

EEL 4412	Applied Magnetism and Magnetic Materials	Spr 2020	Class 23659
EEL 5417	Applied Magnetism and Magnetic Materials	Spr 2020	Class 23664

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
 - d. Web site: <http://www.darnold.ece.ufl.edu/Magnetics> (case-sensitive)
 - e. Office hours: TBD
7. Teaching Assistant: TBD
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*, 2nd 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 Trémolet de Lacheisserie, D. Gignoux, and M. Schlenker (editors), *Magnetism: Fundamentals*, Springer, 2005

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

E. du Trémolet 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	
5	Maxwell Equations, Modeling of Magnets	Wiki2	Test 2
6	Magnetic Circuit Analysis		
7	Demagnetization and Magnetic Energy		
8	Experimental Magnetic Field Sources (coils, electromagnets, permanent magnets)	HW2	Test 3
9	Magnetic Field Measurement Technologies (induction, Hall, MR, flux gate, etc.)	Wiki3	
10	Magnetic Material Characterization (permeameter, VSM, AGM, force/torque magnetometers, SQUID)		
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 (individual)	<u>20%</u>	Presentation + Wiki page on an advanced topic
	100%	

17. Grading Scale:

Numeric Cutoff	Letter Grade	Grade Points
90.00	A	4.00
86.67	A-	3.67
83.33	B+	3.33
80.00	B	3.00
76.67	B-	2.67
73.33	C+	2.33
70.00	C	2.00
66.67	C-	1.67
63.33	D+	1.33
60.00	D	1.00
56.67	D-	0.67
<56.67	E	0.0

18. Make-up Exam Policy:

Homeworks: DUE AT BEGINNING OF CLASS PERIOD
-10% if turned in after lecture begins (i.e. if you are late to class)
-20% if turned in within 24 hr
-50% if turned in within 48 hr

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 professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.afl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their

Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-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://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-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. Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

23. 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.

24. 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: <https://registrar.ufl.edu/ferpa.html>

25. Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but

not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

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 Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](#), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

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. <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.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.