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Emergencies: MacIsaac is carrying a cell phone (716) 909 – 2233 (24h) for the duration of PHY622.

Course Web Pages:  <http://Angel.BuffaloState.Edu> and

Course Particulars:
This is a 6 credit-hour graduate physics course with integrated laboratory. Class meets daily in SC (Science Bldg) 206, 205 and 203 and environs 8:00am-5:00pm M-F 3-21Aug2009, with some supplementary sessions.

Pre-requisites:
- Physics teaching experience or active status in a BSC physics teaching program OR
- Permission of the instructor.

Textbook:
The required text distributed free of charge is: Dukerich, L. (Ed) (2006). *Modeling Instruction in High School Physics 2007*. The authors: Tempe, AZ. You will be provided with a paper copy of this and an editable electronic copy on CD for reproduction and modification free of charge.


We will also be using readings supplied in-class, notably from the *American Journal of Physics (AJP)* and *The Physics Teacher (TPT)*. All readings other than Arons and Chabay will be provided in class.
Course Rationale (approved by BSC Senate):

There is a significant and growing research base in physics education exploring students’ naive conceptions about physical phenomena and examining how pedagogy can be designed to facilitate the construction of powerful mental models. Physics education research suggests that the most effective way to train future science teachers is to combine content courses with pedagogical training. In light of these findings, New York State Education Department regulations require teachers to complete twelve credits of graduate study combining content and pedagogy. This course is designed to meet these requirements and will be part of a course of study for physics teachers and for post baccalaureate students seeking physics certification.

Major Objectives (approved by BSC Senate):

A. The students will develop and apply powerful ideas describing the nature of electric charge including using quantitative modeling to solve complex problems.
B. The students will develop and apply powerful ideas describing electric current including using quantitative modeling to solve complex problems.
C. The students will develop and apply powerful ideas describing the nature of magnetism including using quantitative modeling to solve complex problems.
D. The students will develop and apply powerful ideas in electromagnetism including using quantitative modeling to solve complex problems.
E. The students will apply findings from current education research in examining innovative teaching strategies.

Topical Content (approved by BSC Senate):

PHY622 physics topics will include selected activities a number of Physics Education Research (PER) –informed curricula, particularly featuring activities from the ASU Modeling Physics curriculum, the SDSU CPU curriculum and the texts and readings. Appropriate manuscripts from peer-reviewed PER and Science Education Research (SER) journals, particularly featuring publications from the American Journal of Physics and The Physics Teacher. A detailed but not exclusive list of physics topics likely to be addressed in PHY622 follows:

A. Electrostatics
   1. Charge, field, and potential
   2. Coulomb’s law and field and potential of point charges
   3. Fields and potentials of other charge distributions
   4. Gauss’s law
   5. Conductors, capacitators, dielectrics
      a. Electrostatics with conductors
      b. Capacitors
      c. Dielectrics
B. Current electricity
   1. Current, resistance, power
   2. Steady-state direct current circuits with batteries and resistors only
   3. Capacitors in circuits
C. Magnetism
   1. Nature of magnetic materials and magnetizing objects
2. Forces on moving charges in magnetic fields
3. Forces on current-carrying wires in magnetic fields
4. Fields of long current-carrying wires
5. Biot-Savart and Ampere’s law

D. Electromagnetism
1. Electromagnetic induction (including Faraday’s law and Lenz’s law)
2. Inductance
3. Maxwell’s equations

E. Physics education research in electricity and magnetism
1. Role of reflective journaling
2. Current research findings
   a. Common naive conceptions of students
   b. Identifying powerful ideas central to these topics
3. Role of technology in teaching electricity and magnetism
4. Examining innovative teaching strategies

Course Structure:
This course is not structured as a traditional lecture course; it is much more intense with considerable and unusual responsibility for learning placed upon the student. We will be demonstrating the kind of reformed instruction that physics education research has shown to be responsible for significantly improved student conceptual learning. You will typically work through selected activities alternating between the roles of teacher and student. You will have daily homework, and must plan for weekly learning commentaries, a final project and a final exam. Instructors and facilities will be made available in evenings to supplement regular classroom instruction, and the center of most days is open for student cooperative work and instructor consultation.

Required Materials:
You will have access to a modern internet-connected computer and word-processor for assignments on BSC campus, though you may choose to complete some of these homework assignments offsite. You must also have access to a modern word processor to complete your pre-arrival assignment. All assignments must be word-processed, and available in a readable format (as either .doc, .pdf, .rtf or .htm/.html files). Keep personal back-up copies of your work on your own machines and disks for your own safety. You are strongly urged to have an email account accessible from BSC computers (BSC will supply for-credit registered students with another such account). You must also supply a scientific calculator, a mechanical pencil, a pen, paper, graph paper, a ruler and a protractor.

You will be provided with a three-ring binder, copies of most course materials, including paper and electronic copies of the Modeling Physics curriculum for teaching E&M. At the end of the course, you will also be provided with a CD-ROM of course related materials including student-created artifacts, some limited amount of physics teaching apparatus, and one dozen whiteboards.

Schedule:
The regularly- and frequently-updated course schedule is available from the course webpage.
Assessment of Outcomes and Grades:
Below is the guaranteed grading scale. We reserve the right to lower grade cutoffs but will not raise them.

- ≥ 90% A
- ≥ 80% B
- ≥ 70% C
- ≥ 60% D

Course assignments will be assessed and weighted as follows.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Grade</th>
<th>Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Arrival Assignment</td>
<td>4%</td>
<td>3 Aug 09</td>
</tr>
<tr>
<td>Reading and Modeling HWs, pre/post tests</td>
<td>40%</td>
<td>schedule</td>
</tr>
<tr>
<td>Attendance and Daily Journal</td>
<td>4%</td>
<td>daily</td>
</tr>
<tr>
<td>3 learning Commentaries</td>
<td>12%</td>
<td>Fridays</td>
</tr>
<tr>
<td>Final poster project</td>
<td>10%</td>
<td>21 Aug 09</td>
</tr>
<tr>
<td>Final Content Pyramid exam</td>
<td>30%</td>
<td>20 Aug 09</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

Pre-Arrival Assignment (4%):
A two part project involving reflection on physics pedagogy, setting personal and course learning goals available from the course homepage. It is due on the first day of the course.

Reading Homework, Modeling Homework and Pre/Post testing (40%):
In accord with agreements with the National Science Foundation, on the first and second last days of the course a battery of conceptual and attitudinal instruments will be completed by all students to assess the impact of PHY622. Students will receive credit for completeness and effort upon these instruments. Details for each homework will be made available upon the course webpage as each is assigned.

Attendance and the Daily Diary (4%):
Students will keep a daily word-processed learning journal which will be graded upon completeness at the end of each week of the course. Each daily entry will consist of a single page or less which must contain the following elements: 1) highlights of what happened that day; 2) some new physics OR physics teaching idea you struggled with; 3) a new insight (or AHA!) that you gained during the class; and 4) an open question you have as a result of the day that would you like to have addressed in a discussion. This diary will be used to generate your learning commentaries and electronic and hardcopy versions will be collected at the end of the course. Due to the intense scheduling of this course and SUNY regulations, student absences that result in any student not completing a minimum of 100 hours of contact instruction must result in a grade of F, W or I for PHY622.
Learning Commentaries (3 x 4%):
Each week a learning commentary (LC) will be due Fridays at 8:00am. LCs are brief two to three page formal essays written after completing and reflecting upon each week's effort. A learning commentary is a story describing at length the evolution of your thoughts on ONE SINGLE SCIENTIFIC IDEA of your own choice. You will describe your initial thoughts, activities, discussions that change or confirm how you think with examples and your final scientific thoughts on a single physics concept. Learning commentaries are word-processed and you will hand in paper copy and a second copy either on disk or as an email attachment. Write your learning commentary starting from your diary, notes and classroom materials. Learning commentaries are graded based upon the quality and quantity of your comments and examples, together with how you support claims for your final scientific ideas with specific data taken from classroom observations and activities. In particular, we will be looking for:
- a description of your initial scientific ideas regarding your chosen physics concept based upon your previous life experiences, together with a description of your supporting evidence for your conceptual state regarding this concept:
- a substantive discussion of how various class discussions and activities promoted change in your understanding of this physics concept, giving specific examples as supporting evidence; and
- a brief description of your final scientific ideas and insights regarding your chosen physics concept.

Final Poster Project (10%):
PHY622 will host a poster/presentation session at the end of the course where students will cooperatively present scholarship on the teaching and learning of E&M to all course participants. Details on this assignment will be made available in class.

Final Content Pyramid Exam (20% + 10%):
Electricity and Magnetism content will be evaluated via a one hour content exam given at the end of the course. This exam will address physics ideas treated during the course, including those typical of NYSED Regents' Physics Exams and the NYSTCE Physics CST Exam amongst others. Content details will be forthcoming. The exam will be given in a pyramid format; that is singly for the first hour, then collected; and then again as a cooperative group assignment with a single grade shared amongst groups of three students. The two grades will be combined for a final grade.

Makeup assignments:
There will be one make-up homework assignment to substitute only for homework missed due to legitimate absence. Total absences may not drop any for-credit participant below 100 contact classroom hours for PHY622. There are NO other makeup arrangements. Late homework will be accepted only at the discretion of the instructor, typically for half-credit. Generally, no late assignment will be accepted unless a request is made before the assignment is due. The make-up homework assignment will only be accepted for institutional excuses or illness, and again, only by prior approval from the instructor.

Statement on plagiarism, cheating and professionalism:
This is a graduate course for professional educators, and we have absolutely no patience with cheating. Anyone caught cheating may receive a failing grade in the course. Working with other people on homework and activities is not considered cheating, and is in fact encouraged, though your submitted work should reflect your own interpretations and language. The highest professional conduct is expected of course participants, and unprofessional behavior including repeated tardiness will not be tolerated.
Reading Homework Assignments RHW1-6:

RHW1: Arons Ch6
Write a 2-3 page reflective essay discussing how two of the author’s ideas from this reading can be interpreted in light of your own experiences teaching and learning physics. Be prepared to discuss these in the course morning briefing session, and if possible relate the reading to experience from this course.

RHW2: Chabay & Sherwood Ch14 sections 14.4, 14.7
Read Chapter 14 of C&S, and prepare a Reading Log on Sections 14.4: Conductors and Insulators and 14.7: Sparks in Air. Be prepared to discuss these in the course morning briefing session, and if possible relate the reading to experience from this course.

RHW3: Arons Ch7
Write a 2-3 page reflective essay discussing how two of the author’s ideas from this reading can be interpreted in light of your own experiences teaching and learning physics. Be prepared to discuss these in the course morning briefing session, and if possible relate the reading to experience from this course.

RHW4: Saeli & MacIsaac
Write a 2-3 page reflective essay discussing how one of the author’s ideas from this reading can be interpreted in light of your own experiences teaching and learning physics. Discuss how the manuscript could be clarified for typical HS teachers. Be prepared to discuss these in the course morning briefing session, and if possible relate the reading to experience from this course. Note this paper was written from PHY622 course experiences.

RHW5: Arons Ch8
Write a 2-3 page reflective essay discussing how two of the author’s ideas from this reading can be interpreted in light of your own experiences teaching and learning physics. Be prepared to discuss these in the course morning briefing session, and if possible relate the reading to experience from this course.

RHW6: Chabay & Sherwood Ch18 sections 18.1-10
Read Chapter 18 of C&S, and prepare a Reading Log on Sections 18.1-18.10, focusing on the question of how and why electrons move within wires. Be prepared to discuss these in the course morning briefing session, and if possible relate the reading to experience from this course.

All RHWs are to be completed as word-processed files saved with names like RHW1YOURLASTNAME.doc and submitted by email attachment on Angel, as well as by a hardcopy print out turned in at 8am the due day. Include your full name, the date and title of the assignment at the start of each paper.