Course information:

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1. Course name: Sci Tech & Soc II: Environment

2. Department: Physics

3. Number: 162

4. Cluster requirement: Science in the Engaged Community

Faculty information:

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5. Name: Alan Hirshfeld

6. Email: [ahirshfeld@umassd.edu](mailto:ahirshfeld@umassd.edu)

7. Phone: 617-510-7099

Required components:

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8. Master syllabus: [http:///webroots/www.umassd.edu/genedchecklist/holding/us\_phy162syllabusrev.doc](http://webroots/www.umassd.edu/genedchecklist/holding/us_phy162syllabusrev.doc)

9. Course overview statement:

This course provides a descriptive approach to understanding energy policies, energy production, and associated geological, air and environmental issues. Its quantitative, but otherwise non-mathematical, methodology is designed to provide students with a basic understanding of the many current environmental problems and challenges that we face as a society. Associated course topics include coal and oil production; nuclear energy options; wind, water, and solar power systems; and energy-efficient house-construction design.

PHY 162 is structured to help students fulfill the Cluster 2B science learning outcomes; upon successful completion of the course, they will be able to:

1. Analyze and evaluate the use of scientific information in the context of social, economic, environmental or political issues.

2. Apply scientific theories and knowledge to real-world problems.

3. Effectively communicate scientific information in writing.

Assessment of these learning outcomes is conducted throughout the semester by: direct faculty interaction with individual students as they work through an extended energy-efficient house-design project, a written report on the project, extent and quality of classroom discussion and an oral presentation during the weekly recitations, and grades on three tests and a final exam.

10. Signed faculty and chair sponsor sheet: sent separately.

11. Official course catalog description for the course:

PHY 162 - Science, Technology, and Society II: The Environment

3 credits

This course studies current environmental issues and their relations to technological choices. For example, air and water quality are examined in relation to the use of various renewable and non-renewable energy resources.

12. Course approval form: not entered.

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**Master Syllabus**

**Course: PHY 162, Science, Technology & Society II: The Environment**

**Cluster Requirement: 2B, Science in the Engaged Community**

This University Studies Master Syllabus serves as a guide and standard for all instructors teaching an approved in the University Studies program. Individual instructors have full academic freedom in teaching their courses, but as a condition of course approval, agree to focus on the outcomes listed below, to cover the identified material, to use these or comparable assignments as part of the course work, and to make available the agreed-upon artifacts for assessment of learning outcomes.

**Course Overview:**

This course provides a descriptive approach to understanding energy policies, energy production, and associated geological, air and environmental issues. Its quantitative, but otherwise non-mathematical, methodology is designed to provide students with a basic understanding of the many current environmental problems and challenges that we face as a society. Associated course topics include coal and oil production; nuclear energy options; wind, water, and solar power systems; and energy-efficient house-construction design. Students submit a thoroughly researched, written report on their house-design project.

Most recent instructor: Mr. John Silva, II – 203B, x8354, jsilva@umassd.edu.

**Learning Outcomes:**

Course-Specific Learning Outcomes:

After completing this course, students will have gained a knowledge of :

1. The origins of coal and oil

2. Oil refinery operations and their impact on the proximate environment

3. Coal mining techniques and their impact on the proximate environment

4. The differences between fission and fusion reactors and their operation

5. The inherent environmental impact of nuclear energy generation

6. The variations in wind turbine designs and their operation

7. Solar hot water design variations and limitations

8. Geothermal energy and its uses

9. Types of atmospheric pollution

10. Facts and myths about the greenhouse effect

11. Climate modeling

12. Hazardous waste disposal

13. Fundamentals of energy-efficient house construction

14. Use of house design software

University Studies Learning Outcomes:

After completing this course, students will be able to:

1. Analyze and evaluate the use of scientific information in the context of social, economic, environmental or political issues.

2. Apply scientific theories and knowledge to real-world problems.

3. Effectively communicate scientific information in writing.

**Examples of Texts and/or Assigned Readings:**

*Environmental Science*, G. Tyler Miller, Brooks/Cole Publishing (paperback)

Multiple resources from U. S. Geological Survey website supplement the text.

**Example Assignments:**

**PHY 162 Energy Efficient Home Project Part One**

Below is a map of the area and land tracts on which your projected home may be constructed. Each of the locations has its advantages and disadvantages. You will need to consider those as your home is designed. Along with the floor and exterior design, you will choose one of the four locations by placing a block or rectangular shaped symbol on the plot. The orientation of the house should be apparent.

LOT 1

Near wetlands area

Near access and public roads

Public and private buildings nearby

Area is relatively flat

Lacks public water and sewerage

Most expensive property

LOT 2

Area is relatively flat

Few trees on property

Near access and public roads

Has public water and sewerage installed

LOT 3

Smallest plot

On a slope

Numerous evergreens to the south and west

Has public water and sewerage installed on main road

May be some drainage problems from higher elevations

LOT 4

Highest elevation

Lacks access or public road at this time

Lacks public water and sewerage

Least expensive property

Choice of House Lots

1. Whether you chose the lot or not, which of the numbered house lots would allow you to take greatest advantage of the sun? Explain.

2. If your property does not have public water or sewerage, how did you solve the problem? What part of the budget was used? Note: You will need to use approximately $15,000 of your allotted $200,000 budget for this.

3. Since a constructed wind generator is part of this project, indicate its position on your property. Why did you place it there?

4. Which part of your house faces due south? Why?

5. What are two advantages that your choice of properties would have compared to the others?

6. What are two disadvantages that your choice of properties would have when compared to the others?

7. If you used solar panels, add $10,000 to the cost of construction. If the “payback” will not occur for at least 5 years, were they worth the installation?

**PHY 162 An Energy Efficient Home Part Two**

The fundamental design requirements and property restrictions for the energy efficient home are listed below. They are based upon common zoning rules and the general principles that will make this building energy efficient. Your proposed structure should be compliant with the listed standards and within $ 200,000 budget.

Property Regulations and Considerations

1. Only those trees found within your property boundaries may be removed. All other trees near your property boundaries must remain. A choice of properties will be supplied.

2. You may plant any number and type of tree on your property. Each tree added should be labeled as either an evergreen (E) or deciduous (D).

3. You may plant any type of shrub on your property. The location of each should be clearly indicated.

4. You need to consider the property’s elevation and potential obstruction to sunlight by surrounding trees.

5. Your structure is not limited to one level or story.

Solar Construction Principles

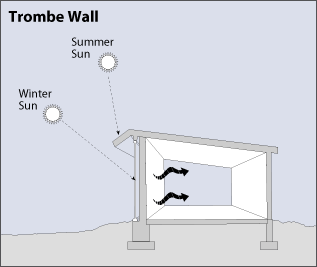
1. The longest wall of the home should face within 15 degrees, plus or minus, of true south to receive the most winter solar heat gain and reduce summer cooling costs. At 30 degrees east or west of south, winter heat gain is reduced by 15 percent from the optimum. Minimizing east and west facing walls with windows reduces excessive summer heat gain.

2. Direct gain systems can have up to 12 percent of the floor area in south-facing windows. However, every square foot of south-facing glass over the 7 percent sun tempering allowance must be accompanied by 5 square feet of 4-inch-thick masonry.

4. Lightweight materials should be lighter in color. Lighter colors absorb less energy (sunlight) and are more reflective. When light energy is absorbed, it is transferred into heat energy. If the material does not have sufficient storage mass, the material may heat up too quickly and release the excess heat to the room air, causing overheating.

5. Buffer the north side of the building. Place rooms with low heating, lighting, and use requirements, such as utility rooms, storage rooms and garages, on the north side of the building to reduce the effect of winter heat loads. This can reduce the normally higher heat loss through northern walls while not interfering with solar access. Rooms that generate their own internal heat, such as the kitchen, should also be placed on the north side. Landscaping elements, such as evergreen trees on the north and west sides of the house, can buffer against the cold winter winds and strong afternoon summer sun.

6. Sunspaces should include only vertical glass. Sloped glazing can cause serious overheating. Thermal storage or Trombe walls should be 8 to 12-inch-thick masonry. The outside of the masonry wall should be coated with a selective surface and the inside surface should be free of coverings. The outside of the glass should be covered or shaded in summer.



7. Your completed design should also indicate the air flow pattern within the building.

8. Each of the following is required with your floor plan:

a. family room

b. at least one bathroom

c. at least two bedrooms

d. a kitchen area

e. closet space

9. A completed project includes:

a. the cost estimate from Building-Cost.net

b. a completed question sheet that appears on the next page

c. a property plan with a footprint of the house

d. a floor plan with dimensions

e. one front and one side view of the structure

10. Building designs are not limited to a particular style. However, any unusual characteristics should be included on the floor plans or exterior illustrations.

Site / Building Questionnaire

Note: Answer to the following questions are only acceptable in essay form. Answers MUST be detailed.

1. Which room in your home would receive the greatest benefit from direct solar gain? Why?

2. What benefit did you gain by the removal or addition of trees or vegetation to your home?

3. Which part of your home is likely to be the warmest? Why?

4. Which part of your home is likely to be the coldest? Why?

5. In which direction is your family room oriented? Why was this done?

6. How does your home differ in efficiency compared to a typical home constructed in the past few years?

7. Which design features made your home more/less expensive than standardized new home construction?

8. What alternative energy forms are you using for this design? Why did you choose these?

9. How is this home heated?

10. Are wind generators or solar panels part of this project? If so, the location of each should be identified on the property plan.

11. What part of your house design are you willing to invest the most in? Why?

12. What part of your house design are you willing to invest the least in? Why?

13. What color did you choose to paint your house? Why?

14. How did you choose to make your house secure?

15. Attach a completed construction drawing of the house to this document.

16. What was the eventual cost of your project? Attach a completed construction cost estimate to this document.

**Outcomes Mapping and Grading**

This portion of the course will cause students to gain knowledge of the following:

1. The actual cost of construction.

2. Labor versus building material cost.

3. Energy options from inexpensive to costly.

4. Reading a topographic map.

5. Literal and visual step-by-step construction methodology.

6. Use of house design software to create a desired product.

7. Producing a formal design package in writing for financial or building contractors.

The project is a “real-world” life lesson that connects general scientific principles to a practical application. If students wish to pursue home ownership, they are now well aware of the economic barriers, environmental issues, practical energy alternatives, and construction choices through a combination of class lectures, cost estimate computer programs, Google Sketchup software, and class demonstrations.

The above project on the design and construction of an energy-efficient house clearly addresses all three of the category 2B learning outcomes:

1. Analyze and evaluate the use of scientific information in the context of social, economic, environmental or political issues.

2. Apply scientific theories and knowledge to real-world problems.

3. Effectively communicate scientific information in writing.

Variations in house styles are so numerous that multiple answers are possible for most of the questions that appear within the design project package. Grading of the assignment is based on the completeness and correctness of students’ answers to the questions and on the quality, viability, and justification of their house design. Students receive instructor feedback to understand any technological shortfalls in their design. Students submit a thoroughly researched, written report on their house-design project, fulfilling the writing component of the learning outcomes.

**Sample Course Outline:**

**PHY 162, Science, Technology and Society II: The Environment**

A general descriptive course in environmental issues and related geology for the non-science major. This quantitative, but otherwise non-mathematical, approach includes an introduction to air and water quality problems, a review of current energy applications and technologies, plus issues of concern that include global warming.

Instructors: John Silva and TBA

Recommended Text: *Environmental Science*, G. Tyler Miller, Brooks/Cole Publishing

Office Hours: Physics Department (203- B) hours to be posted

Campus Phone: 508-999-8354 or e-mail at: jsilva@umassd.edu

Grading Procedure: The semester grade will represent the average of the semester's 3 best exam scores, the assigned semester house-design project, and in-class and recitation presentation. The semester house-design project and in-class and recitation presentation are mandatory requirements of everyone. You CANNOT receive a grade in this course without the completion of the recitation requirements. Unless specified, all in-class assignments are due at the end of class and cannot be made-up at a later date. Late or missed assignments are not accepted due to the limited time frame of each topic. Also, with the exception of the final exam, dates for all exams will be announced in class. The potential of class cancellation due to weather conditions makes this a common sense requirement.

Recitation Requirements: The recitation hour will be used to discuss course related issues. Each class member will be responsible for a one-time, ten-minute presentation of a course-related topic. The procedure for this will be explained to you at your first recitation meeting. Further details concerning this portion of the class will be introduced at the first recitation meeting.

Classroom Computers: The use of individual laptops during recitation classes is NOT ALLOWED unless student services mandates a special needs requirement. A signed letter from the appropriate student service must accompany this request.

Semester Assignments:

Weeks 1, 2 and 3: Nonrenewable Energy Resources

Oil, coal, and nuclear energy, etc.

Topics also include pollution, energy limits, resource limits, and costs.

Week 4: Exam #1

Weeks 5, 6 and 7: Energy Efficiency and Renewable Energy

Wind power and wind turbines, solar panels for heating and electricity, and

geothermal potential.

Topics also include pollution problems, removing wastes, soil damage, and

assorted health issues.

Week 8: Exam# 2

Weeks 8, 9 and 10: Water and Air Pollution and Climate Change

Ozone Loss, types of pollutants, past episodes of climate change, future

climate models, hurricane modeling.

Week 11: Exam # 3

Weeks 12 and 13: Solid and Hazardous Waste, EPA standards, ozone levels, industrial

pollutants, reducing home energy expenses, artificial foods, food dyes,

sustainable resources, automotive engine designs, and public transportation.

Week 14: Final Exam

Topics and weeks listed above do not include overlaps into the following week or introduction to related topics.