S.m.16. PRAMOOD, K.V.–Numerical and analytical studies of some problems of water waves–1989–Dr. M. Jathavedan

One of the most interesting and successful application of hydrodynamical theory is to the study of wave propagation on water surface. Over the last one century the theory was further developed to study more complex phenomena associated with wave propagation. Thus nonlinear and dispersive processes have been studied to a great extent and even the phenomenon of wave breaking has been tackled mathematically though not fully satisfactorialy. The invention of highspeed computers has helped the scientists to attempt problems which are not otherwise amenable.

In this thesis we are analysing some problems of water wave propagation. The problems can be broadly classified into two: (a) The study of waves at the interface of two immiscible liquids, (b) Long wave propagation modelled by Korteweg-de Vries (KdV) type equations.

The thesis consists of four chapters. The first chapter is introductory and gives the basic ideas used in the following chapters.

In chapter two we analyse two problems which falls under the category (a) mentioned above. In the first problem wave propagation at the interface between two inviscid fluids of different densities is studied. The discontinuity in the tangential velocities at the interface gives rise to a vortex sheet whose motion is studied numerically. In the second problem that we discuss in this chapter, wave propagation at the interface between two fluids of different densities where the lower fluid is viscous, is analysed. The integral equation for the interface displacement is solved numerically for different values of Atwood ratio, nondimensional viscosity and Froude number. In both the problems the associated conserved quantities are computed to check the accuracy of computation.

It is well known that the KdV equation represents waves on shallow water which are propagated as solitary waves, since the nonlinear and dispersive effects are balanced. Korteweg and de Vries derived the equation assuming that the depth is constant. In recent studies by a number of scientists, it has been found that KdV type equations arise in many other problems of water wave propagation, in particular when the depth of the channel is not constant. The wave propagation is governed by the equation which can be reduced to a KdV equation with variable coefficients, the coefficients being functions of time. In chapter three we consider a model equation which is a KdV equation, the coefficients being time like variables. The integrability of this equation is studied by Nirmala Antharjanam ('Studies on KdV Equatiuons', Ph.D. thesis, 1987, Cochin University of Science and Technology). Here we consider the numerical solutions of this equation in different cases, viz. the integrability condition is satisfied and not satisfied. It is found that the solution is soliton, only in the case in which the equation can be transformed to the classical KdV equation. The conservations of momentum and energy provide a check for the accuracy of the computation.

In chapter four we consider the long wave propagation when there is a sharp discontinuity at the bottom, forming a shelf. The problem is first attempted by considering the wave as a solitary wave running over a shelf. The method of characteristic can predict only the deformation of wave profile and its breaking. In this chapter a new KdV type equation which accounts for the discontinuity, in terms of generalized functions is derived. The equation is studied analytically.

We conclude the thesis pointing out the salient features of our studies and scope for further work.