of a vector space; linear maps/transformations; image and kernel
8	Linear maps; image and kernel; matrices; connection with linear maps
9	Matrices; connection between linear maps and solving systems of linear equations; matrix multiplication
10	Invertible matrices and determinants
11	Invertible matrices and determinants; eigenvalues and eigenvectors
12	Eigenvalues and eigenvectors (continued)

COURSE COMMUNICATION

QUESTIONS ABOUT COURSE MATERIAL

Questions or comments regarding the course material that can be of benefit to other students should be posted in the Q&A forum on the class website. The instructor, TAs, and students are encouraged to answer these questions directly in the discussion forum for the benefit of everyone in the course.

COURSE ANNOUNCEMENTS

The instructor will routinely post course news in the Announcements section on the main course homepage on OnQ. Please sign up to be automatically notified by email when the instructor posts new information in the Announcements section. Instructions on how to modify your notifications are found in the **Begin Here** section of the onQ course site.

OFFICE HOURS

In addition to interaction in the Q&A discussion forums, you will have the opportunity to interact with either a TA or the instructor through office hours. The instructor will provide a schedule of availability at the beginning of the term.

CONFIDENTIAL MATTERS

If you have a confidential matter you would like to discuss with your instructor, their contact details are on the first page of this document. Expect email replies within 48 hours.

ABSENCES (ACADEMIC CONSIDERATIONS) AND MISSED ASSIGNMENTS

For information on academic considerations due to extenuating circumstances, please review the information on the Smith Engineering website. Note that unacceptable reasons include extra-curricular activities, travel plans, generally behind on schoolwork, etc. Do not schedule travel during midterms and final exams, as travel is not an acceptable reason for granting academic considerations.

- Weekly Assignments (Webwork) – only the best 10 out of 12 counts, so missed weeks are not made up unless students report a longer-than-2-week absence. In that case, email the instructor.
- Missed midterm test will not be re-taken. For a missed midterm test with appropriate notification, the 22.5% for the missed midterm test will be added to the weight of the final exam.

STANDARD QUEEN'S AND SMITH ENGINEERING POLICIES

NETIQUETTE

In this course, you may be expected to communicate with your peers and the teaching team through electronic communication. You are expected to use the utmost respect in your dealings with your colleagues or when participating in activities, discussions, and online communication.

Following is a list of netiquette guidelines. Please read them carefully and use them to guide your online communication in this course and beyond.

1. Make a personal commitment to learn about, understand, and support your peers.
2. Assume the best of others and expect the best of them.
3. Acknowledge the impact of oppression on the lives of other people and make sure your writing is respectful and inclusive.
4. Recognize and value the experiences, abilities, and knowledge each person brings.
5. Pay close attention to what your peers write before you respond. Think through and re-read your writings before you post or send them to others.
6. It's alright to disagree with ideas, but do not make personal attacks.
7. Be open to be challenged or confronted on your ideas and challenge others with the intent of facilitating growth. Do not demean or embarrass others.
8. Encourage others to develop and share their ideas.

STUDENT CODE OF CONDUCT

Queen's University values maintaining an environment free of, and will not tolerate, harassment, discrimination, and reprisal. The Student Code of Conduct applies to all students at Queen's. It outlines the activities and behaviours that could be considered Non-Academic Misconduct (NAM). The Code also describes the NAM process and the sanctions that could be imposed on a student found responsible for a violation. All students should be familiar with the Student code of conduct and related policies on sexual violence prevention and response and harassment and discrimination prevention and response.
https://www.queensu.ca/nonacademicmisconduct/policies

COPYRIGHT

Course materials created by the course instructor, including all slides, presentations, synchronous and asynchronous course recordings, handouts, tests, exams, and other similar course materials, are the intellectual property of the instructor. It is a departure from academic integrity to distribute, publicly post, sell or otherwise disseminate an instructor's course materials or to provide an instructor's course materials to anyone else for distribution, posting, sale or other means of dissemination, without the instructor's ***express consent***. A student who engages in such conduct may be subject to penalty for a departure from academic integrity and may also face adverse legal consequences for infringement of

intellectual property rights and, with respect to recordings, potentially privacy violations of other students.

Academic Integrity

As an engineering student, you have made a decision to join us in the profession of engineering, a long-respected profession with high standards of behaviour. As future engineers, we expect you to behave with integrity at all times. Please note that Engineers have a duty to:

- Act at all times with devotion to the high ideals of personal honour and professional integrity.
- Give proper credit for engineering work

The standard of behaviour expected of professional engineers is explained in the Professional Engineers Ontario Code of Ethics. Information on policies concerning academic integrity is available in the Queen's University Code of Conduct, in the Senate Academic Integrity Policy Statement, on the Smith Engineering website, and from your instructor.

Departures from academic integrity include plagiarism, use of unauthorized materials or services, facilitation, forgery, falsification, unauthorized use of intellectual property, and collaboration, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the University.

In the case of online or remotely proctored exams, impersonating another student, copying from another student, making information available to another student about the exam questions or possible answers, posting materials to online services, communicating with another person during an exam or about an exam during the exam window, or accessing unauthorized materials, including internet sources and using unauthorized materials, including smart devices, are actions in contravention of academic integrity.

Generative Artificial Intelligence (AI) Tools, like ChatGPT

Using generative AI writing tools such as ChatGPT in your submitted work is prohibited in this class. This type of use constitutes a Departure from Academic Integrity.

Invalid Exams

An exam may be declared invalid in case of an interruption in an in-person examination; if the instructions in a remote or online exam were not followed; if the student uploads wrong materials; or if a situation arises where the integrity of the exam cannot be verified. If an exam is declared invalid, the student may be granted a re-write.

ACADEMIC AND STUDENT SUPPORT

Queen's has a robust set of supports available to you including the Library, Student Academic Success Services (Learning Strategies and Writing Centre), and Career Services. Learners are encouraged to visit the Smith Engineering Current Students web portal for information about various other policies such as academic advisors, registration, student exchanges, awards and scholarships, etc. Students are also encouraged to review the information that is available in the EngQ Hub, posted in onQ.

ABSENCES (ACADEMIC CONSIDERATIONS) AND ACADEMIC ACCOMMODATIONS

For academic accommodations and considerations please review the information on the Smith Engineering website.

ACCOMMODATIONS FOR DISABILITIES

Queen's University is committed to working with students with disabilities to remove barriers to their academic goals. Queen's Student Accessibility Services (QSAS), students with disabilities, instructors, and faculty staff work together to provide and implement academic accommodations designed to allow students with disabilities equitable access to all course material (including in-class as well as exams). If you are a student currently experiencing barriers to your academics due to disability related reasons, and you would like to understand whether academic accommodations could support the removal of those barriers, please visit the QSAS website (https://www.queensu.ca/studentwellness/accessibility-services) to learn more about academic accommodations. To start the registration process with QSAS, click the ***Access Ventus*** button found on the Ventus student portal: https://www.queensu.ca/studentwellness/accessibility-services/ventus

Ventus is an online portal that connects students, instructors, Queen's Student Accessibility Services, the Exam's Office, and other support services in the process to request, assess, and implement academic accommodations. To learn more about Ventus, visit A Visual Guide to Ventus for Students: https://www.queensu.ca/ventus-support/students/visual-guide-ventus-students

For questions or assistance with requesting Academic Consideration or Accommodation, contact the Smith Engineering Program Advisor (Accommodations and Considerations) at engineering.aac@queensu.ca

Every effort has been made to provide course materials that are accessible. For further information on accessibility compliance of the educational technologies used in this course, please consult the links below.

Educational Technology	Accessibility Compliance Information
OnQ	https://www.d2l.com/accessibility/standards/
Crowdmark	https://app.crowdmark.com/sign-in/queensu
WeBWorK	https://qse-webwork.smithengineering.queensu.ca/webwork2
Zoom	https://zoom.us/accessibility

If you find any element of this course difficult to access, please discuss with your instructor how you can obtain an accommodation.

Requests for Religious and Other Human Rights-Based Accommodations in Smith Engineering

Religious Accommodations

Students in need of accommodation for religious observance are asked to complete the Religious Observance and Academics activities form within a week of receiving their course syllabus (each term) and submit the form via email to the Engineering Program Advisor, (Accommodations & Considerations), engineering.aac@queensu.ca

- Please use this form: Religious Observance and Academics Activities
- Alternative assignments are considered a "reasonable accommodation" under the Ontario Human Rights Code
- Please refer to the Queen's Multi-faith Calendar for all of this year's faith dates
- Students with questions about their rights and responsibilities regarding religious accommodations can contact chaplain@queensu.ca

Other human-rights based Accommodations

Engineering students who need accommodations on Human Rights grounds are asked to contact, in confidence, the Engineering Program Advisor, (Accommodations & Considerations) engineering.aac@queensu.ca or to call 613-533-6000 x 78013.

Technical Support

Some basic comfort level with basic hardware and software skills are required for this course. If you require technical assistance, please contact Technical Support.

Supportive Personal Counselling

If at any time you find yourself feeling overwhelmed, anxious, sad, lonely, or distressed, consider confidential personal counselling and wellness services offered by Smith Engineering and the Queen's student wellness services.