1. Course number and name
   EML 4450 Energy Conversion Systems for Sustainability
2. Credits and contact hours
   3 cr, 2.5 contact hours (2 hrs. 30 min. lecture)
3. Instructor's or course coordinator's name
   Instructor: Dr. Juan Ordonez, Coordinator: Dr. Juan Ordonez
4. Text book, title, author, and year
   Fundamentals of Renewable Energy Processes, Da Rosa, A. V., 2012

   a. References, Additional Resources
   - Advanced Engineering Thermodynamics, Bejan, A., 2006
   - Solar Energy Engineering: Processes and Systems, Kalogirou, S. A., 2009
   - Fuel Cell Systems, Larminie, J. and Dicks, A., 2003
   - Sustainable Energy, Tester, J.W., Drake, E. M., Driscoll, M. J., Golay, M. W., and Peters, W. A., 2005
   - Renewable Energy, Sorensen, B., 2004
   - Direct Energy Conversion, Angrist, S. W., 1982
   - Energy and the Environment, Fay, J. A. and Golomb, D. S., 2002
   - Fundamentals of Engineering Thermodynamics, Sonntag, R. E., Borgnakke, C., and Van Wylen, G. J., 1998
   - Solar Engineering of Thermal Processes, Duffie, J. A. and Beckmann, W. A., 1991
   - Wind Energy Explained, Manwell, J.F., McGowan, J. G., and Rogers, A. L., 2002
   - One with Nineveh: Politics, consumption and the Human Future, Ehrlich, P. and Ehrlich, A., 2004.
   - The Solar Economy, Scheer, H., 2002
   - Renewable and Efficient Electric Power Systems, Masters, G. M., 2004
5. Specific course information
   a. brief description of the content of the course (catalog description)
   This course presents the challenge of changing the global energy system so it addresses reducing dependence on finite fossil energy sources and moving to environmentally sustainable energy sources. The emphasis is on greenhouse gas emissions-free energy production strategies, including renewable energy sources such as solar, wind and biomass. Topics include photovoltaic cells, fuel cells, and thermoelectric systems.
   b. prerequisites or corequisites
   Prerequisites: EML 3016C and senior standing in engineering
   c. indicate whether a required, elective, or selected elective course in the program
   Selected Technical Elective course
6. Specific goals for the course
   a. Course Outcomes
   1. Be able to understand why sustainable energy matters [1]
   2. Be able to analyze the intimate connection between the economics of development, the environment and energy [2]
   3. Be able to understand the processes involved in the emissions of greenhouse gases that affect climate [2]

4. Be able to calculate the thermal efficiencies of fossil fuel energy conversion systems using first and second laws of thermodynamics [3]
5. Be able to calculate the average solar radiation on horizontal and sloped surfaces [4]
6. Be able to analyze Stirling, Rankine and Brayton cycles with considerations of reheating, regeneration, and cogeneration [3, 4]
7. Be able to design a thermoelectric cooler [4]
8. Be able to design of a photovoltaic converter [4]
9. Be able to design a solar powered thermionic diode to supply power [4]
10. Be able to carry out design calculations for a PEM fuel cell [4]
11. Be able to carry out calculations of simple solar thermal system components – flat plate and concentrating collectors [5]
12. Be able to use simplified rotor performance calculation procedure to estimate the wind turbine performance [5]
13. Be able to carry out simple calculations for biomass power generation plant [5]

Numbers refer to Course Objectives below, e.g. for course outcome 1, [1] refers to course objective 1.

b. Course Objectives and Relation to Student Outcomes

1. To provide an understanding of the concept of sustainable future [6, 8]
2. To provide critical and thorough introduction to the subject of energy, its use and environmental effects, especially global warming [6, 8]
3. To provide an understanding of the role thermodynamic principles in energy conversion [3]
4. To introduce the major methods of direct energy conversion – thermoelectricity, photovoltaics, thermionics and fuel cells [1, 3]
5. To provide a survey of renewable energy systems, solar, wind and biomass [8]

Numbers refer to Departmental Student Outcomes, e.g. for course objective 1, [6, 8] refers to student outcomes 6, 8.

7. Brief list of topics to be covered
    - Energy systems in sustainable future
    - The science of global warming
    - Move towards a solar economy
    - Solar radiation characteristics
    - Photovoltaic generators
    - Thermodynamic fundamentals for energy conversion systems
    - Thermoelectric generators
    - Thermionic generators
    - Fuel cells
    - Wind Energy
    - Bioenergy
    - Ocean Energy
    - Geothermal energy