1. *Course number and name*
   ENGR 469: Alternative and Renewable Energy Systems

2. *Credits and contact hours*
   2 unit. Three 50-min or two 1-hr 15 min lectures per week.

3. *Instructor's or course coordinator's name*
   Instructor: Ed Cheng, Associate Professor

   Course coordinator: Ed Cheng, Associate Professor

4. *Text book, title, author, and year*
   Tidwell, J. and T. Wier. *Renewable Energy Resources*, 3rd Edition, Taylor & Francis, 2015

   e. *other supplemental materials*
      Various references and online material delivered via iLearn.

5. *Specific course information*
   m. *brief description of the content of the course (catalog description)*
      Theory and practical applications of renewable energy systems, including solar, hydro, and wind power. Biomass and biofuels. Environmental, social, and economic factors related to energy conversion processes.

   n. *prerequisites or co-requisites*
      ENGR 303.

   o. *indicate whether a required, elective, or selected elective course in the program*
      Elective for Civil Engineering; elective for Mechanical Engineering.

6. *Specific goals for the course*
   g. *specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.*
      - Identify the types and relative amounts of energy sources currently being used.
      - Understand the fundamentals and principal environmental impacts of conventional energy conversion processes.
      - Calculate direct solar irradiance based upon latitude and time.
      - Conduct basic engineering analyses of solar thermal systems used for both heating and electricity generation.
      - Understand the principles of photovoltaic electricity generation.
      - Assess the power available in stored water, given the elevation difference.
      - Perform basic calculations related to impulse and reaction hydro-turbines.

- Assess the power available in the wind, given the velocity or elevation and wind characteristic data.
- Understand aerodynamic design considerations with respect to wind turbine blade design.
- Identify the feedstocks, production methods, and life-cycle considerations associated with biomass and biofuels.
- Carry out basic energy and energy density calculations associated with biomass and biofuels.
- Calculate the energy available in waves given wave parameters or wave characteristic data.
- Identify the basic design characteristics and components associated with various practical renewable energy conversion devices.
- Identify the operation and energy storage density of various energy storage devices.
- Assess the relative environmental and economic impact of different renewable energy systems.
- Research a technical topic related to renewable energy systems and present the information to the class in an effective manner.

h. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
Course addresses ABET Student Outcome(s): a, c, e, g, h, j, k.

7. Brief list of topics to be covered

- Thermodynamics, fluid mechanics, and physics review
- Energy and the environment (including climate change issues) – petroleum and non-petroleum energy resources, energy consumption of developed vs. developing countries, regulated pollutants, CO2 and other global warming gases, importance of energy efficiency
- Solar power – characteristic of solar radiation, direct solar heating, and photovoltaic technologies
- Hydro power – fundamental energy analysis and types of hydro-turbines
- Wind power – review of wind turbine designs and performance; characteristics of the wind
- Nuclear power – brief overview of nuclear power and options for nuclear waste storage/disposal
- Biomass fuels – including ethanol, biodiesel, solid biomass fuels; discussion of different biomass feedstocks
- Geothermal power
- Wave and tidal power
- Fuel cells and hybrid vehicles
- Carbon sequestration
- Energy storage systems
- Life-cycle analyses