1. **Course number and name:** Hydrokinetic Turbine Systems

2. **Credits and contact hours:** (3-0-3) 3 hours of lecture per week, 3 credit hours.

3. **Instructor's or course coordinator's name:** Lakshmi N. Sankar

4. **Course Resources**
   - Lecture Notes and Modeling Tools
   - Technical reports at https://www.nrel.gov/

5. **Specific course information**
   a. **brief description of the content of the course (catalog description)**
   Assessment and quantification of hydrokinetic resources including tidal energy; horizontal axis and vertical axis hydrokinetic turbine modeling and design, airfoil design; integration of generators into a distributed energy system; cost of energy; environmental and societal factors.
   b. **prerequisites**
   At the level of AE 3030 (Aerodynamics) or ME 3340 (Fluid mechanics) or CEE 3040 (Fluid Mechanics)
   c. **corequisites**
   None
   d. **indicate whether a required, elective, or selected elective course in the program:**
   Elective.

6. **Course Outcomes**

   Outcome 1: The student will be able to use public domain resources to assess the annual production of energy in streams, rivers, and tidal basins taking into consideration seasonal variations, taking into consideration environmental effects, public policy, and societal factors.

   Outcome 2: The student will be able to use publicly available modeling tools to analyze and design horizontal and vertical axis hydrokinetic turbines.

   Outcome 3: The student will be able to estimate the levelized cost of energy production and assess the return on investment in isolated and distributed turbine systems,

7. **Brief list of topics to be covered**

   1) Course Overview and Fluid Dynamics Review (9 hours)
      a. Streamlines, vorticity, and Bernoulli equation
      b. Hydrofoil theory and modeling
      c. Cavitation effects
      d. Hydrofoil design

   2) Assessment of Hydrokinetic Energy Resources (6 hours)

a. Seasonal Variations
b. Tidal parameters for power production
c. Power density
d. Market size and Energy price.
e. Public Policy, green credit, and production tax credit
f. Environmental and Societal Considerations on the Placement of Turbine Systems

3) Modeling and design of Turbine Systems (18 hours)
   a. Actuator disk models
   b. Blade element - momentum theory-based modeling and design of Horizontal Axis and vertical axis turbine systems
   c. Rotating actuator line modeling of isolated and distributed turbine systems
   d. Computational fluid dynamics tools
   e. Incorporation of cavitation effects
   f. Optimization of turbine rotor Geometries

4) Levelized Cost of Energy (6 hours)

5) Case Studies (6 hours)

Assessment: Based on five equally weighted independent project reports. The reports will cover the following topics:

a. Selection of a hydrokinetic turbine site and assessment of its energy production potential
b. Computational modeling of benchmark horizontal axis water turbines and comparisons against available data
c. Computational modeling of benchmark vertical axis water turbines and comparisons against available data
d. Levelized Cost of Energy Estimates for the selected site and proposed turbine systems
e. Assessment of environmental and societal factors, and public policy considerations for the selected site and the proposed configurations