Phys 6570 Electromagnetic Theory I

Instructor: Viktor A. Podolskiy
Office: Olney 125
e-mail: viktor_podolskiy@uml.edu
www: https://sites.uml.edu/viktor-podolskiy/teaching/electromagnetic-theory-i/

Textbook: Classical Electromagnetism, 3-rd edition
J.D. Jackson
ISBN: 0-471-30932-X

Meeting times: scheduled time: MWF 10:00am…10:50am

Office hours: MW 11:00am…noon, other times by appointment

Class format: As any math-intensive subject, electromagnetism is best understood by solving problems. Therefore, students are required to read and work through the relevant material before the class. The instructor will summarize the material during one or two classes per week. Students will solve and discuss selected homework problems the remaining classes.

Pre/co-requisites: Math Methods or instructor permission

Student learning outcomes: Upon completion of this course students will demonstrate the ability to:

1. Understand the relationship between polarization, electric field, and electric displacement, as well as between magnetization, magnetic field, and magnetic flux density.
2. Apply Maxwell equations to solve electrostatic and magnetostatic problems
3. Use Green's Function formalism to solve inhomogeneous partial differential equations
4. Perform integrals in complex coordinate plane

Homework grading policy: Student's performance while solving the problem during the class will count towards 50% of homework score. The other 50% of homework score will be based on graded homeworks. Teamwork is permitted and encouraged during homework solutions. However, it must be acknowledged.

Quizzes: will be based on material covered in class. Quizzes are closed/books/notes, and will be assigned throughout the problem-solving classes;

Midterm exam: is closed books, closed notes, based on problems assigned for in-class and homeworks.

Final exam is closed books, closed notes, based on homework problems and on problems solved in class. One single-sided formula sheet (prepared by the students) will be available during final exam.

Regrade policy: It is student's responsibility to prove that grading mistake has been made. When the issue of the regrade concerns the general method of solving the problem, partial credits, etc., the student will be asked to solve the problem on the blackboard in with closed books/closed notes. The instructor will then question the student on the related course material, and assign a new grade for the problem. The new grade can be higher or lower than the original grade.

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Grading policy: The grade is determined according to the total score based on:

In-class performance/homeworks:	20%
Quizzes	30%
Midterm:	25%
Final exam:	25%

E-mail communication with instructor: The instructor will use SIS to e-mail important course updates, class notes, etc. to the class. It is assumed that the students regularly check their e-mail.

Student Mental Health and Well-being: We are a campus that cares about the mental health and well-being of all individuals in our campus community, particularly during this uncertain time. If you or someone you know are experiencing mental health challenges at UMass Lowell, please contact Counseling Services, who are offering remote counseling via telehealth for all enrolled, eligible UMass Lowell students who are currently residing in Massachusetts or New Hampshire. I am available to talk with you about stresses related to your work in my class

Missed classes/exams/homeworks: as a rule, there are no makeup exams/homeworks/quizzes. In extraordinary circumstances (severe but short illness, jury duty, etc.) the homework may be postponed, the makeup exam can be arranged, or the score of other assignments can be prorated to cover the missed work. In these cases, the student must inform the instructor as early as possible, and obtain a written approval.

Diversity, Inclusion, and Classroom Community Standards: UMass Lowell community values human diversity in all its forms, whether expressed through race and ethnicity, culture, political and social views, religious and spiritual beliefs, language and geographic characteristics, gender, gender identities and sexual orientations, learning and physical abilities, age, and social or economic classes. Enrich yourself by practicing respect in your interactions, and enrich one another by expressing your point of view, knowing that diversity and individual differences are respected, appreciated, and recognized as a source of strength

Academic integrity: any suspected cheating or other academic fraud cases will be reported and prosecuted according to UML policy: (https://www.uml.edu/Catalog/Graduate/Policies/Academic-Integrity.aspx). It is the students' responsibility to familiarize themselves with these policies. Students are responsible for the honest completion and representation of their work.

Tentative Course Schedule:

Week #		Chapter	Analytical HW	Numerical HW
1 2	Sep 1,3, Sep 8, 10	1.1-1.11, 1.13	1.3, 1.5, 1.6, 1.21 (a) (due 9/20)	1.21(b), V1
3 4 5	Sep 13, 15, 17 Sep 20, 22, 24 Sep 27, 29, Oct 1	2.1-2.7 2.10,2.11	Section 2.7, prbs. 2.2, 2.3, 2.7,2.9, 2.26 (due 10/4)	V2,V3, 2.26
6 7	Oct 4, 6, 8 Oct 13, 15	3.1-3.10	3.3, 3.5, 3.7 (due 10/18)	V4,V5
8 9	Oct 18, 20§, 22 Oct 25, 27, 29	4.1-4.5, 4.7	4.1, 4.2*, 4.7, 4.9, V6, V7 (due 11/1)	4.11, V8
10 11	Nov 1, 3, 5 Nov 8,10,12	5.1-5.4 5.6-5.12	V9, 5.3, 5.10, 5.15, V10,5.19 (due 11/15)	
12 13	Nov 15,17,19 Nov 22	5.15, 5.16	5.21 (due 11/29)	
14 15	Nov 29, Dec. 1, 3 Dec. 6, 8, 10	6.1-6.4, 6.7	6.1, 6.3(a,b), 6.5 (a,b,c*) (due 12/10)	

Quiz, HW solution, §=midterm, *=Extra Credit

Updated versions of the schedule will be posted online/e-mailed to the class.

Additional problems (Vxx):

1. Solve problem 1.21 using relaxation technique
2. Demonstrate that solutions obtained with relaxation method are consistent with analytical results of Sec. 2.10,
3. Demonstrate that the solution obtained with relaxation method are consistent with analytical results of Sec. 2.11
4. Analyze the convergence of the series 3.23 from the textbook; plot the partial sums, as well as the mean deviation between the partial sum of 3.23, and the function shown in Fig.3.2 as the function of the number of terms in the partial sum.
5. Plot the potential along the z axis using Eq.(2.22) from Jackson and using series (3.33) with appropriately chosen A_l, B_l coefficients.
6. Derive Eq. (4.18) from Jackson
7. Calculate effective permittivity of a multi-layer mixture formed by layers of permittivity ϵ_i, concentration p, dispersed within host layers of permittivity ϵ_h. Note: your permittivity is anisotropic (depends on direction)! Calculate permittivity in the direction along the layers and perpendicular to layers.
8. Extend your relaxation technique to ponderable media. Use your numerical codes to calculate the field inside a polarizable cylinder (relative polarizability ϵ_i) subject to homogeneous electromagnetic field, directed *perpendicular* to the cylinder. Check your solution analytically. Does your code work for $\epsilon_i < 0$?
9. Derive Eq.(5.36)
10. Section 5.12