Abstract

Within the framework of linearized theory of water waves, some problems involving the wave scattering by submerged obstacles and surface discontinuities have been studied in this thesis. When a train of surface waves travelling from a large distance falls on the obstacles, it experiences partial reflection and transmission. Determination of the reflection and the transmission coefficients are the prime objectives of a wave scattering problem. A substantial part of this thesis deals with the interaction of normally incident waves with porous and elastic plates submerged either in deep or in finite depth water. Moreover the scattering of obliquely incident waves by the edges of two inertial surfaces in presence of porous sea bottom composed of non-dissipative porous particles has also been investigated in this thesis.

The content of the thesis is divided into eight chapters. Chapters 1 and 2 are the introductory part of the thesis. A general introduction, brief literature survey and mathematical preliminaries required to study different problems of this thesis have been discussed in these chapters. Chapter 3 consists of the problem of wave scattering by a thin vertical and an inclined porous plate submerged beneath the free surface in the deep as well as in the finite depth water. In chapter 4, the effect of scattering of flexural gravity waves with the circular-arc-shaped thin porous plate submerged in finite depth of water has been studied. The problems of chapters 3 and 4 are formulated in terms of second kind hypersingular integral equations in the difference in velocity potential across the plates. Exploiting the conditions at the two tips of the plate, the discontinuity is approximated by expanding it in terms of a finite series involving Chebyshev polynomials of the second kind, multiplied by an appropriate weight function and then solved numerically by a collocation method. The solutions are utilized in computing the reflection and the transmission coefficients and the hydrodynamic forces acting on the plate. Also, relevant energy identities for these scattering problems are derived from which it has been possible to get a mathematical expression for the energy dissipation by porous structures. In chapter 5, the concept of hypersingular integral equation has been extended to investigate the water wave scattering involving double porous barriers. Using the Green's integral theorem, the boundary value problem for finding the velocity potential is reduced to two hypersingular integral equations of the second kind in the difference of the symmetric and the anti-symmetric velocity potentials across one of the plates. Chapter 6 deals with two wave scattering problems involving single or dual thin vertical elastic plates submerged either in deep water or in finite depth of water. The analysis is based on the linearized theory of water waves and hypersingular integral equation formulation. Using the solution of this hypersingular integral equation, the reflection and the transmission coefficients, hydrodynamic force acting on the plate, the shear stress and the shear strain of the plate are evaluated. In chapter 7, the problem of oblique wave scattering by the edges of two semi-infinite inertial surfaces on the top of the water with uniform porous bottom is described. The two-dimensional problem is solved by employing Green's second identity which leads to two coupled Fredholm integral equations with regular kernels in the pressure and the velocity across the vertical line below the point of discontinuity. Finally in chapter 8 conclusions and the scope for future research have been included.

Keywords: Water wave scattering; Linear theory; Porous plate; Elastic plate; Hypersingular integral equation; Reflection coefficient; Flexural-gravity wave; Green's integral theorem; Energy identity; Hydrodynamic force; Shear force; Shear strain; Inertial surface; Porous bottom, Non-dissipative porous medium; Fredholm integral equation.