

## Standardized Syllabus for the College of Engineering

EEL 4412	Applied Magnetism and Magnetic Materials	Fall 2017
EEL 5417	Applied Magnetism and Magnetic Materials	Fall 2017

1. Catalog Description: (*3 credits*) Introduction to magnetism, magnetic materials, and magnetic devices. The course offers a balance of theory and application from an applied engineering perspective.
2. Pre-requisites (undergrads): EEL 3008 Physics of EE (or consent of instructor)
3. Course Objectives: The objective of this course is to introduce the fundamentals of magnetism and explore applications of magnetic materials, primarily hard and soft ferromagnets. The course complements theory with practical design and application principles and is intended primarily to equip scientists and engineers to employ magnetic materials in functional systems.
4. Contribution of course to meeting the professional component (ABET B.S. program objectives): 3 hours of Engineering Science
5. Relationship of course to program outcomes (ABET B.S. program objectives):
  - a - an ability to apply knowledge of mathematics, science, and engineering: constitutive magnetic laws, Maxwell equations, magnetic circuit calculation, atomic origin of magnetism
  - EE2 - knowledge of mathematics, basic and engineering sciences necessary to analyze and design complex systems: magnetic circuit analysis, magnetic material modeling
  - EE3 - knowledge of advanced mathematics including linear algebra, complex variables and discrete mathematics: vector calculus, magnetic field analysis
6. Instructor: David Arnold
  - a. Office location: LAR 213
  - b. Telephone: 392-4931
  - c. E-mail address: [darnold@ufl.edu](mailto:darnold@ufl.edu)
  - d. Web site: <http://www.darnold.ece.ufl.edu/Magnetics> (case-sensitive)
  - e. Office hours: MF 9:30-10:30am
7. Teaching Assistant: Nicolas Garraud ([ngarraud@ufl.edu](mailto:ngarraud@ufl.edu))
8. Meeting Times: T 2-3, R 3
9. Class/lab schedule: Three 50-minute lectures per week
10. Meeting Location: MAEA 327
11. Material and Supply Fees: None
12. Textbooks and Software Required: None (but a few below are **HIGHLY** recommended)
13. Recommended Reading:

### Good introductory:

**E.P. Furlani, *Permanent Magnet and Electromechanical Devices: Materials, Analysis and Applications*, Academic Press, 2001 [my favorite, but expensive]**

**J.M.D. Coey, *Magnetism and Magnetic Materials*, Cambridge University Press, 2009. [excellent book on materials and applications]**

B.D. Cullity and C.D. Graham, *Introduction to Magnetic Materials, 2nd Ed.*, Wiley, 2009 [a "classic" and very accessible.. emphasis on materials, but decent section on engineering applications]

N. Spaldin, *Magnetic Materials: Fundamentals and Device Applications*, Cambridge Univ. Press [excellent intro to the materials and atomic aspects]

**D. Jiles, *Introduction to Magnetism and Magnetic Materials*, 2<sup>nd</sup> Ed., CRC Press, 1998. [good interesting intro text, covering all areas, but not very well organized]**

P. Campbell, *Permanent Magnet Materials and their Application*, Cambridge University Press, 1994 [good on permanent magnets and engineering aspects (especially PM manufacturing), but fairly brief]

E. du Trémolette de Lacheisserie, D. Gignoux, and M. Schlenker (editors), *Magnetism: Fundamentals*, Springer, 2005

Available: <http://uf.catalog.fcla.edu/permalink.jsp?20UF003304724>

E. du Trémolette de Lacheisserie, D. Gignoux, and M. Schlenker (editors), *Magnetism: Materials & Applications*, Springer, 2005

Available: <http://uf.catalog.fcla.edu/permalink.jsp?20UF003304643>

[comprehensive, but sometimes not well translated to English]

More detailed:

F. Fiorillo, *Characterization and Measurement of Magnetic Materials*, Elsevier, 2004 [best book on “engineering” aspects and experimental methods]

R.C. O’Handley, *Modern Magnetic Materials: Principles and Applications*, Wiley, 2000. [emphasis on materials]

14. Course Outline:

Week	Topic	Due Dates (estimated)	
1	History & Overview		Test 1
2	Magnetic Fields & Forces		
3	Magnetism in Materials	Wiki1	
4	Classic Observations and Magnetic Laws (Biot-Savart, Ampere, Faraday, Lorentz)	HW1	Test 2
5	Maxwell Equations, Modeling of Magnets	Wiki2	
6	Magnetic Circuit Analysis		
7	Demagnetization and Magnetic Energy		Test 3
8	Experimental Magnetic Field Sources (coils, electromagnets, permanent magnets)	HW2	
9	Magnetic Field Measurements (induction, Hall, MR, flux gate, etc.)	Wiki3	
10	Magnetic Material Characterization (permeameter, VSM, AGM, force/torque magnetometers, SQUID)		Test 3
11	Atomic Magnetic Theory	HW3	
12	Diamagnetism, Paramagnetism, Ferromagnetism, Domain Theory	Wiki4	
13	Advanced Topics – Student Presentations	HW4	
14	Advanced Topics – Student Presentations	Projects	

15. Attendance and Expectations: Students are expected to attend class lectures and arrive on time. Please turn off phones and other electronic devices.

16. Grading:

**UNDERGRAD SECTION (EEL 4412)**

Homeworks	20%	~4 assignments + ~4 Wiki site updates
In-Class Demo (team)	20%	Demonstration of something magnetic + Wiki page
Tests	<u>60%</u>	3 tests (equal weighting)
	100%	

**GRAD SECTION (EEL 5417)**

Homeworks	15%	~4 assignments + Wiki site updates
In-Class Demo (team)	15%	Demonstration of something magnetic + Wiki page
Tests	50%	3 tests (equal weighting)
Class Project	<u>20%</u>	Presentation + Wiki page on an advanced topic
	100%	

17. Grading Scale:

Numeric Cutoff	Letter Grade	Grade Points
90	A	4.00
87	A-	3.67
83	B+	3.33
80	B	3.00
77	B-	2.67
73	C+	2.33
70	C	2.00
67	C-	1.67
63	D+	1.33
60	D	1.00
57	D-	0.67
<57	E	0.0

18. Make-up Exam Policy:

Homeworks: DUE AT BEGINNING OF CLASS PERIOD

**-10% if turned in after lecture begins**

**-20% if turned in after lecture ends (up to 24 hours late)**

Exams: No make-up unless prior written documentation from Dean of Students, Physician, or Judge.

19. Students Requiring Accommodations:

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter, which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

20. Course Evaluation:

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

21. University Honesty Policy:

UF students are bound by The Honor Pledge which states, “*We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code.*” On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

22. Software Use:

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. *We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.*

23. Student Privacy:

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see:

<http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

24. Campus Resources:

*Health and Wellness*

- U Matter, We Care: If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575 so that a team member can reach out to the student.
- Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.
- Sexual Assault Recovery Services (SARS): Student Health Care Center, 392-1161.
- University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

*Academic Resources*

- E-learning technical support, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu). <https://lss.at.ufl.edu/help.shtml>.
- Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.
- Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.
- Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.
- Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.
- Student Complaints Campus: [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).
- On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.