Electromagnetic Field Theory - PHYS 3332
Department of Physical and Environmental Science
Fall 2019

A. COURSE INFORMATION

Course number/section: PHYS 3332.301
Class meeting time: Tuesday, Thursday 11:00AM – 12:15PM (Lecture)
Class location: CCH 221 (Corpus Christi Hall)
Course Websites: https://wtclass.wtamu.edu
Campus Numbering:

<table>
<thead>
<tr>
<th>Campus Numbering</th>
<th>Course Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midwestern State University</td>
<td>PHYS 3323</td>
<td>Texas A&amp;M University-Corpus Christi</td>
</tr>
<tr>
<td>Prairie View A&amp;M University</td>
<td>PHYS 3123</td>
<td>Texas A&amp;M University-Kingsville</td>
</tr>
<tr>
<td>Tarleton State University</td>
<td>PHYS 332</td>
<td>Texas Southern University</td>
</tr>
<tr>
<td>Texas A&amp;M University-Commerce</td>
<td>PHYS 412</td>
<td>West Texas A&amp;M University</td>
</tr>
</tbody>
</table>

B. INSTRUCTOR INFORMATION

Instructor: Dr. Barbara Szczerbinska
Office location: NRC 3508
Office hours: Tuesday 8:30AM-10:30AM CDT
Wednesday 1PM-3PM CDT
Thursday 8:30AM-10:30AM CDT
Telephone: (361) 825-3916
E-mail: Barbara.Szczerbinska@tamucc.edu
Appointments: Appointments outside of the office hours should be scheduled via email

C. COURSE DESCRIPTION

This course contains a mathematical introduction to electricity and magnetism, including electrostatics, Laplace's equation, the theory of dielectrics, magnetostatic fields, electromagnetic induction, magnetic fields of currents, and Maxwell's equations.
This course is offered through the Texas Physics Consortium (TPC).

D. PREREQUISITES AND COREQUISITES

Prerequisites: PHYS 2426, University Physics II

Co-requisites: MATH 3315 – Differential Equations or MATH 2415 – Calculus III

E. REQUIRED TEXTBOOK, READINGS AND SUPPLIES

Other Required Materials: Scientific Calculator and access to WTClass.
F. STUDENT LEARNING OUTCOMES AND ASSESSMENT

Student Learning Outcomes:
Upon successful completion of this course, students will:
1. Know Coulomb’s law and be able to use it to solve for the electrostatic force applied upon a point charge by a collection of other point charges.
2. Know the definitions of standard terms in electromagnetism including electric potential, electric field, magnetic field, magnetic vector potential, induction, capacitance, etc.
3. Know the formula for the electric field due to an infinitesimal point charge and be able to use it to calculate the electric field due to either a collection of discrete point charges or a continuous surface, line or volume charge density.
4. Know the formula for the electric potential due to an infinitesimal point charge and be able to use it to calculate the electric potential due to either a collection of discrete point charges or a continuous surface, line or volume charge density.
5. Be able to find the electric field at a point in space given the electric potential
6. Be able to apply Gauss’ Law to solve for the electric field in an electrostatic problem that involves a high degree of symmetry.
7. Be able to apply various solution techniques to solve Poisson’s and Laplace’s Equations.
8. Know the meaning of polarization, displacement vector, and dielectric constant and be able to use these concepts to solve problems involving dielectric media.
9. Be able to determine the magnetic field created by either a line, area, or volume current density.
10. Be able to write Maxwell’s equations in both integral and differential form.
11. Be able to show that the solution to Maxwell’s equations for time varying fields in free space are electromagnetic waves with the speed c.
12. Be able to apply mathematical techniques necessary to solve E&M problems including the application of vectors, vector and integral calculus

Content of the Course:
1. Vector Analysis
2. Electrostatics
3. Potentials
4. Electric Fields in Matter
5. Magnetostatics
6. Magnetic Fields in Matter
7. Electrodynamics
8. Conservation Laws
9. Electromagnetic Waves

G. INSTRUCTIONAL METHODS AND ACTIVITIES

Reading Assignments: Students are expected to complete the assigned reading before the stated deadline – see the Course Content/Schedule section for details.

Homework Assignments: There will be 7 homework assignments throughout the semester. Each assignment will be posted on the WTClass course webpage. Homework has to always be uploaded on the course website. Please see section I Course Content/Schedule for details regarding the deadlines. There are no homework makeups and homework will not be accepted late. All homework must be hand-written (no typed homework will be accepted) on standard 8.5 by 11 inches paper in ink.
pencil). Each page must have the student’s first and last name, the homework number (HW#1, HW#2, HW#3, etc) and the due date written at the top of each page. The homework pages need to be scanned into a single PDF document and submitted through WTClass. Please, make sure that your handwriting and the resulting digital images are legible. The title of the pdf file needs to include the homework number followed by the student’s name (for example HW1_Barbara_Szczerbinska, HW2_Barbara_Szczerbinska, etc.). The homework will be graded on the quality of your reasoning and math and how well they support the result obtained. Collaboration in figuring out how to approach the homework is permitted and encouraged, but you must work out and write up your solutions independently. You need to be able to explain each step of your solution. Copying from your colleagues or manual solutions is forbidden and will result in grade of zero for that assignment.

**Teamwork:** Study groups for this course are encouraged. Such groups should meet outside of designated class time in order to discuss the reading materials, physics concepts, and numerical problems. However, each homework assignment is required to be worked out and submitted individually. Midterm test and final exam are also based on the individual work.

**Exams:** All exams will be closed book exams. You are allowed to prepare a basic formula sheet (handwritten, 1 page on standard 8.5 by 11 inches paper) to be used during the midterm and final exam that will need to be submitted together with the exams. No solutions to the problems/examples are allowed on the formula sheet! Copy of the cover pages 2, 3, 4 and 5 of the textbook will be provided during the exams. Exams will require to work out the solutions to problems similar to the one on the homework assignments, textbook examples (frequently worked out in class) or problems recommended for review study. Exam dates and times are tentatively posted in the Course Content/Schedule section and will also be announced in class. More specific guidance on material for the exams will be provided prior to the exams. If you know ahead of time you must miss an exam, please make arrangements with me as soon as possible. If you miss an exam I will require a reason in writing and documentation before I will consider a make-up.

**WTClass:** All Class notes, homework assignments and videos will be posted using TPC’s WTClass management system. It is student’s responsibility to check the system prior to each class meeting, complete reading and homework assignment and submit the latter through WTClass prior to the deadline. All graded homework will be returned via WTClass.

**H. MAJOR COURSE REQUIREMENTS AND GRADING**

Final composite numerical requirements grade is based on the following weightings to the different components:

<table>
<thead>
<tr>
<th>Evaluation Type</th>
<th>Percentage of Total Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework Assignment</td>
<td>45%</td>
</tr>
<tr>
<td>Midterm Test</td>
<td>25%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>30%</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Your letter grade will be determined using the university catalog's description of the meaning of each letter grade, and the instructor's criteria for translating that description to actual numerical grade ranges. The procedure for awarding letter grades will be as follows:

<table>
<thead>
<tr>
<th>% Grade</th>
<th>Letter Grade</th>
<th>Catalog Meaning of the Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>90% and above</td>
<td>A</td>
<td>Excellent</td>
</tr>
<tr>
<td>80% to 89.9%</td>
<td>B</td>
<td>Good</td>
</tr>
<tr>
<td>70% to 79.9%</td>
<td>C</td>
<td>Average</td>
</tr>
<tr>
<td>60% to 69.9%</td>
<td>D</td>
<td>Passing</td>
</tr>
<tr>
<td>Below 60%</td>
<td>F</td>
<td>Failing</td>
</tr>
</tbody>
</table>

The numerical value of the grade will be rounded to one decimal place. Example: 89.94 is equivalent to 89.9 and will be considered B; 89.96 is equivalent to 90 and will be considered A.

**I. COURSE CONTENT/SCHEDULE**

**Tentative PHYSICS 3332 Course Calendar**

If any changes to any of the below stipulations are made, they will be announced in class and on the course website, and you are responsible for keeping yourself informed of such changes:

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Lecture topic</th>
<th>Reading Assignment</th>
<th>Homework Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>08-27</td>
<td>Introductions and Expectations. Vector Algebra</td>
<td>Ch.1.1</td>
<td>HW #1</td>
</tr>
<tr>
<td></td>
<td>08-29</td>
<td>Differential Calculus</td>
<td>Ch.1.2</td>
<td>Open: 08/27 @11:00am Due: 09/09 @11:00am</td>
</tr>
<tr>
<td>2</td>
<td>09-03</td>
<td>Integral calculus</td>
<td>Ch.1.3</td>
<td></td>
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<tr>
<td></td>
<td>09-05</td>
<td>Spherical and Cylindrical Coordinates</td>
<td>Ch.1.4</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>09-10</td>
<td>Dirac Delta Function Theory of Vector Fields</td>
<td>Ch.1.5-1.6</td>
<td>HW #2</td>
</tr>
<tr>
<td></td>
<td>09-12</td>
<td>Electric Field Divergence and Curl of Electrostatic Fields</td>
<td>Ch.2.1-2.2</td>
<td>Open: 09/10 @11:00am Due: 09/23 @11:00am</td>
</tr>
<tr>
<td>4</td>
<td>09-17</td>
<td>Electric Potential</td>
<td>Ch.2.3</td>
<td></td>
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<tr>
<td></td>
<td>09-19</td>
<td>Work and Energy in Electrostatics Conductors</td>
<td>Ch.2.4-2.5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>09-24</td>
<td>Laplace’s Equation Method of Images</td>
<td>Ch.3.1-3.2</td>
<td>HW #3</td>
</tr>
<tr>
<td></td>
<td>09-26</td>
<td>Separation of Variables</td>
<td>Ch.3.3</td>
<td>Open: 09/24 @11:00am Due: 10/07 @11:00am</td>
</tr>
<tr>
<td>6</td>
<td>10-01</td>
<td>Separation of Variables cont. Multipole Expansion</td>
<td>Ch.3.3-3.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10-03</td>
<td>Polarization</td>
<td>Ch.4.1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>10-08</td>
<td>The Field of Polarized Object</td>
<td>Ch.4.2</td>
<td>HW #4</td>
</tr>
<tr>
<td></td>
<td>10-10</td>
<td>Electric Displacement Linear Dielectrics</td>
<td>Ch.4.3-4.4</td>
<td>Open: 10/08 @11:00am Due: 10/21 @11:00am</td>
</tr>
<tr>
<td>Date</td>
<td>Week</td>
<td>Details</td>
<td></td>
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</tbody>
</table>
| 8    | 10-15 | Midterm Exam 11am-12:15pm CDT  
Material covered:  
Ch. 1.1-4.1 (textbook, homework, lectures)  
Ch.4.2-4.4 (lectures) |
| 9    | 10-17 | Lorentz Force Law  
Ch.5.1 |
| 10   | 10-22 | Biot-Savart Law  
Ch.5.2-5.3 |
| 10   | 10-24 | Divergence and Curl of B  
Magnetic Vector Potential  
Ch.5.4 |
| 10   | 10-29 | Magnetization  
Field of magnetized Object  
Ch.6.1-6.2 |
| 10   | 10-31 | Auxiliary Field  
Linear and nonlinear Media  
Ch.6.3-6.4 |
| 11   | 11-05 | Electromotive Force  
Ch.7.1 |
| 11   | 11-07 | Electromagnetic Induction  
Ch.7.2 |
| 12   | 11-12 | Maxwell’s Equations  
Ch.7.3 |
| 12   | 11-14 | Charge and Energy  
Ch.8.1 |
| 13   | 11-19 | Momentum  
Ch.8.2 |
| 13   | 11-21 | Waves in One Dimension  
Ch.9.1 |
| 14   | 11-28 | Electromagnetic Waves in Vacuum  
Ch.9.2 |
| 14   | 11-30 | Thanksgiving – no classes |
| 15   | 12-05 | Electromagnetic Waves in Matter  
Ch.9.3 |
| 15   | 12-07 | Reading Day – no classes |
| 16   | 12-10 | Final Exam 11am-1:30pm CDT  
Material covered:  
Ch.1.1-4.4 (textbook, homework, lectures) – 40%  
Ch.5.1-9.3 (textbook, homework, lectures) – 60% |

**J. COURSE POLICIES**

**Attendance/Tardiness**
Students are expected to be present for all scheduled classes. In case of missing the scheduled class, students are responsible for all material covered and/or assigned during that class period. Students need to contact the instructor in advance about missing assignment or exam AND need to provide a valid reason in writing and documentation for the absence to be considered an excused absence. Valid reasons for missing homework or exam are (1) health related, backed by a doctor's note, (2) family emergency which can be documented, (3) job interview with the letter of invitation for the interview, and (4) participation in a previously scheduled athletic, or university event or travel to a conference. In case of excused absence, missed homework and tests may be made up and will be handled on a case by case basis with prior notification required unless absolutely impossible.

**Late Work and Make-up Exams**
There are NO provisions for making up exams except in cases where prior arrangements have been made with the instructor and which are approved by university guidelines. Valid reasons for missing a
homework or exam are (1) health related, backed by a doctor's note, (2) family emergency which can be documented, (3) job interview with the letter of invitation for the interview, and (4) participation in a previously scheduled athletic, or university event or travel to a conference. In case of emergency resulting in not informing the instructor of your absence from class, contact the instructor at your earliest convenience regarding your absence.

**Cell Phone Use**

Cell phones can not be used in class.

**Computer Use**

The lecture videos, lecture notes and homework assignments will be posted on the course website. The internet access will be needed to access the materials.

K. COLLEGE OF SCIENCE AND ENGINEERING AND TEXAS A&M UNIVERSITY CORPUS CHRISTI POLICIES

- **Academic Integrity (University)**
  
  University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

- **Classroom/Professional Behavior**
  
  Texas A&M University-Corpus Christi, as an academic community, requires that each individual respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

- **Statement of Civility**
  
  Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

- **Deadline for Dropping a Course with a Grade of W (University)**

  I hope that you never find it necessary to drop this or any other class. However, events can sometimes occur that make dropping a course necessary or wise. *Please consult with your academic advisor, the Financial Aid Office, and me, before you decide to drop this course.* Should dropping the course be the
best course of action, you must initiate the process to drop the course by going to the Student Services Center and filling out a course drop form. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Please consult the TAMU-CC Academic Calendar (http://www.tamucc.edu/academics/calendar/) or corresponding campuses for the last day to drop a course.

- **Grade Appeals (TAMU-CC, College of Science and Engineering)**
  As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at http://www.tamucc.edu/provost/university_rules/index.html, and the College of Science and Engineering Grade Appeals webpage at http://sci.tamucc.edu/students/GradeAppeal.html. For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the Col. of Science and Engineering Dean, or the Office of the Provost.

- **Disability Services**
  The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116. If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816. http://disabilityservices.tamucc.edu/

- **Statement of Academic Continuity**
  In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

L. **OTHER INFORMATION**

- **Academic Advising**
  At Texas A&M University–Corpus Christi, the College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising
Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

- **Academic Calendar (TAMU-CC campus)**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 26</td>
<td>Classes begin</td>
</tr>
<tr>
<td>September 2</td>
<td>Labor day Holiday</td>
</tr>
<tr>
<td>September 3</td>
<td>Last day to late register or add a class</td>
</tr>
<tr>
<td>November 8</td>
<td>Last day to drop a class</td>
</tr>
<tr>
<td>November 14</td>
<td>Last day to apply for December graduation</td>
</tr>
<tr>
<td>November 27</td>
<td>Reading Day-No Class</td>
</tr>
<tr>
<td>November 28-29</td>
<td>Thanksgiving Holidays</td>
</tr>
<tr>
<td>December 3</td>
<td>Last day to withdraw from the University</td>
</tr>
<tr>
<td>December 4</td>
<td>Last day of classes</td>
</tr>
<tr>
<td>December 5</td>
<td>Reading Day</td>
</tr>
<tr>
<td>December 6-7, December 9-12</td>
<td>Final examinations</td>
</tr>
<tr>
<td>December 13-16</td>
<td>Grading days</td>
</tr>
<tr>
<td>December 14</td>
<td>Fall Commencement</td>
</tr>
<tr>
<td>December 17</td>
<td>Fall grades due at noon</td>
</tr>
</tbody>
</table>

**M. GENERAL DISCLAIMER**

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods. The updated information will also be available on the Blackboard website.