1. Course Number and Title
   ORE 612 Dynamics of Ocean Structures

2. Credit and Hours
   Credits, two 3-hour sessions per week

3. Instructor
   Deniz Gedikli

4. Textbooks
   Textbooks: None
   References:
   a. Bhattacharyya, R., Dynamics of Marine Vehicles, John Wiley & Sons, 1978
   b. Chakrabarti, S.K., Hydrodynamics of Offshore Structures, Springer, 1987
   c. Faltinsen, O.M., Sea Loads on Ships and Offshore Structures, Cambridge University Press, 1990
   d. Jackson, Leland B., Signals, Systems, and Transforms, Addison-Wesley, 1991
   e. Jacobson, Lydik S. and Ayre, Robert S., Engineering Vibrations, McGraw-Hill, 1958
   f. Newman, J.N., Marine Hydrodynamics, MIT Press, 1977
   g. Wilson, J.F., Dynamics of Offshore Structures, John Wiley & Sons, 2003

5. Course Information
   a. Course content: Response of floating platforms and vessels to wave action, spectral analysis in sea keeping. Frequency and time domain analyses of rigid body motions in six degrees of freedom.
   b. Prerequisite:
      i. ORE 411 or consent.
      ii. Co-requisite ORE 609 or consent.
   c. Designation: Offshore Option

6. Course Goal
   Upon satisfactory completion of the course, the student should:
   a. Understand the wave forces which act on offshore structures
   b. Be able to calculate these forces for various situations
   c. Have a sound background in the mathematical tools involved
   d. Have a basic understanding of offshore structure kinematics

7. Topics covered
   a. Linear Oscillator – One Degree of Freedom
   b. Free Vibration with Linear Damping
      i. Motion of a Floating Body in Quiescent Water
   c. Forced Vibration – Steady State Oscillation (Part I)
      i. Motion of a Floating Body in Regular Waves
   d. Forced Vibration – Transient and Nonperiodic Vibrations
      i. Review of Laplace Transform
      ii. Unit Step Function – Indicial Response
      iii. Unit Impulse Function – Impulsive Response

iv. Pulsed Sinusoidal Excitation
v. Arbitrary Excitation

e. Forced Vibration – Steady State Oscillation (Part II)
   i. Review of Fourier Transforms
   ii. Impulsive Response and Complex Frequency Operator
f. Time Domain Solutions
g. Time Domain Solution of Equations of Motion Containing Frequency Dependent Coefficients
   i. Connection between Frequency Domain and Time Domain
   ii. Time Domain Description – Linear Equations of Motion
   iii. Hydrodynamic Force on Body Making Arbitrary Oscillations in Originally Calm Water
h. Motion of Floating Bodies
   i. Kinematics of Rigid Bodies
   ii. Linear Momentum of a Rigid Body
   iii. Angular Momentum
   iv. Dynamics of a Rigid Body
      Linear Motions
      Rotational Motions
      The General Six Scalar Equations of Motion
      The Linearized Equations of Motion for a Body with a Plane of Symmetry
i. Hydrodynamic Coefficients and Wave Excitation – 3D Source Distribution
   i. Review of Ideal Fluid Theory
   ii. Green's Theorem and Distribution of Singularities
   iii. Hydrodynamic Pressure Forces
   iv. Force on a Moving Body in an Unbounded Fluid
   v. General Properties of Added Mass Coefficients
   vi. The Body-Mass Force
   vii. Linear Diffraction Theory Equations of Motions
   viii. Non-Linear Equations of Motion – Frequency Domain
   ix. Non-Linear Restoration Function – Ritz-Galerkin Method
   x. Forced Oscillation with Non-Linear Damping and Non-Linear Restoration
   xi. General Types of Non-Linear Damping and Linear Restoration
j. Two Moving Body Interaction Problem
   i. Van Oortmerssen (1979)
   ii. Cummins (1962)
   iii. Greeson (1997)
k. Ship Motions in Irregular Seas
   i. St. Denis, et al (1950)