1. Course number and title
   ORE/CEE 624 Coastal Modeling

2. Credits and contact hours
   3 credits, one 2.5-hour session per week

3. Instructor
   Oceana Francis

4. Textbooks
   Textbooks: None
   Reference books:
   g. Coastal Engineering Manual – Part II, US Army Corps of Engineers, 2006 (PDF version on http://chl.erdc.usace.army.mil).
   h. *Handbook of Coastal and Ocean Engineering*, Vol. I, II, and III, Edited by John Herbich, Gulf Publishing Company, 1990.
   i. Aquaveo (2019). Aquaveo SMS 13.0 Tutorials. https://www.aquaveo.com/software/sms-learning-tutorials.
   j. XMS Wiki (2019). SMS. https://www.xmswiki.com/wiki/SMS:SMS.
   k. Francis, O., H. Brandes, G. Zhang, D. Ma, L. Yang, O. Doygun, H. Togia, C. Rossi, G. Costanzo (2019). State of Hawai‘i Statewide Coastal Highway Program Report. Prepared for the State of Hawai‘i Department of Transportation, Project Number HWY-06-16, August 21, 2019, https://hidot.hawaii.gov/highways/files/2019/09/State-of-Hawaii-Statewide-Coastal-Highway-Program-Report_Final_2019.pdf.
   l. Francis, Oceana; Yang, Linqiang; Togia, Harrison ; Tumino Di Costanzo, Giannicola (2019), Ocean Hazards Database (OHD) for the State of Hawai‘i Statewide Coastal Highway Program Report, Mendeley Data, doi: 10.17632/7p3hyypmjm.
   m. Other references provided by the Instructor, depending on model (e.g. BOUSS-2D, CMS, etc.) used that semester.

5. Specific course information
   d. Course context: Coastal modeling using the SMS Surface-Water Modeling software. Applications to solving coastal problems for different ocean hazard scenarios by applying models for tides, waves, coastal circulation, wave-current interaction, sediment transport, and/or morphology change. Pre-req: consent; knowledge of ORE 607 desirable.
   e. Prerequisites by Topics:
      i. Applied mechanics
      ii. Engineering economics
      iii. Fluid mechanics
      iv. Hydraulics
      v. Probability and Statistics
      vi. Soil Mechanics
      vii. Wave mechanics
   f. Designation: ORE elective course

6. Specific goals for the course

a. Learning Outcomes:
The goal is to develop the student's ability to understand and model surface water flow in several key areas:
- To use the SMS tool as a grid generator for multiple platforms.
- To setup and implement a coastal model in SMS.
- To apply the modeled output toward solving coastal problems.

c. Student Outcomes:

viii. Course provides in-depth technical knowledge in a subdiscipline of specialization (i.e. numerical modeling of coastal environments).

ix. Course provides the understanding of the interconnectivity of social, built infrastructure and natural systems.

x. Course provides evidence based thinking on the implications of sustainability problems and proposed solutions.

xi. Students evaluate and synthesize literature to develop engineering solutions.

xii. Students present their technical work orally in a formal setting.

xiii. Students produce a technical final report.

xiv. Students perform engineering research and a conduct project that address open-ended problems.

7. Topics covered

a. Introduction
Coastal processes management for communities

b. Nearshore Wave Models
Governing equations, linear dispersion properties, nonlinear properties, wave breaking, bottom friction

c. Solving the Numerical Solution
Finite difference scheme, boundary conditions, damping, porosity, wave runup

d. Grid Generation
Redistribute vertices along an arc, generate a Cartesian grid, merge unstructured grids, mesh Generation, manual mesh editing, quadtree grid generation

e. Working with Data
GIS, Google Earth, online data, measured field data, data visualization, spectral data, rasters, projections

f. Scatter Data, Size Function, Printing
Scatter data import/export, define extent of a scattered data set or TIN (triangulated irregular networks), scatter data filtering larger TIN files, adding breaklines to a scatter dataset, create and apply a size function to a 2D mesh model, print layout

g. Model Interface
Use the interface for model, setup, and run a simulation using data, create a cell-centered grid using data, use the model interface advanced features, roughness and probes, model instabilities and creating structures

h. Incorporating Climate Stressors into Coastal Modeling
Sea level rise, tides, waves, shoreline change, storm surge, tsunamis, implications on society, ecosystem and built infrastructure