Coastal and Ocean Wave Hydrodynamics
K.N.T. University of Technology
Assignment 3

3-1.

Waves normally incident on a straight gently sloping beach are recorded to have a wave height 1 m and period 8 s in water depth of 3 m. Assume linear theory is valid and neglect reflection and energy dissipation.

(1) What is the wave height and wave length in deep water condition?

(2) Use linear wave theory and the simplified breaking criteria (H_b/h_b)=0.8, and predict the water depth and wave height at breaking point.

Waves with wave height 0.88 m and period 8 s are obliquely incident on a long straight beach of gentle slope. The angle of incidence in deep water is 45 degree.

(3) Use linear wave theory and estimate the wave height and angle of incidence in water depth of 8 m and 3 m. compare the result with the result of (1).

3-2.

The surface profile of a second order Stokes wave is given as

$$\eta(x,t) = a\cos(kx-\sigma t) + \frac{ka^2}{4}\frac{\cosh kh}{\sinh^3 kh}(3+2\sinh^2 kh)\cos 2(kx-ct)$$

Simplify the general solution of the surface profile of a second order Stokes wave, using the assumption of long waves, to obtain a simple expression for the amplitude of the second harmonic relative to the amplitude of the first harmonic. Show that this ratio is a function of the Ursell parameter. (The assumption of long wave: $kh \to 0$)

As the amplitude of the second harmonic increases relative to the amplitude of the first harmonic the possibility of a profile with a small secondary crest in the trough of the primary wave arises. Deduce analytically the maximum value of the Ursell parameter for which the profile does not exhibit secondary crest.

3-3.

Determine which wave, Stokes wave or Cnoidal wave, should be used in the following conditions (Use linear wave theory to calculate Ursell parameter).

(1) Wave height: 2 m
Wave period: 7 s
Water depth: 15 m

(2) Wave height: 2 m
Wave period: 7 s
Water depth: 5 m

(3) Wave height: 2 m
Wave period: 4 s
Water depth: 5 m

(Note: The choice of transition form one wave theory to the other theory depends on the individual problem. It is left up to individual. Problem 2-3 gives only a first approximation.)