RUTGERS
Graduate School of Education

Learning and Teaching
Graduate School of Education
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Engineering Education: High School Physics
14:440:401 - 3 Credits
Syllabus - Summer 2014

Instructor: Tovi Spero	tdspero@gmail.com
Office Hours: by appointment	Prerequisites or other limitations: Background in physics, physical science, or engineering.
Mode of Instruction: Seminar	Permission Required: No

Learning Goals:

1. Learn about real-life engineering research through shadowing of Rutgers Engineering Faculty.
2. Be able to define and relate different types of engineering to high school level physics curricula.
3. Understand the process of engineering and how it relates to the Investigative Science Learning Environment Cycle (ISLE cycle).
4. Understand expectations for engineering-based learning in high school science classrooms under the Next Generation Science Standards (NGSS).
5. Develop real lesson plans for a high school physics classroom that incorporates engineering-based activities and projects.
6. Learn how to choose appropriate equipment for engineering design and building tasks including simulations.

Course Catalog Description

This course will afford pre-service teachers the opportunity to learn about the exciting world of engineering through hands-on investigation and link to their future classrooms through lesson development. By the end of the course, each participant should be able to give a sophisticated definition of engineering, give examples of how to apply physics content knowledge to engineering applications, and identify various ways to infuse engineering into the physics high school curriculum.

Reading Materials

1. Massachusetts Curriculum Frameworks – Science and Technology/Engineering
2. Next Generation Science Standards
3. Select articles published in peer-reviewed journals and conference proceedings

Online Resources

www.edmodo.com

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Meeting & Location
June 23rd – July 18th, 2014
Mondays, Tuesdays, Wednesdays & Thursdays 1:30 – 4:15pm
(3:30 – 6:25pm from July 7th – 10th)
Room 225, Graduate School of Education, College Avenue Campus

Assessment

Assessment in this course will be a mix of in-class engineering design projects, written homework, research shadow reflections, written lesson plans, and final exam. All assessments will be scored using a standards-based assessment approach.

Lesson Plans

Lesson plans submitted should include the following components:

- Teacher Name
- Title of lesson
- Date of lesson (date the lesson plan is due)
- Physics Unit (that the lesson fits in)
- Essential Question of the Unit
- Goals of the lesson
  - Relate each goal to NGSS where applicable
- Lesson Description (content of the lesson)
  - Include time intervals for each activity to estimate length of lesson
  - Include formative assessments and highlight in some way so they are easy to see
- Homework assigned
- Differentiation within the lesson
- Modifications made for students with specific needs

Make sure the lesson plans are formatted appropriately and submitted to www.edmodo.com. Also share them with me at tdspero@gmail.com via Google Drive so that I can give direct feedback and suggestions for each lesson plan.

Literature Review

Select articles from peer-reviewed journals and conference proceedings will introduce students to engineering education. Topics will relate to the P-12 classroom and focus on professional development and student learning. All pre-service teachers must read each assigned article and be prepared to engage in meaningful discussion. All will be responsible for facilitating class discussion on a select article, which includes composing a concise summary and preparing a list of 5 to 10 discussion questions for the class.

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Research Shadow

The research component provides an opportunity for pre-service teachers to shadow engineering graduate students and faculty. Pre-service teachers will learn about various engineering research projects by visiting labs, observing experiments, and discussing topics with hosting faculty/graduate students. At the conclusion of each shadow day, a one-paragraph reflection on what the research is about, the necessary science needed to understand it, and its possible use in a high school classroom should be uploaded to www.edmodo.com by midnight.

Final Exam

Final exam will be a lesson plan implemented in our class in the last week of the course. The teacher must come prepared with a lesson plan for a 45 min – 1 hour long lesson along with any materials necessary for the engineering design project. The teacher will lead the class in their lesson (including the professor) and be evaluated on their preparation and implementation.

Standard Assessment Scale

0	I did not hand in the assignment or skipped a portion of the assignment related to this standard.
1	I need significant help to improve my understanding of this standard. My current attempts do not show a solid understanding of the assignment or content assessed.
2	I am starting to understand this standard and need to work to improve my performance because my current work shows many errors or indicates a lack in proficiency.
3	I am proficient in this standard and meet the basic criteria for understanding but still make some mistakes or show a lack of complete and in-depth understanding.
4	I excel at this standard and made a few minor mistakes or none at all.

Standards (tentative and subject to change)

Teaching as a Profession Standards (teacher standards)
TAP1 – My work is submitted in a timely manner and is complete and does not exclude required content.
TAP2 – My work is formatted appropriately and checked for grammar and spelling errors.
TAP3 – I am prepared for class (e.g. reading assigned materials).

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Physics & Engineering Content Standards (student standards)
PEC1 – I can plan and carry out an investigation to answer questions or test solutions to problems; to perform investigations that provide evidence for and test conceptual, mathematical, physical and empirical models.
PEC2 – I can analyze and interpret data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
PEC3 – I can use mathematical and computational thinking to make mathematical representations of phenomena to describe explanations.
PEC4 – I can design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
PEC5 - I can communicate technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

Pedagogical Content Knowledge Standards (teacher/student standards)
PCK1 – I can ask a question or define a problem to formulate, refine, and evaluate empirically testable questions and design problems using models and simulations.
PCK2 – I can engage in an argument based on evidence to evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
PCK3 – I can find multiple ways of using a single engineering design project in a physics class (e.g. for different physics topics).
PCK4 - I can relate the Engineering Design Cycle and ISLE Cycle to each other and place an engineering design project at the appropriate place in the ISLE cycle and within a unit plan depending on the purpose of the project.
PCK5 – I can modify the difficulty or purpose of an engineering design task with materials requirement or other constraints.

Grade Calculation

Each standard is assessed multiple times and all scored for each standard are averaged. Standards are then identified as being:
Not Assessed (0 – 0.5)
Basic (0.5 – 1.5)
Developing (1.5 – 2.5)
Proficient (2.5 – 3.5)
Distinguished (3.5 – 4)

$$\text{Final Grade} = \frac{\text{Distinguished standards (avg score } \geq 3.5) + \frac{\text{Proficient standards } (2.5 \leq \text{avg score } \leq 3.5)}{2}}{\text{total \# of standards}}$$

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Students with Disabilities

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: https://ods.rutgers.edu/students/documentation-guidelines. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at: https://ods.rutgers.edu/students/registration-form.

Academic Integrity

Cheating and plagiarism are **NOT** acceptable. You must submit original work; i.e. lesson plans, hands-on projects, and reflections. "Students are responsible for understanding the principles of academic integrity fully and abiding by them in all their work at the University. Students are also encouraged to report alleged violations of academic integrity to the faculty member teaching the course in which the violation is alleged to have occurred" (http://academicintegrity.rutgers.edu/integrity.shtml).