1. Department, Course Number, Title

ORE 612 Dynamics of Ocean Structures

2. Designation as a Required or Elective Course

Offshore Engineering Required Course

3. Course Catalog Description

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. Pre: 411 or consent. Co-requisite: 609 or consent.

4. Prerequisites

Applied mechanics
Differential equations
Hydrostatics
Water wave theories

5. Textbooks and/or Other Reading Material

Textbook: None

Reference books

1. R. Bhattacharyya, Dynamics of Marine Vehicles, John Wiley & Sons, 1978
2. S.K. Chakrabarti, Hydrodynamics of Offshore Structures, Springer, 1987
3. W.E. Cummins, The Impulse Response Function and Ship Motions, Institut fur Schiffbau der Universitat Hamburg, 1962
4. B.R. Clayton and R.E.D Bishop, Mechanics of Marine Vehicles, E. & F.N. Spon, 1982
5. J.P. Den Hartog, Mechanical Vibrations, McGraw-Hill, 1940
6. O.M. Faltinsen, Sea Loads on Ships and Offshore Structures, Cambridge University, 1990
7. B.D. Greeson, The Relative Motion of Two Adjacent Bodies, One Significantly Larger Than the Other, Floating in Waves, With a Non-Linear Line Connection, Ph.D. Dissertation, University of Hawaii, 1997.
8. J.B Hooft, Advanced Dynamics of Marine Structures, John Wiley & Sons, 1982
9. L.B. Jackson, Signals, Systems, and Transforms, Addison-Wesley, 1991
10. L.S. Jacobsen and R.S. Ayre, Engineering Vibrations, McGraw-Hill, 1958
11. J.N. Newman, Marine Hydrodynamics, MIT Press, 1977
12. W.G. Price and R.E.D. Bishop, Probabilistic Theory of Ship Dynamics, John Wiley & Sons, 1974
13. G. Van Oortmerssen, Hydrodynamic Interaction Between Two Structures, Floating in Waves, Second International Conference on Behaviour of Off-Shore Structures, 1979

6. ABET Course Learning Outcomes

1. Understand the wave forces which act on offshore structures
2. Be able to calculate these forces for various situations
3. Have a sound background in the mathematical tools involved

4. Have a basic understanding of offshore structure kinematics

7. Topics Covered
   1. Linear Oscillator. One Degree of Freedom; Free Vibration with Linear Damping; Forced Vibration – Steady State Oscillation, Transient, and Nonperiodic Vibrations; Steady State Oscillation; Time Domain Solutions
   2. Motion of Floating Bodies. Kinematics of Rigid Bodies, Linear Momentum of a Rigid Body, Angular Momentum, Dynamics of a Rigid Body
   3. Hydrodynamic Coefficients and Wave Excitation – 3D Source Distribution. Review of Ideal Fluid Theory, Green's Theorem and Distribution of Singularities,
   1. Hydrodynamic Pressure Forces, Force on a Moving Body in an Unbounded Fluid, General Properties of Added Mass Coefficients, The Body-Mass Force, Linear Diffraction Theory Equations of Motion
   4. Non Linear Equations of Motion – Frequency Domain. Non Linear Restoration Function – Ritz-Galerkin Method, Forced Oscillation with Non Linear Damping and Non Linear Restoration, General Types of Non Linear Damping and Linear Restoration
   5. Ship Motions in Irregular Seas. St. Denis et al. (1950)
   6. Two Moving Body Interaction Problem. Van Oortmerssen (1979), Cummins (1962), Greeson (1997)

8. Schedule
   Two 1.25-hour sessions per week.

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

   Assessment
   7 Homework Assignments (30%)
   Midterm Exam (30%)
   Final Exam (40%).

   Usage of Engineering Tools and Computers
   MathCad, FORTRAN

   Contribution to Professional Component
   Engineering Science: 2 credits
   Engineering Design: 1 credit

10. Relationship to Program Outcomes
    Program Outcome 2: Basic science, mathematics, & engineering
    Program Outcome 4: Ocean engineering specialization
    Program Outcome 6: Problem formulation & solution

11. Prepared by
    B.D. Greeson, Spring 2009

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Course Objectives
To familiarize students with the theoretical methods and numerical techniques in analyzing the dynamic response of floating structures in regular and irregular waves.