

# PHYS 513

## Applied Electromagnetic Theory

- Day and Time: Thursday from 4:30 – 7:10 pm
- Location: 1004 Exploratory Hall
- Instructor: Bob Weigel
- Email: [rweigel@gmu.edu](mailto:rweigel@gmu.edu)
- Office Hour: Thursday from 3:30 – 4:30 pm
- Office: 259 Planetary Hall
- Course URL: <https://rweigel.github.io/phys513>

## 1 Syllabus

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### 1.1 Catalog Description

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Classical electromagnetic theory with applications. Topics include electrostatics, magnetic fields and materials, electromagnetic wave propagation, waveguides, transmission lines, radiation, and antennas.

### 1.2 Format

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My primary objective for this course is for students to be able to solve and present advanced electricity and magnetism problems related to the topics given in the catalog description. I will cover topics in chapters 1-6 of [Fields and Waves in Communication Electronics](#), third edition by Simon Ramo, John R. Whinnery, Theodore Van Duzer, Wiley, 1994.

Approximately 1/2 of class time will be a lecture. The rest of the time will be spent with students working on problems or presenting problems using the whiteboard.

The homework assignments will have two parts:

1. Basic problems that cover topics that have not been discussed in class. These problems are intended to prepare the students for the lecture on the topic.
2. Advanced problems that cover topics on the previous HWs basic problems and the lecture.

Homework assignments are due at 11:59 pm on Thursday so you have 3 hours to revise them after class is finished.

### 1.3 Grading

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- Homework: 30%
- Mid-term (take-home): 35%
- Final (take-home): 35%

The course letter grade is nominally determined using  $> 97$ : A+, 93 to 96.999: A-, 90 to 92.999: A-, 87 to 89.999: B+, 83 to 86.999: B, 80 to 82.999: B-, 70 to 79.999: C, 60 to 69.999: D,  $< 60$ : F. It is quite likely that these grade cut-offs will change downwards.

## 1.4 Textbook and References

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The textbook for this course is *Fields and Waves in Communication Electronics*, 3rd edition by Simon Ramo, John R. Whinnery, Theodore Van Duzer, Wiley, 1994.

You will likely need to reference other textbooks in this course. The following is a partial list of books that you may find useful.

### 1.4.1 Mathematical

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- *An Introduction to Fourier Methods and the Laplace Transformation* by Philip Franklin. This short book has many examples related to Maxwell's equations and transmission lines.
- *Fourier Analysis class notes* by Peakcock; the *Chapter 12 lecture notes* provides a review of the mathematical background and justification for solving ODEs using what Ramo calls "the phasor method".

### 1.4.2 Undergraduate-level

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- *Introduction to Electrodynamics* by David J. Griffiths - the most commonly used junior-level undergraduate textbook for physics majors.
- *Field and Wave Electromagnetics* by David K. Cheng - a commonly used junior-level undergraduate textbook for engineering majors.
- *Elements of Electromagnetics* by Matthew N. O. Sadiku - a commonly used junior-level undergraduate textbook for engineering majors.
- *Electricity and Magnetism (3rd Edition)* by Edward M. Purcell and David J. Morin covers the same topics as Griffiths at the same level. If you are looking for an alternative explanation, this textbook will be helpful. The book contains far more examples, discussion, and content than Griffiths. It also includes solutions.
- *Schaum's outline of theory and problems of electromagnetics* by Joseph A. Edminister is a useful reference for problems with full solutions and summaries of topics. *The 4th edition* contains chapters on transmission lines and waveguides.
- *Div, Grad, Curl, and All That: An Informal Text on Vector Calculus (4th Edition)* by H. M. Schey is an excellent reference for the mathematical background that you need to understand for this course. The book contains a concise and clear review of topics that are covered in a vector calculus course (usually "Calculus III").
- *The Feynman Lectures on Physics: Mainly Electromagnetism and Matter, Volume 2, 1977* contains excellent lecture-style expositions on Electricity and Magnetism. The full volume is [available online](#).

### 1.4.3 Graduate-level

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Two textbooks that cover applied E&M topics in detail are

- *Microwave Engineering* by David M. Pozar.
- *Electromagnetic Fields and Energy* by Hermann Haus and James Melcher. RES.6-001, Spring 2008.
- *Electromagnetic Waves and Antennas* by Sophocles J. Orfanidis. This book is dense and comprehensive, but a supplement such as the course textbook and *Microwave Engineering* by Pozar is probably needed as a primary reference initially.

Textbooks that cover advanced E&M theory are

- Classical Electrodynamics by David J. Jackson - the most commonly used graduate-level textbook for physics students
- Classical Electricity and Magnetism: Second Edition (Dover Books on Physics) by Wolfgang K. H. Panofsky and Melba Phillips, 2005
- Classical Electromagnetism by Richard Fitzpatrick

## **1.5 Academic Calendar and University Policy**

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<https://www2.gmu.edu/academics/academic-calendar>

<http://universitypolicy.gmu.edu/>

- Last class Thursday, December 1st.
- Sunday, December 11th at 11:59 pm.

## **1.6 Disability Accommodations**

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Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University. If you are seeking accommodations, please visit <http://ds.gmu.edu/> for detailed information about the Disability Services registration process. Disability Services is located in Student Union Building I (SUB I), Suite 2500 | [ods@gmu.edu](mailto:ods@gmu.edu) | Phone: (703) 993-2474.

If you have a learning disability or other condition that may affect academic performance, please: a) make sure documentation is on file with the Office of Disability Services to determine the accommodations you need; and b) talk with me to discuss your accommodation needs.

## **1.7 Counseling and Student Support**

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Counseling and Psychological Services provides confidential psychological services, including 24/7 crisis intervention and consultation to faculty and staff: <http://caps.gmu.edu/>.