1. Course number and name
   ORE 766 - Numerical Methods in Ocean Engineering

2. Credits and contact hours
   3 credits, Two 1.25-hour sessions per week. 50% lecture, 50% computer lab.

3. Instructor
   Eva-Marie Nosal

4. Textbooks
   a. Textbooks:
      i. C. Moler (2004), Numerical computing with MATALB, Society for Industrial Mathematics.
   b. Reference books:
      i. RL Burden *et al.*, *Numerical Analysis*, Brooks Cole, 2000
      ii. A Iserles, *A First Course in the Numerical Analysis of Differential Equations*, Cambridge University Press, 1996
      iii. Y Kwon, H Bang, *The Finite Element Method using MATLAB*, CRC Press, Inc., 2000
      iv. CA Brebbia *et al.*, *Boundary Element Techniques*, Springer-Verlag, 1984
      v. P Lin, *Numerical Modeling of Water Waves*, Taylor & Francis, 2008

5. Specific course information
   a. Course content: Formulation and application of numerical methods for simulating and solving ocean engineering problems. Topics include: Mathematical and computational fundamentals with implications for accuracy and stability; numerical interpolation, differentiation, and integration; boundary element, finite difference, and finite element methods. Pre: consent.
   b. Prerequisites:
      i. Computer programming language
      ii. Differential equations Basic numerical methods Fluid mechanics
      iii. Water wave theory
   c. Designation: Elective

6. Specific goals for the course
   a. Learning Outcomes: The objective of this course is to provide students with the background and skills required to numerically simulate and solve Ocean Engineering problems. This will be a hands-on class with theory accompanied by practical implementation in MATLAB. After a review of programming in MATLAB and basic numerical methods (linear equations, interpolation, numerical differentiation, integration), methods to solve various ordinary and partial differential equations will be covered. Emphasis will be placed on application to Ocean Engineering problems such as potential flow, water waves, ocean structures, and ocean acoustics.
   b. Upon successful completion of ORE 766, students will be able to:
      i. Demonstrate an understanding of the fundamental principles of digital computing, including number representation and arithmetic operations.
      ii. Develop and implement stable and accurate numerical methods to solve linear systems of equations and find roots of linear and non-linear equations.
      iii. Perform numerical interpolation, curve fitting, integration, and differentiation.
      iv. Develop and implement stable algorithms to solve ordinary differential equations and simple partial differential equations.

7. <u>Brief list of topics to be covered</u>
    a. MATLAB review
    b. Fundamental of Numerical Analysis
    c. Solving linear systems
    d. Curve fitting and interpolation
    e. Numerical differentiation and integration
    f. Numerical ordinary differential equations
    g. Single-step methods Multistep methods Stability, stiffness, errors
    h. Numerical partial differential equations
    i. Finite difference method
    j. Boundary element method
    k. Finite element method