Four (+1) lectures on water waves

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(1) Water waves and Hamiltonian partial differential equations

a) Physical derivation of the equations for free surface water waves

b) Derivation of the Zakharov Hamiltonian

c) Dirichlet - Neumann operator and its analysis

(2) Model equations for water waves

a) Canonical transformation theory

b) Shallow water scaling - the Kano - Nishida theorem

c) Boussinesq and KdV scaling limits

d) The nonlinear Schrödinger equation, and the modulational scaling limit

(3) Birkhoff normal forms

a) Gravity waves

b) Capillary - gravity waves

c) Formal normal forms in infinite depth

d) Analytic properties of normal forms transformations

(4) Initial value problems

a) Variational equations

b) Energy estimates

c) Nalimovs theorem, S. Wus theorem

d) Analytic properties of the solution map

e) Cases $x \in \mathbb{T}^{d-1}$ and $x \in \mathbb{R}^{d-1}$

(5) Traveling wave solutions (Optional lecture)

a) Periodic solutions of Levi-Civita and Struik

b) Solitary waves of Friedrich and Hyers

c) Extremal waves of Amick and Toland and the Stokes conjecture

d) Symmetry of solitary waves

e) Tanakas numerical solutions

f) Collisions between solitary waves