ELEC 211 / MATH 264: Engineering Electromagnetics with Integrated Vector Calculus

Time and Place (January 2026 offering)

Lecture Section 201: Tuesday and Thursday 11am - 12:30pm – DMP 110	Lecture Section 202: Tuesday and Thursday 2pm - 3:30pm – MCLD 2018
Tutorials: • Alternate Wednesdays starting January 21st, 5pm – 7pm, ANGU 098 • Note that an asynchronous video will be posted in place of the January 7th tutorial	

Instructors

Carol Jaeger Department of Electrical and Computer Eng. carolj@ece.ubc.ca Office hours: Please see Canvas Syllabus page	**Seckin Demirbas** Department of Mathematics s.demirbas@math.ubc.ca Office hours: Please see Canvas Syllabus page

Calendar Description

ELEC 211 (2) **Engineering Electromagnetics**
Electrostatics, electric currents, dielectrics, capacitance, electrostatic potential, magnetostatics. [2-0-1] Prerequisite: MATH 253 and one of APSC 178, PHYS 108, PHYS 118, PHYS 158. Corequisite: MATH 264.

MATH 264 (1) **Vector Calculus for Electrical Engineering**
Divergence, gradient, curl, theorems of Gauss and Stokes. Applications to Electrostatics and Magnetostatics. MATH 264 content is strongly coupled to BMEG 220 and ELEC 211 with topics and student evaluations weighted accordingly.
Prerequisite: One of MATH 200, MATH 217, MATH 226, MATH 253, MATH 254.
Corequisite: One of BMEG 220, ELEC 211.

About the Course

This course is a complete integration of ELEC 211 and MATH 264. Lectures topics are interwoven such that mathematical concepts are taught at appropriate times to support and illuminate the electromagnetics topics. The course builds on what you have learned in 1st year physics (PHYS 157/8/9) but adds the framework of vector calculus – a key ingredient in taking the study of electromagnetics to the next level.

The majority of this course is dedicated to static problems (things not changing with time), though towards the end some slowly time-varying phenomena will be introduced. The material contained in this course is key to the further study of nearly all areas of electrical engineering.

Grading Scheme

ELEC 211 and MATH 264 are fully integrated. Both courses will share the same final grade, and sufficient accomplishment must be demonstrated in the learning outcomes of both courses in order to earn a passing grad.

For the MATH 264 portion of the course, grading will be based on a "Mastery" system. About 30% of your course grade will be based on solving math problems in the midterms, quizzes, and the final exam. Each problem will align with a specific learning objective, which will be clearly identified. Grades for this portion are calculated from the weighted percentage of objectives you have "mastered" (see Canvas for descriptions of the learning objectives (LOs). Solutions that are "nearly perfect" or "perfect" solutions will receive a score of 1 ("Mastery"), and once a student receives a score of 1 for any given LO they do not have to retake it at any time in the term (including the final exam). Solutions that are "beginning" or "progressing" towards the right track but not to the level of "nearly perfect" will receive a score of 0. With the exception of 3 LOs that will appear on exclusively on the final exam, LOs will have at least one (and often multiple) retake opportunities. To pass MATH 264, you must achieve "Mastery" in at least 50% of the LOs.

For the ELEC 211 portion of the course, problems on the two midterms and the final exam will be graded using a marks breakdown that includes part marks (i.e., a relatively traditional marking scheme). Students must earn a minimum of half of the marks available on the ELEC 211 portion of the midterms and final exam in order to be eligible for a passing grade.

A student who does not meet the eligibility criteria to pass the course on either the MATH 264 Learning Outcomes or the ELEC 211 tests will have their final grade capped at 49%.

Assessment	**Description**	**Course**	**Weight ELEC**	**Weight MATH**
Homework	• WeBWorK assignments, unlimited attempts • Best N-2 scores will count, where N ≈11	ELEC + MATH	15%	
GRFTW*	• Short auto-graded quizzes to help you prepare for the week	ELEC	5%	
Midterms	• 2 Midterms (T3, T5)	ELEC + MATH	20%	30%
Final Exam	• Single comprehensive exam covering material from both courses	ELEC + MATH	30%	
Quizzes	• 3 Quizzes (T2, T4, T6)	MATH		
Total			**100%**	

* GRFTW = Getting Ready For The Week

Tutorial Schedule

Tutorial #	Date	Activity	MATH 264 LOs^
T1	January 7	Asynchronous video - parameterization	
T2	January 21	Quiz 1 – Math 264 LOs	TBD
T3	February 4	Midterm 1 – ELEC 211 + MATH 264 content	TBD
T4	March 4	Quiz 2 – MATH 264 LOs	TBD
T5	March 18	Midterm 2 – ELEC 211 + MATH 264 content	TBD New:
T6	April 1	Quiz 3 – MATH 264 LOs	TBD

^ Tentative schedule

Test Dates

Midterms: February 4; March 18, during the common tutorial period.
Quizzes: January 21; March 4; April 1, during the common tutorial period.
Final Exam: scheduled by UBC (April 14 – 25).

Resources

We will rely on materials provided on Canvas and open-source textbooks for reference. Please see the Canvas Syllabus page for a list of suggested references. You will not need to buy any textbooks.

Course Topics

• Coordinate Systems & Unit Vectors	• Electric field for charged points, and lines
• Electric field for general oblique line and surface charges	• Potential difference from energy: point, line of charge
• Line integrals	• Potentials and antiderivatives
• Gauss' law	• Flux integrals
• Divergence theorem	• Dielectrics
• Conductors, continuity of current, resistance	• Boundary conditions
• Capacitors	• Biot-Savart law
• Ampere's Circuital law	• Stokes' theorem
• Magnetic flux	• Magnetic potential
• Magnetic forces and torques	• Magnetic dipoles
• Magnetic materials & boundary conditions	• Magnetic circuits
• Induced EMFs	• Inductors
• Linear motors & generators	• Maxwell's equations

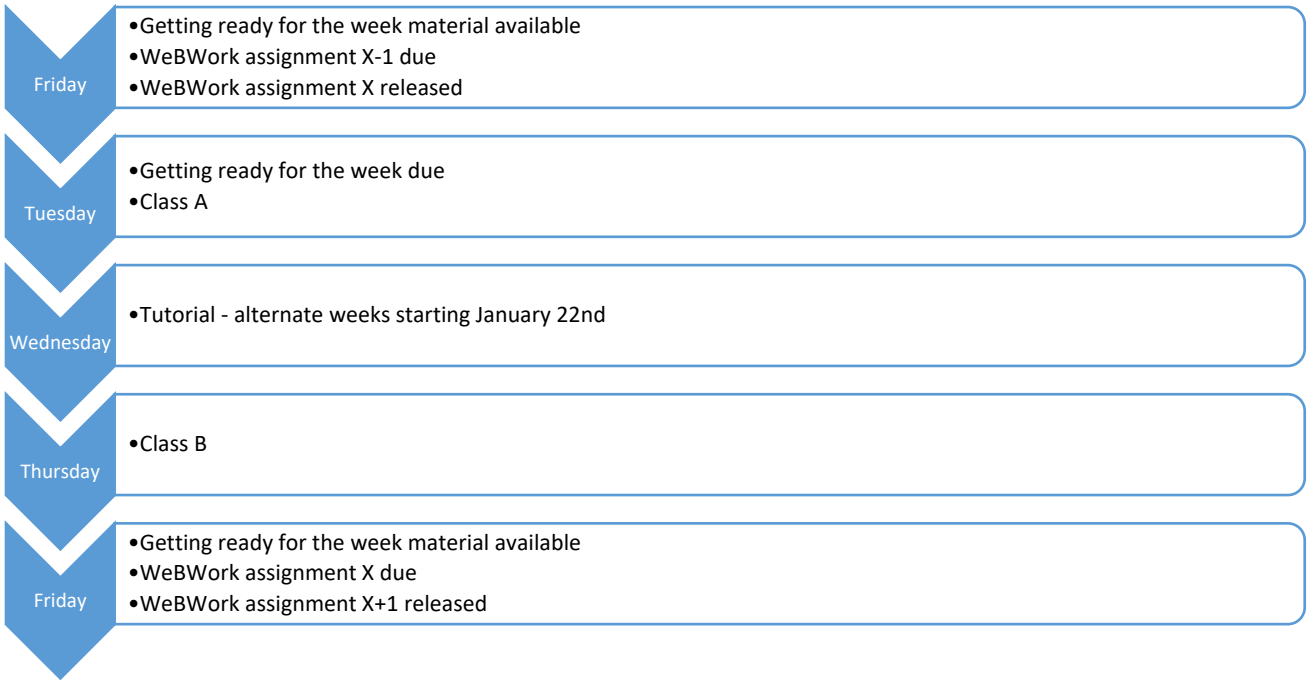
Learning Goals

By the end of this course you should be able to:

- Work comfortably with vector quantities, and perform a variety of mathematical operations with same
- Solve line, surface, and volume integrals in multiple coordinate systems
- Convert word problems to mathematical equations (and then solve them)
- Apply Divergence and Stokes' theorems correctly in problem solving
- Solve for the force on charged structures in the presence of electric fields
- Solve for the electric field at a point due to a variety of charge distributions
- Apply Gauss' law in the solution of electric field distributions resulting from charge distributions
- Use boundary conditions to determine the effect of different materials on electric and magnetic fields
- Evaluate the capacitance or inductance of a variety of structures
- Apply Ampere's law in the solution of magnetic field distributions resulting from current distributions
- Describe the different types of magnetic materials
- Calculate magnetic forces and torques
- Calculate the displacement current in simple circuits
- Explain the principal of operation of a variety of electromagnetic devices
- Analyze the behavior of a variety of conducting structures in the presence of a time-varying magnetic field
- Understand and apply Maxwell's equations

Weekly Schedule

This course is taught in a blended format. In class, there will be some formal lecturing, but also some activities and guided problem solving. Some lecture notes will often be released before class, but these should not be considered the full content. Each week there will be some materials to review prior to coming to the lectures. Weekly assignments will be released on the WebWork platform (available through the Canvas site. Assignments will be based on the material from the week that has just been completed.



Course Policies

Pre-requisites: The pre-requisites for this integrated pair of courses are: MATH 253 and one of APSC 178, PHYS 108, PHYS 118, or PHYS 158. These are hard pre-requisites, and if you have not successfully completed these or equivalent courses, you will not be permitted to remain registered in the course.

Homework: Weekly assignments will be released on the WebWorK platform every Thursday and will generally be due on the following Friday at 11:59 pm. Some adjustments (extensions) may be made at the discretion of the instructors (e.g. to account for reading week). If there are a total of N WebWorK assignments, the best N-2 will count towards your final grade. No other concessions will be granted. The homework questions will be related to the material covered in the lectures for that week. In other words, we will cover material before assigning homework problems.

Missed Midterms: If you miss a midterm and wish to apply for an in-term academic concession, you must fill out the online form available here: https://academicservices.engineering.ubc.ca/exams-grades/academic-concession/. For a missed midterm, the weight of the ELEC 211 portion of the midterm will be transferred to the final exam, and the MATH 264 portion of the midterm can be made up through the retesting opportunities (the quizzes or the final).

Final Exam: The final exam will be a comprehensive exam covering the full course. It is scheduled centrally by UBC, and we have no control over the exam date. If you miss (or are going to miss) the final exam, and you wish to apply for deferred standing, you must fill out the online form available here: https://academicservices.engineering.ubc.ca/exams-grades/academic-concession/.

Centre for Accessibility (CfA): If you are registered with the CfA and require academic accommodations for test writing, it is your responsibility to register the midterm and final exam dates with the Centre in a timely fashion. The course instructors do not have the ability to provide accommodations during the midterms or the final exam.

Discussion Board: The discussion board within Canvas will be made available during the term but will not be monitored continuously by the course instructors. You may use the discussion board to communicate with your peers, but you may **not** post solutions to homework questions, and you must adhere to the UBC Respectful Environment Policy at all times when posting to the discussion board. Failure to do so will result in removal of the discussion board.

Reproduction of course materials: All material provided by the course instructors is for your personal use only. Redistribution or reposting of notes, videos, or other teaching materials is forbidden. Misconduct proceedings will be initiated if any such cases are identified.

Policy on recordings: Audio or video recording of lectures, discussions, or other instructional activities is not permitted unless approved through a Centre For Accessibility (CfA) accommodation. Students granted permission to record through an accommodation must ensure recordings are used only for personal study, are not edited or shared, and are deleted after use or by the course end date. Unauthorized recording is considered academic misconduct and may result in disciplinary action.

Use of Integrity Statements

You may be asked to agree to an academic integrity statement as part of testing and other assessment activities. As a student in a professional program, adhering to course rules and upholding the academic integrity of your educational experience is in your best interest. Every effort will be made to ensure that assessment is fair for all students in the course. You can do your part by following the rules set out by your course instructors and seeking assistance or clarification if you have any questions. Students found to have violated the rules set out for any given assessment will be reported to the Faculty of Applied Science Dean's Office for investigation.

University Policies

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious, spiritual and cultural observances. UBC values academic honesty and students ae expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all their actions. Details of the policies and how to access support are available here.