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
   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