# PHYS 7311: Electromagnetic theory

## General information

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| **Time and location:** | Tuesday, Thursday, 9:30-10:50am, 152 Fondren Science |
| **Instructor:** | Pavel Nadolsky |
| **E-mail:** | nadolsky@smu.edu |
| **Phones:** | (214) 768-1756 (office) |
| **Mailbox:** | 102 Fondren Science |
| **Office:** | 203 Fondren Science |
| **Office hours:** | By appointment |
| **Course webpage** | Posted on SMU Canvas (courses.smu.edu (Links to an external site.)), also accessible from http://www.physics.smu.edu/~nadolsky/teaching.html. (Links to an external site.) To view, enter yc password. |

### Textbook, learning objectives, grading, policies

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| Text: | ***Classical Electromagnetism in a nutshell*** **(Links to an external site.), by Anupam Garg, 1st Edition** |
| Recommended reading | ***Classical Electrodynamics by John D. Jackson (3rd edition)*** |
| | ***Introduction to Electrodynamics*** **by David J. Griffiths** |
| | **Electromagnetic Fields and Energy (Links to an external site.) by Herman A. Haus and James R. Melcher** |
| | ***A student's guide to Maxwell's equations*** **by Daniel Fleisch** |
| | ***Fundamentals of Electromagnetic Phenomena*** **by Lorrain and Corson** |
| Grading: | **Homework 60%** |
| | **Two midterm tests 20%** |
| | **Final test 20%** |
| Homework assignments | **In the Assignments folder on the website. Due dates are strictly enforced. 50% if late; 0% once the solutions are posted.** |
| Final test | **Saturday, 10 December 2016, 11:30am; a sample final exam** |

Students' learning outcomes:

# Syllabus

Chapter 1. Introduction
1.The field concept
2.The equations of electrodynamics
3.SI and Gaussian units

Chapter 2. Review of mathematical concepts
5.Vector algebra
6.Derivatives of vector fields
7.Integration of vector fields
8.The theorems of Stokes and Gauss
9.Fourier transforms, delta functions, and distributions
10.Rotational transformations of vectors and tensors
11. Orthogonal curvilinear coordinates

Chapter 3. Electrostatics in vacuum
12. Coulomb's law
13. The electrostatic potential
14. Electrostatic energy
15. Differential form of Coulomb's law
16. Uniqueness theorem of electrostatics
17. Solving Poisson's equation: a few examples
18. Energy in the electric field
19. The multipole expansion

Chapter 4. Magnetostatics in vacuum
21. Sources of magnetic field
22. The law of Biot and Savart
23. Differential equations of magnetostatics; Ampere's law
24. The vector potential
25. Gauge invariance
26. Point dipole
27. Magnetic multipoles

Chapter 5. Induced electromagnetic fields
28. Induction
29, 30. Energy in the magnetic field
31. Inductance
32. The Ampere-Maxwell law
33. Potentials for time-dependent fields

Chapter 6. Symmetries and conservation laws
34. Discrete symmetries of the laws of electromagnetism
35. Energy flow and the Poynting vector
36. Momentum conservation
37. Angular momentum conservation*
38. Relativity at low speeds
39. Electromagnetic mass*

Chapter 7. Electromagnetic waves
40. The wave equation for E and B
41. Plane electromagnetic waves
42. Monochromatic plane waves and polarization
43. Nonplane monochromatic waves; geometrical optics*
46. Oscillator representation of electromagnetic waves
47. Angular momentum of the free electromagnetic field*

Chapter 8. Interference phenomena
48. Interference and diffraction
49. Fresnel diffraction
50. Fraunhofer diffraction