ABSTRACT

Thesis Title : Surface gravity wave interaction with floating and submerged plates resting on an elastic foundation within the framework of blocking dynamics
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The present thesis deals with a class of physical problems associated with the study of surface gravity wave interaction with floating and submerged flexible structures resting on an elastic foundation in the context of blocking dynamics. The following specific physical problems are investigated:

- The dynamics of flexural gravity wave blocking in the presence of elastic foundation with and without viscous damping are studied by analyzing the loci of the roots of the dispersion relation.
- Surface gravity wave scattering by an array of floating flexible plates and a submerged articulated plate are investigated to account for multiple propagating wave modes within the limits of primary and secondary blocking frequencies. Here, mathematical methods used for single propagating wave modes are generalised to account for multiple propagating wave modes. Consequently, energy relation is obtained using Green's identity in which the reflection and transmission coefficients are a combination of the amplitudes of different reflected, transmitted wave modes and the associated energy transfer rate.
- The characteristics of flexural wave and flexural gravity waves in the vicinity of blocking as well as saddle points are analyzed. Moreover, the wave characteristics in the vicinity of the saddle point are obtained in terms of generalised Airy functions and the analytically obtained results are validated through linear time-domain simulations.

Besides, an attempt has been made to study capillary gravity waves in a two-layer fluid in the presence of current. In this study, blocking dynamics of capillary gravity waves along with the occurrence of Kelvin-Helmholtz instability and dead water analogue are investigated in a two-layer density stratified fluid in the presence of surface and interfacial tensions with variable currents in the layers. In the aforementioned studies, the physical problems are analyzed in the linearised water wave theory under the assumption of small amplitude structural response in finite water depth.

Apart from the discussion on blocking dynamics as discussed above, a study has been pursued to find the criteria for the modulation instability in the capillary/flexural gravity waves are investigated using the nonlinear Schrödinger (NLS) equation. In this context, the method of multiple scales is used in the perturbational analysis involving the interfacial flow at the air-water interface to derive the nonlinear Schrödinger (NLS) equation. In this class of problems, a shear flow with the tangential discontinuity of uniform vertical velocity due to wind-generated waves is studied. The modulation instability of flexural as well as capillary gravity waves are studied through the analysis of dispersive and nonlinear coefficients of the NLS equation with the help of the Lighthill criterion, when the tangential discontinuity of velocity increases up to the onset of the Kelvin-Helmholtz type instability.

Keywords: Wave-structure interaction, flexural gravity wave, compressive force, wave blocking, capillary gravity wave, Kelvin-Helmholtz instability, non-linear Schrödinger equation, modulation instability