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

5. **Specific course information**
   a. **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.
   b. **prerequisites or co-requisites**
      ENGR 303.
   c. **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**
   a. **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.

b. 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, i, 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