South Dakota School of Mines & Technology
Electric and Magnetic Fields
Fall 2026
EE 381-M01 3 credits

Instructor Information

Instructor's Name- Thomas Montoya

Instructor's Contact Information- (605) 394-1219, Thomas.Montoya@sdsmt.edu, EEP 314

Office Hours- 2-4 pm MWF, or when available (open door policy). No appointments.

As I do not always notice voicemails in a timely fashion, e-mails or in-person are the preferred contact methods. Unless I am traveling or it arrives after 5 pm, I typically respond to e-mails the same day.

Course Information

Course Start/End Dates- 8/24/2026 to 12/16/2026

Course Final Exam Date and Time- Friday, December 11, 2026 from 2-3:50 pm, EEP 208

Course Meeting Times and Location- MWF from 12-12:50 pm in EEP 208

Course Delivery Method- The course will be delivered in-person for lectures, quizzes, and exams. Course information will be posted on D2L and/or my webpage http://montoya.sdsmt.edu. E-mail will be used to notify students of course-related information/events (**check daily**) using your first.last@Mines.sdsmt.edu address.

Course Description

Fundamentals of field theory (i.e., Maxwell's equations) as applied to static electric and magnetic phenomena. Also, theory and applications of transmission lines are covered.

Course Prerequisites- EE 221/221L with a grade of "C" or higher, MATH 225, and (PHYS 213 or PHYS 209).

Student Learning Outcomes

Student Outcomes (SOs)

Student Outcomes are defined in ABET's accreditation standards for engineering programs:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. An ability to communicate effectively with a range of audiences
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Course Learning Outcomes (CLOs)

Upon completion of this course, students should demonstrate the ability to:

A. Calculate distributed parameters, e.g., *R*, *L*, *G*, and *C*, as well as dependent quantities (e.g., characteristic impedance, phase velocity, and propagation constant) for transmission lines. (SOs 1, 2)
B. Solve frequency-domain problems (e.g., find impedances, reflection coefficients, currents, voltages, and powers) for transmission line circuits. (SOs 1, 2)
C. Perform basic vector algebra operations such as addition, dot product, and cross product in Cartesian, cylindrical, and spherical coordinates. (SOs 1, 2)
D. Perform basic vector calculus operations such as line, surface & volume integrals, gradient, divergence & curl operations, Laplacians, Divergence & Stoke's Theorems, and perform vector field classification in Cartesian, cylindrical, and spherical coordinates. (SOs 1, 2)
E. Calculate the electric field and electric potential in regions containing point charges and/or line, surface, and/or volume charge densities. (SOs 1, 2)
F. Solve Poisson's and/or Laplace's Equations for one-dimensional electrostatic boundary-value problems to calculate the electric potential, electric field, electric flux density, capacitance, and/or resistance of/for structures with spherical, cylindrical, and planar symmetry containing dielectric materials. (SOs 1, 2)
G. Apply electrostatic and magnetostatic boundary conditions. (SOs 1, 2)
H. Calculate the magnetic field, flux density, flux, and vector potential near wires, surfaces, and/or volumes carrying current(s). (SOs 1, 2)
I. Determine the magnetic forces and torque on wires carrying current. (SOs 1, 2)
J. Calculate the inductance of/for simple structures with or without magnetic materials. (SOs 1, 2)

Course Topics

As shown in attached schedule (subject to revision), transmission lines, electrostatics, magnetostatics, and the electrical properties of materials are introduced along with relevant supporting mathematics.

Course Materials

Required Textbook(s) and Materials

Elements of Electromagnetics (Seventh Edition), Sadiku, Oxford, 2018, ISBN 978-0-19-069861-4.

Technology Equipment and Skills Needed for the Course

The course requires use of a computer and a scientific calculator (capable complex number operations). Ability to navigate D2L and internet, upload/download files (e.g., pdf files), using MS-Office programs, communicating via email, and possibly connecting computer audio/video and using tools such as Zoom. MATLAB and/or MathCad may be useful for some assignments.

Course Grading

Coursework

- Course instruction will be delivered in lectures.
- Bring notes, text, and calculator to every class. Most quizzes will be unannounced and require a calculator (no smartphones/computers/tablets). Occasionally, a quiz may be open book/notes (no borrowing/sharing).
- To facilitate grading, homework shall meet the following specifications (see example on course web page):

(a) Use the front side (i.e., single-sided) of 8.5" × 11" engineering graph paper or plain white paper (NO pages torn from spiral notebooks) for assignments. Hardcopy only!

(b) At the top of **each** page should be the date, course number, problem number(s), your name, and the page numbering (i.e., page *x* of *y* or *x*/*y* formats in the right-hand corner). Ensure problems & pages are in order. PE4.1 = Practice Exercise 4.1. 'Review Questions' are never assigned.

(c) All work exceeding one page should be stapled - no paper clips, folded corners, or folders.

(d) Write-out problem descriptions, copy/draw figures, and **show all** work so it can be understood without the text. No work (i.e., "magic" answer) → no credit.

(e) **Reference equations** derived in the text (e.g., **equation number** or page number if not numbered). 'Notes' is not considered a reference if equation is found in text. Fundamental equations (e.g., Maxwell's equations, Ohm's Law ...) are excluded from this requirement.

(f) Use notation, especially for vectors, and conventional engineering units & prefixes (i.e., MKS) as given in class and text. For example, $\bar{E} = \hat{a}_\theta\, 10$ kV/m and 100 MHz ***NOT*** $\bar{E} = \hat{\theta}\, 100$ V/cm and 10^5 kHz. Answers with incorrect notation and/or incorrect/missing units are incomplete/incorrect.

(g) Writing/figures/graphs must be legible and large enough to read → illegible = no credit.

(h) Answers should be boxed/double underlined, in **decimal format** (if numeric), and the variables, values & units (if any) included. For example, $d = 3.4896$ m and ***NOT*** $d = 7\sqrt{42}/13$ m. Use lead zeros for decimal answers, e.g., 0.4 not ".4". Typically, ~5 significant digits are used.

(i) Work problems sequentially in a **single** vertical column with subparts clearly labeled, e.g., a), b) ... Leave a space (e.g., 1/2") between consecutive parts of a problem, and draw a line across the page at the end of each problem if there is more than one. No 'checker boarding'.

(j) **No** more than **two** problems on any single page.

Attendance Policy

Excused absences will be handled in accordance with South Dakota Mines Policy 3-1. Attendance is required. Notify instructor in advance (when possible) if you will be absent from class.

Late/Make-up Assignment Policy

- Homework (HW) is due in hardcopy form at the beginning of class on the specified days (up to 20% penalty for being late). SDM Policy 3-1 will usually not apply as HW assignments are given at least 3 business days in advance. If you know that you will be missing a class, it may be turned in early. HW will **not** be accepted or graded after solutions are posted.
- Missed quizzes will **not** be made up for unexcused absences. See SDM Policy 3-1 for excused absences.
- If 2/3 of quizzes and 2/3 of HW are completed at a **passing** level and **no** excused make-up quizzes are taken, the lowest HW grade and lowest two quiz grades will be dropped (no questions asked). If not, **all** quizzes and HW will count (no drops).

Academic Integrity

South Dakota Mines is committed to academic honesty and scholarly integrity. The South Dakota Board of Regents (BOR) Policy 2.9.2 provides a comprehensive definition of "Academic Dishonesty", which include cheating and plagiarism. All Instructors at South Dakota Mines are required to report allegations of academic misconduct to the Student Conduct Officer. BOR Policy 3.4.1 provides detailed information regarding key definitions, policy information, prohibited conduct, and the Student Conduct process adhered to at South Dakota Mines. Any student suspected of violating academic integrity standards will be reported in accordance with the process outlined on the South Dakota Mines website.

- Students are encouraged to discuss homework with classmates in general terms. However, direct copying/plagiarism … is not acceptable and will be penalized (e.g., grade of zero).

Grading and Assessment

Student learning is assessed by a combination of in-person exams and quizzes as well as homework.

Description	Percent
Three (3) Hourly exams	45%
Quizzes	20%
Homework	15%
Final exam	20%
TOTAL	**100%**

Special Note Regarding Final Exams: Per South Dakota Mines Policy (2-8), if you are scheduled to take three or more final/last exams on the same day during finals week, you may request that the middle exam(s) of the day be rescheduled. ***You are required to make this request of your Instructor(s) at least 30 days prior to the last day of regular classes***.

Grading Scale- 100 > A > 90, 89 > B > 80, 79 > C > 70, 69 > D > 60, F < 60.

Academic Freedom Statement

Academic Freedom is the cornerstone upon which higher education is built. Academic freedom, as defined by BOR Policy 1.6.1, is fundamental to the advancement of truth, development of critical thinking, promotion of civil discourse, and contribution to the public good. Each course includes the freedom to discuss relevant matters and present various scholarly views in the classroom, as determined by the subject-matter expertise of the instructor. Students are encouraged to develop the capacity for critical thinking and to pursue the truth, debate ideas, express and evaluate their opinions, and draw conclusions. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled.[1]

[1] *Language adapted from the American Association of University Professors "Joint Statement on Rights and Freedoms of Students".*

Complaint Process

While we hope that every student has a meaningful and positive experience at South Dakota Mines, should a concern arise, students are encouraged to first attempt to resolve their concern directly with the person or office directly involved. Following that attempt, should the concern remain unresolved, students are encouraged to reach out to the Dean of Students office at DeanOfStudents@sdsmt.edu or 605.394.2416. Additionally, students may access the online form to submit their complaint, appeal, or grievance.

Grade Appeal Policy

In alignment with BOR Policy 2.9.1,and SDSMT Policy 2-21, students who wish to appeal their final course grade shall first discuss the matter with the course instructor. If the concerns are unresolved following that discussion, students may appeal to the instructor's department head or supervisor for a decision. If the student is dissatisfied with the supervisor decision, the student may then utilize the online form to submit "Appeal – Academic" for a "Grade Dispute".

Opportunity for All - Student Success Services and Support

Students are provided a one-stop source for information regarding all the services and supports to ensure success. Visit the Opportunity Center page to learn more.

Accessibility Accommodations

If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and the Accessibility Services office at 605.394.2533 or DisabilityServices@sdsmt.edu as early as possible in the semester.

South Dakota Board of Regents Required Syllabus Statements

The following statements may be found online in South Dakota Board of Regents Academic Affairs Council Guideline 2.7.3.A(1):

- Freedom in Learning
- Americans with Disabilities Act
- Academic Dishonesty and Misconduct
- Acceptable Use of Technology
- Emergency Alert Communications

Electronic Devices Policy

Please silence/turn off your cell phone before class starts. No text messaging or headphones in class. You may use a laptop/tablet in class for purposes of note taking (NOT allowed for exams or quizzes). No other use of any other electronic/computer media, other than calculators, is allowed during class time.

Generative Artificial Intelligence Tool Utilization

To fully support the development of your independent thinking and creativity in this course, the use of generative Artificial Intelligence (genAI) tools is only allowed on the specific assignments and other course-related work expressly identified by the instructor. In instances where you are not specifically told it is acceptable to use a genAI tool, embrace the challenges of learning, scholarship, and personal growth and complete the assignment without the support of a genAI tool.

It is important to be aware of the risks of utilizing genAI tools in courses:

- Data privacy: genAI tools collect and store a significant amount of personal data from students. This raises concerns about how this data is used and protected, as well as the potential for misuse or unauthorized access. When you copy your own work into the genAI tool, keep in mind that your work no longer belongs to you, and it can be used in the genAI tool's learning.
- Bias in algorithms: genAI tools may be trained on bias data sets, which will then result in the algorithm reproducing that bias in the responses.
- Feedback loop inaccuracies: genAI models rely on feedback to improve their accuracy over time. If the feedback provided by students or instructors is incorrect, the genAI model may make inaccurate predictions based on faulty information.
- Hallucinations: Artificial intelligence systems may generate erroneous or misleading information that is not based on real data or patterns.
- Lack of transparency: The AI algorithm and decision-making processes are often complex and opaque, making it difficult for students to understand how their interactions with the genAI tool are being evaluated and assessed.
- Lack of training data: AI models require large amounts of high-quality training data to learn and make accurate predictions. If the training data used to build the AI model is incomplete or biased, the model may not be able to accurately predict answers.
- Limited context awareness: genAI tools lack the ability to understand the full context of an assignment, which can lead to inaccurate recommendations, responses, or assessments.

Topics/Course Schedule: See attached tentative schedule (subject to revision).

Tentative Course Schedule

Class | Date	Topics/Activities	Reading/Text
1 | 8/24/26 2 | 8/26/26 3 | 8/28/26 4 | 8/31/26 5 | 9/2/26 6 | 9/4/26 **9/7/26** 7 | 9/9/26 8 | 9/11/26 9 | 9/14/26	**Transmission Lines-** Introduction, transmission line parameters, equations, reflection coefficient, input impedance, SWR, and power. Both lossy and lossless transmission lines and transmission line circuits in the frequency-domain are discussed. Also, the Smith Chart is introduced.	• 11.1 - 11.2 • 11.2 - 11.3 • 11.3 • 11.4 • 11.4 • 11.4 **Holiday** • 11.4 • 11.5 • 11.5
10 | 9/16/26 11 | 9/18/26	**Vector Algebra-** Intro, scalars & vectors, unit vector, addition & subtraction, position/distance vectors, dot/cross products, components	• 1.1 - 1.6 • 1.7 - 1.8
12 | 9/21/26 13 | 9/23/26	**Coordinate Systems & Transformation-** Introduction, Cartesian, Circular Cylindrical, Spherical, constant-coordinate surfaces	• 2.1 - 2.3 • 2.4 - 2.5
14 | 9/25/26[M] 15 | 9/28/26	**Vector Calculus-** Intro; diff. length, area & vol.; line, surf. & vol. integrals, Del operator, gradient	• 3.1 - 3.3 • 3.3 - 3.5
16 | 9/30/26	**Exam #1**- Covers material from Chapters 11, 1, and 2	
17 | 10/2/26 18 | 10/5/26	**Vector Calculus cont.-** divergence & divergence theorem, curl & Stoke's theorem, vector & scalar Laplacian; vector classification	• 3.5 - 3.7 • 3.7 - 3.9
19 | 10/7/26 20 | 10/9/26 **10/12/26** 21 | 10/14/26 22 | 10/16/26	**Electrostatic Fields-** Introduction, Coulomb's Law and field intensity, electric fields, electric flux density, Gauss's Law & applications, electric potential, electric potential, electric dipole, energy density	• 4.1 - 4.3 • 4.3 - 4.6 **Holiday** • 4.6 - 4.8 • 4.8 - 4.10
23 | 10/19/26 24 | 10/21/26 25 | 10/23/26 26 | 10/26/26	**Electric Fields in Material Space-** Intro, material properties, convection & conduction currents, conductors, dielectric polarization, dielectric constant & strength	• 5.1 - 5.3 • 5.4 - 5.5 • 5.6 - 5.7 • 5.8
27 | 10/28/26	**Exam #2**- Covers material from Chapters 3 and 4	
28 | 10/30/26	**Electric Fields in Material Space cont.-** boundary conditions	• 5.9
29 | 11/2/26 30 | 11/4/26 31 | 11/6/26	**Electrostatic Boundary-Value Problems-** Intro, Poisson's & Laplace's equations, Uniqueness theorem, solution procedure, resistance & capacitance	• 6.1 - 6.3 • 6.3 - 6.4 • 6.5
32 | 11/9/26 **11/11/26** 33 | 11/13/26 34 | 11/16/26 35 | 11/18/26	**Magnetostatic Fields-** Intro, Biot-Savart's Law, Ampere's Circuit Law & applications, magnetic flux density, static Maxwell's equations, magnetic scalar and vector potentials	• 7.1 - 7.2 **Holiday** • 7.2 - 7.3 • 7.3 - 7.5 • 7.5 - 7.7
36 | 11/20/26 37 | 11/23/26 **11/26 - 11/28** 38 | 11/30/26	**Magnetic Forces, Materials, and Devices-** Introduction, magnetic forces, magnetic torque & moment, magnetic dipole, magnetization of materials, magnetic materials classification	• 8.1 - 8.2 • 8.3 - 8.5 **Holiday** • 8.5 - 8.7
39 | 12/2/26	**Exam #3**- Covers material from Chapters 5, 6, and 7	
40 | 12/4/26 41 | 12/7/26	**Magnetic Forces, Materials, and Devices cont.-** boundary conditions, inductance, and magnetic energy. Review for final exam	• 8.7 - 8.8 • 8.9
	Final Exam- Friday, December 11, 2026 from 2-3:50 pm, EEP 208	