1. Department, Course Number, Title
ORE 766 Numerical Methods in Ocean Engineering

2. Designation as a Required or Elective Course
Elective Course

3. Course Catalog Description
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.

4. Prerequisites
Computer programming language
Differential equations
Basic numerical methods
Fluid mechanics
Water wave theory

5. Textbooks
C. Moler (2004), Numerical computing with MATALB, Society for Industrial Mathematics.

Reference books
1. S.C. Chapra (2008), Applied numerical methods with MALTAB, 2nd ed., Mc.Graw Hill.
2. R. Burden, J.D. Faires (1993), Numerical analysis 5th ed., PWS Publishing Company.

6. ABET Course Learning Outcomes

7. Topics Covered
1. MATLAB fundamentals
2. Solving linear systems
3. Curve fitting and interpolation
4. Numerical differentiation and integration
5. Numerical ordinary differential equations: single- and multi-step methods, stability, stiffness, errors
6. Numerical partial differential equations: finite difference, finite element, and boundary element methods

8. Schedule
Two 1.25-hour sessions per week. 50% lecture, 50% computer lab.

9. Contribution of Course to Meeting the Requirements of Criterion 5

Assessment

Homework	60%
Final project	40%

Contribution to Professional Component
Engineering Science: 3 credits

10. Relationship to Program Outcomes
Program Outcome 2: Basic science, mathematics, & engineering
Program Outcome 5: Use of latest tools in ocean engineering
Program Outcome 6: Problem formulation & solution
Program Outcome 10: Communication skills

Student Learning Outcomes
Upon successful completion of ORE 766, students will be able to:
1. Demonstrate an understanding of the fundamental principles of digital computing, including number representation and arithmetic operations.
2. Develop and implement stable and accurate numerical methods to solve linear systems of equations and find roots of linear and non-linear equations.
3. Perform numerical interpolation, curve fitting, integration, and differentiation.
4. Develop and implement stable algorithms to solve ordinary differential equations and simple partial differential equations.

11. Prepared by
E.-M. Nosal, Spring 2009

Course Objectives
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.