

ORE 612 Dynamics of Ocean Structures

Designation

Offshore Engineering Required 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.

Prerequisites by Topics

Applied mechanics
Differential equations
Hydrostatics
Water wave theories

Textbooks

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 für Schiffbau der Universität 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

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.

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, 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)

Assessment

7 Homework Assignments (30%)

Midterm Exam (30%)

Final Exam (40%).

Usage of Engineering Tools and Computers

MathCad, FORTRAN

Schedule

Two 1.25-hour sessions per week.

Contribution to Professional Component

Engineering Science: 2 credits

Engineering Design: 1 credit

Relationship to Program Outcomes

Program Outcome 2: Basic science, mathematics, & engineering

Program Outcome 4: Ocean engineering specialization

Program Outcome 6: Problem formulation & solution

Prepared by

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