

EE 381-01 Electric and Magnetic Fields (3-0), SDSM&T, Fall 2020

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Office Hours: 8-9 am & 3-4 pm MWF, or when available (open door policy).

Lecture Room & Time: EEP 336 on MWF from 10-10:50 am

D2L: In this course, we will use D2L to allow quick response to changing public health conditions. You can access D2L from the [central D2L login page](#). You can also go to the “[Current Students](#)” section on the SD Mines homepage and click on the D2L icon. Use your campus Single Sign On email and password to get in. If you have problems, call the helpdesk at (605)394-1234 or email helpdesk@sdsmt.edu. For additional help on using zoom, D2L and other computer related items, visit the ITS “How Do I” page: <https://www.sdsmt.edu/its/help/>.

WWW: See link from <http://montoya.sdsmt.edu>. Depending on D2L, the course web page may be used for posting **assignments**, examples, solutions, ... E-mail will be utilized to notify students of course-related information and events (**check daily**). Your first.last@Mines.sdsmt.edu address will be used.

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

Course Structure: This class will include a mixture of online and face to face sessions. A face to face class will be held at the scheduled class times of 10-10:50am on Monday/Wednesday/Friday, with half/third (depends on class size) of the class attending each live session and the rest participating live via Zoom. EEP 342 and EEP 338 will be available for those participating via Zoom. The class sessions will be recorded and made available for students who are unable to participate in a session now and then, but attendance is expected. **Quizzes and exams will be taken in person in EEP rooms 336, 338, & 342.**

EE 381 Prerequisites: EE 221/221L (Circuits II) with a minimum grade of “C”, MATH 225 (Calculus III), and PHYS 213/213-A (University Physics II).

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

Technology: The course requires use of a tablet computer with a camera and microphone (for Zoom) and a calculator. Software needed/used in the course will include a pdf reader(Acrobat), D2L, Zoom, and Microsoft Office (or equivalent).

COVID-19 Attendance Policy for classes with face-to-face elements (see <https://www.sdsmt.edu/Rockers-Return/COVID-19-FAQ/#If> for more detail)

Out of an abundance of caution, you should contact the Dean of Students office at deanofstudents@sdsmt.edu and *not come to class* if you experience any symptoms associated with COVID-19 (fever or chills, cough, shortness of breath or difficulty breathing, fatigue, muscle or body aches, headache, new loss of taste or smell, sore throat, congestion or runny nose, nausea or vomiting, diarrhea). The Dean of Students will contact your instructor(s). Any make-up of course requirements missed shall be worked out between you and your instructor(s). Your responsibility is to follow up with your instructor(s) quickly. Instructor(s) will respond with the aim of being flexible while retaining the integrity of your academic experience. To facilitate this process, you should do any or all of the following if you are able:

- Join scheduled synchronous remote class sessions;
- Participate in remote class activities, whether synchronous or asynchronous;
- Keep up with classwork;
- Submit assignments digitally;
- Work with your instructor(s) to try to reschedule exams, labs, and other critical academic activities.

Even if your absence has not been validated by the Dean of Students, instructors are required to allow for such make-up in a timely manner. You, on the other hand, are required to remain in timely contact with your instructor(s) to the greatest degree possible. Failure to communicate quickly and follow up may result in your inability to complete your semester.

COVID-19 Statement (see <https://www.sdsmt.edu/Rockers-Return/COVID-19-FAQ/#Health-and-Prevention> for more detail)

Mitigating the spread of COVID-19 is everyone's responsibility. In order to ensure your health and safety and that of the entire campus community, please monitor your health daily and abide by the following protocols:

- If you are exposed to COVID-19, develop COVID-19 symptoms, or anticipate being absent for more than two weeks due to COVID-19, communicate your circumstances immediately via deanofstudents@sdsmt.edu. The Dean of Students office will communicate with your instructor(s) and provide appropriate University communication to impacted parties while also preserving privacy.
- If you miss class due to medical reason, please inform your instructor(s) in a timely fashion.
- If you have been told to isolate or quarantine, you cannot attend classes in person. You should ask your instructor(s) about options for remote participation. Your instructor(s) will work with you to determine whether remote participation, an incomplete grade, or withdrawal is most appropriate.

Thank you for following these important measures to keep our community healthy and safe.

COVID-19 Face Covering Policy

Under the [COVID-19 Face Covering Protocol](#) approved by the South Dakota Board of Regents, SD Mines begins the fall term at Level 3, which requires face coverings in all public indoor spaces on campus. If you come to class not wearing an appropriate face covering, you will be asked to put one on. If supplies exist, a disposable mask will be provided if you do not have one. If no mask is available, you will be advised about virtual education options under the Informal Correction process in the COVID-19 Face Covering Protocol. If you decline to wear a face covering and do not leave the classroom, you will be referred to the Dean of Students for Formal Correction under the [COVID-19 Face Covering Protocol](#), which may include noncompliance with the [Student Code of Conduct](#). Your instructor(s) may be required to provide virtual options for you to continue to participate in the course until the allegations against you of non-compliance are resolved. Students who repeatedly come to class without a face covering will be subject to the consequences outlined in the [COVID-19 Face Covering Protocol](#).

Copyright and Terms of Use of Course Materials

Lectures, presentations, and other course materials are protected intellectual property under South Dakota Board of Regents Policy. Accordingly, recording and/or disseminating lectures, presentations or course materials is strictly prohibited without the express permission of the faculty member. Violation of this prohibition may result in the student being subject to Student Conduct proceedings under SDBOR Policy 3:4.

Course Policies:

- Course instruction will be delivered in lectures/live Zoom. Attendance is required. Notify instructor in advance (when possible) if you will be absent from class.
- Except when otherwise specified, all coursework is to be individually completed. See the *Cheating Academic Integrity Policy* and *Community Standards* links under the *Policies/Definitions* link of the catalog (<http://ecatalog.sdsmt.edu/>).
- Students are encouraged to discuss homework with classmates in general terms. However, copying, plagiarism ... is not acceptable and will be penalized (e.g., grade of zero).
- Homework (HW) is due at the beginning of class (hardcopy) on the specified days (up to 20% penalty for being late w/out doctor's note, etc.). 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 on the course web page.
- Bring notes, text, and calculator (capable of complex number & linear algebra operations) to every class. **Unless otherwise announced, quizzes will be in-person on HW turn-in days and require a calculator (no computers/smartphones).** Occasionally a quiz may be open book/notes (no borrowing, no computers).
- Missed quizzes will **not** be made up. If you know that you will be missing a class for a school-related activity (athletic travel, conference, etc.), you may stop by the day before and ask to take a quiz early (if available). Make-ups for exams only allowed for school-sponsored events, documented illness, ...

- If 2/3 of quizzes and 2/3 of HW are completed at a **passing** level, 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). The drops are meant to cover any absences, including those due to illness, interviews, trips...
- To facilitate grading, homework shall meet the following specifications (see example at 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.
 - (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.
 - (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 and/or page number). 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, $\vec{E} = \hat{a}_\rho 10 \text{ kV/m}$ and 100 MHz **NOT** $\vec{E} = \hat{\theta} 100 \text{ V/cm}$ and 10^5 kHz . Answers with incorrect notation and without applicable units are incomplete/incorrect.
 - (g) Writing/figures/graphs must be legible/large enough to read → illegible = no credit.
 - (h) Answers should be boxed/double underlined, in **decimal format** (if numbers), and the variables, values & units (if any) included. For example, $d = 3.4896 \text{ m}$ and **NOT** $d = \frac{7\sqrt{42}}{13} \text{ m}$. Use lead zeros for fractional answers, e.g., 0.4 not ".4". Typically, 4-5 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.
 - (j) **No more than two** problems on any single page.

Course Goals: The goal of this course is to introduce students to the basic concepts of electromagnetic field theory. In particular, lossless transmission lines, electrostatics, magnetostatics, and the electrical properties of materials are introduced. By the end of the course, students should be able to calculate relevant quantities (e.g., impedances, voltages, currents, power ...) for lossless transmission lines and simple circuits in the frequency-domain. For static fields, student should be able to calculate the electric field, electric flux density, and/or electric potential for symmetric electrostatic problems, and the magnetic field, magnetic flux density, magnetic flux, and/or magnetic vector potential for symmetric magnetostatic problems. Also, students should be able to calculate the resistance, capacitance, and inductance of simple structures.

Course Learning Objectives:

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

- A. Calculate distributed parameters, e.g., L and C , for simple lossless transmission lines and dependent quantities (e.g., characteristic impedance, phase velocity, and phase constant).
- B. Solve frequency-domain problems (e.g., find impedances, reflection coefficients, currents, voltages, and powers) for lossless transmission line circuits.
- C. Perform basic vector algebra operations such as addition, dot product, and cross product in Cartesian, cylindrical, and spherical coordinates.

- 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.
- E. Calculate the electric field and electric potential in regions containing point charges and/or line, surface, and/or volume charge densities.
- F. Apply Gauss' Law to problems with spherical, cylindrical, and/or planar symmetry.
- G. Calculate the electric potential, field, flux density, capacitance, and resistance of/for structures with spherical, cylindrical, and planar symmetry containing dielectric materials.
- H. Apply electrostatic and magnetostatic boundary conditions.
- I. Solve Poisson's and Laplace's Equations for one-dimensional electrostatic boundary-value problems.
- J. Calculate the magnetic field, flux density, flux, and vector potential near wires, surfaces, and/or volumes carrying current(s).
- K. Apply Ampere's Law to problems with cylindrical and/or planar symmetry.
- L. Determine the magnetic forces and torque on wires carrying current.
- M. Calculate the inductance of/for simple structures with or without magnetic materials.

Evaluation:	3 Hour Exams	45%
	Quizzes	20%
	Homework	15%
	Final Exam (required, online Fall 2020)	20%
	Total	100%

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

ADA: SD Mines strives to ensure that physical resources, as well as information and communication technologies, are reasonably accessible to users in order to provide equal access to all. If you encounter any accessibility issues, you are encouraged to immediately contact the instructor of the course and the Title IX and Disability Coordinator, Ms. Amanda Lopez at disabilityservices@sdsmt.edu or 394-2533. Students with special needs or requiring special accommodations should also contact the instructor and the Title IX and Disability Coordinator. More information can be found at <https://www.sdsmt.edu/Campus-Life/Student-Support/Disability-Services/>.

Freedom in learning: Under Board of Regents and University policy student academic performance may be evaluated solely on an academic basis, not on opinions or conduct in matters unrelated to academic standards. Students should be free to take reasoned exception to the data or 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. Students who believe that an academic evaluation reflects prejudiced or capricious consideration of student opinions or conduct unrelated to academic standards should contact the Provost and Vice President for Academic Affairs to initiate a review of the evaluation.

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/Zoom (NOT allowed for exams or quizzes). No other use of any other electronic/computer media, **other than calculators**, is allowed during class time. **During synchronous Zoom sessions, please ensure that you are logged in and participating. Please keep outside disruptions to a minimum and refrain from using other devices that will distract you/colleagues. Utilize your Zoom microphone (default mute) and video (default off) controls as well as headphones/earbuds to prevent distractions from disturbing your colleagues.**

Topics/Course Schedule: Chapters 1-8 & parts of 11 (subject to revision).

Course Schedule

Class	Date(s)	Topics	Reading/ Text
1	8/19	Transmission Lines- Introduction, transmission line parameters and equations. Only lossless transmission line case in the frequency-domain is discussed.	11.1-11.2
2	8/21		11.2-11.3
3	8/24		11.3
4	8/26	Continued. Transmission line equations, reflection coefficient, input impedance, SWR, and power. Only lossless transmission line case in the frequency-domain is discussed.	11.4
5	8/28		11.4
6	8/31		11.4
7	9/2		11.4
8	9/4	Vector Algebra- Intro, scalars & vectors, unit vector, addition & subtraction, position/distance vectors, dot/cross products, components	1.1-1.6
9	9/7		1.6-1.8
10	9/9	Coordinate Systems & Transformation- Intro, Cartesian, Circular Cylindrical, Spherical, constant-coordinate surfaces	2.1-2.3
11	9/11		2.4-2.5
12	9/14	Vector Calculus- Intro; differential length, area & volume; line, surface & volume integrals, Del operator	3.1-3.2
13	9/16		3.2-3.3
14	9/18	Exam #1 (covers sections 11.1-11.4, Chapters 1 - 2)	
15	9/21	gradient; divergence & divergence theorem; curl & Stoke's theorem, Laplacian; classification	3.4-3.5
16	9/23		3.6-3.7
17	9/25		3.8-3.9
18	9/28	Electrostatic Fields- Intro, Coulomb's Law and field intensity, electric fields, electric flux density, Gauss's Law & applications	4.1-4.2
19	9/30		4.2-4.4
20	10/2		4.5-4.6
21	10/5		4.6-4.7
22	10/7	electric potential, electric potential, electric dipole, energy density	4.9-4.10
23	10/9	Electric Fields in Material Space- Intro, material properties, convection & conduction currents, conductors, dielectric polarization, dielectric constant & strength	5.1-5.3
24	10/12		5.4-5.5
25	10/14		5.6-5.7
26	10/16	Exam #2 (covers Chapters 3-4)	
27	10/19	continuity equation, boundary conditions	5.8
28	10/21		5.9
29	10/23	Electrostatic Boundary-Value Problems- Intro, Poisson's & Laplace's equations, Uniqueness theorem, solution procedure, resistance & capacitance, Method of Images	6.1-6.3
30	10/26		6.3-6.4
31	10/28		6.5-6.6
32	10/30	Magnetostatic Fields- Intro, Biot-Savart's Law, Ampere's Circuit Law & applications, magnetic flux density	7.1-7.2
33	11/2		7.2-7.3
34	11/4		7.3-7.5
35	11/6	static Maxwell's equations, magnetic scalar and vector potentials	7.5-7.7
36	11/9	Magnetic Forces, Materials, and Devices- Intro, magnetic forces, magnetic torque & moment, magnetic dipole	8.1-8.2
37	11/11		8.3-8.4
38	11/13	magnetization of materials, magnetic materials classification	8.5-8.6
39	11/16	Exam #3 (covers Chapters 5-7)	
40	11/18	boundary conditions, inductance, magnetic energy, & possibly magnetic circuits.	8.7-8.8
41	11/20		8.9-8.10
42	11/23	Make-up &/or Review for Final	
EE 381 Final Exam- Tuesday, December 8, 2020 from 11am - 12:50 pm, internet/online			