

EE 680 Engineering Electromagnetics, 3-0 (3 credit hours)
South Dakota School of Mines & Technology
Spring 2021

Lecture Room & Time: MWF 1-1:50 pm in EEP 255

D2L: We will use D2L as a backup, so we can respond quickly 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

Instructor: Dr. Thomas Montoya, EEP 310, 394-1219, tmontoya@ieee.org or tmontoya@sdsmt.edu.

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

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

Catalog Description: The course will cover topics often encountered in engineering electromagnetic practice, e.g., uniform plane waves and their normal and oblique scattering from planarly-layered media; physical optics and scattering by strips; metallic waveguides and resonant cavities; and dielectric waveguides.

Course Structure: The class will meet face to face with the entire class expected to be present at all class meetings. Class time (lectures) will not be recorded. Assignments (hardcopy) will be submitted at the beginning of class on the due date. Exams and quizzes will be given during class time. The final exam will be in class as scheduled during finals week.

EE 680 Prerequisites: Undergraduate course in electromagnetic, or the equivalent, and knowledge of a mathematics package; or permission of instructor.

Technology: The course requires use of a computer and calculator. Software needed/used in the course will include a pdf reader (Acrobat), D2L, MATLAB, and Microsoft Office.

Text: *Advanced Engineering Electromagnetics* (Second Edition), Balanis, Wiley, 2012, ISBN-10: 0470589485, ISBN-13: 978-0470589489.

Course Policies:

- Course instruction will be delivered in lectures. 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/>). Under *Community Standards*, links to the *Student Code of Conduct* and *Academic Misconduct Policy* can be found.
- 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 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. Most quizzes will be unannounced 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 ...
- Timing, content, requirements, and format of computer projects will be announced when assigned.
- To aid 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 put date, course number, your name, and page numbering (i.e., page x of y or x/y formats in upper 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 numbers & 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/SI) as given in class and text. For example, $\vec{E} = \hat{a}_\theta 10 \text{ kV/m}$ and 100 MHz **NOT** $\vec{E} = \hat{\theta} 100 \text{ V/cm}$ and 10⁵ kHz. Answers with incorrect notation and without applicable 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 a number (no fractions) with variables, values & units (if any) included. Also, use lead zeros for fractional answers. For example, " $V_x = 0.4 \text{ V}$ " **not** " $V_x = .4$ " or " $V_x = 2/5 \text{ V}$ ". Typically, 4-6 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 objective of this course is to have students develop a deeper understanding of electromagnetics and introduce students to more advanced engineering electromagnetics topics not covered at the undergraduate level, e.g., waveguides and resonators.

Evaluation:	Two Hourly Exams @ 15%/each	30%
	Quizzes	20%
	Homework	20%
	Computer Projects	10%
	Final Exam (required)	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 in class. No headphones. You may use a laptop/tablet computer 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.

Software: Software needed/used in the course will include a pdf reader (Acrobat), D2L, MATLAB, and Microsoft Office.

COVID-19 (and other personal extenuating circumstances) attendance guidelines for classes

- If you experience any symptoms associated with COVID-19, you should complete the COVID-19 Case Notification Form and not attend face-to-face class(es). Once the form has been reviewed by the Dean or Students or designee, instruction will be provided on notifying your faculty as soon as possible. (see <https://www.sdsmt.edu/Rockers-Return/COVID-19-FAQ/#If> for more detail).
- If you are ill or injured and are not able to engage in course work (non-COVID related) you should contact the Dean of Students Office at deanofstudents@sdsmt.edu. The Dean of Students will contact your instructor(s) or provide information on notifying your faculty ASAP. Documentation of absence may be requested.
- Any make-up of course requirements missed shall be worked out between you and your instructor(s). Instructor(s) will respond with the aim of being flexible while retaining the integrity of your academic experience. Failure to communicate quickly and follow-up may result in your inability to complete the semester. Contact the Dean of Students office at deanofstudents@sdsmt.edu if you have additional questions or concerns regarding processes related to missing classes due to personal extenuating circumstances.

Topics/Course Schedule: Selected topics from Chapters 1-5, 8, and 9. See attached tentative schedule. As this is the first time this course has been taught in many years, the schedule is very much subject to revision.

Tentative Course Schedule/Topics

Class	Date(s)	Topics	Reading/ Text
1	1/11	Time-Varying and Time-Harmonic Electromagnetic (EM) fields –	1.1-1.3
2	1/13	Intro, Maxwell's equations, Constitutive Parameters and Relations,	1.3-1.5
3	1/15	Circuit-field Relations, Power and Energy	1.5-1.6
1/18		Holiday	
4	1/20	Time-Harmonic Electromagnetic fields	1.6-1.7
5	1/22	Wave Equation and its Solution - Intro, Time-Varying and Time-	3.1-3.2
6	1/25	Harmonic EM fields, Solution to Wave eq'n in Cartesian coordinates	3.3-3.4.1
7	1/27	Wave Propagation and Polarization – Intro, Transverse EM Modes,	4.1-4.2.1
8	1/29	Uniform Plane Waves (UPWs) in lossless medium- principal axis and	4.2.2
9	2/1	oblique, UPWs in lossy medium- principal axis and oblique,	4.3.1
10	2/3	Polarization	4.3.2
11	2/5		4.4
12	2/8	Reflection and Transmission – Intro, UPWs normally incident on	5.1-5.2
13	2/10	lossless half-space, UPWs obliquely incident on lossless half-space,	5.2, 5.3.1
14	2/12	Exam #1 over Chapters 1, 3, & 4 material	
2/15		Holiday	
15	2/17	UPWs obliquely incident on lossless half-space w/ Brewster and critical	5.3.1-5.3.2
16	2/19	angles, Reflection and Transmission of Multiple Interfaces, Polarization	5.3.2-5.3.3
17	2/22	Characteristics on Reflection	5.3.3-5.3.4
18	2/24		5.4.1-5.4.2
19	2/26		5.4.2-5.5.1
20	3/1		5.5.1-5.5.2
21	3/3		5.5.2-5.6
22	3/5		5.6
3/8 - 3/12		Spring Break	
23	3/15	Electrical Properties of Matter – Intro; Dielectrics, Polarization, &	2.1-2.2
24	3/17	Permittivity; Magnetics, Magnetization, & Permeability; Linear,	2.2-2.3
25	3/19	Homogeneous, Isotropic, & Nondispersive Media; AC Variations	2.8-2.9
26	3/22	Rectangular Cross-Section Waveguides and Cavities – Intro;	8.1, 8.2.1
27	3/24	Rectangular Waveguide- TE modes, TM modes, TE ₁₀ mode, Power, &	8.2.2-8.2.3
28	3/26	Attenuation; Rectangular Resonant Cavities- TE & TM modes	8.2.4-8.2.5
29	3/29		8.2.5, 8.3.1
30	3/31		8.3.1-8.3.2
4/2		Holiday	
31	4/5	Exam #2 over Chapters 5, 2, & 8 (through 8.2) material	
32	4/7	Dielectric Waveguide- slab, TM modes, & TE modes; Dielectric-	8.7.1-8.7.2
33	4/9	covered ground plane	8.7.3, 8.7.5
34	4/12	Solution to Wave equation in cylindrical coordinates;	3.4.2, 9.1
35	4/14	Circular Cross-Section Waveguides and Cavities – Intro; Circular	9.2.1-9.2.2
36	4/16	Waveguide- TE, TM, & attenuation; Circular Resonant Cavities- TE &	9.2.2-9.2.3
37	4/19	TM modes & Quality Factor; Circular Dielectric Waveguides and	9.3.1-9.3.2
38	4/21	Circular Dielectric Resonators	9.3.2-9.3.3
39	4/23		9.5.1
40	4/26		9.5.1-9.5.2
41	4/28		9.5.2
42	4/30	Review/Catch-up	
EE 680 Final Exam- 1-2:50 pm, Wednesday 5/5/2021, EEP 255			