Random Wave Kinematics

1. Explain what is meant by an unsteady or transient wave form, and indicate under what circumstances such waves develop. Why is the description of these waves becoming increasingly important in present design practice?

2. Figure 1 describes an amplitude spectrum measured in deep water during a severe storm. Using this information, determine the maximum possible water surface elevation, and comment on the validity of any assumptions made. Applying both linear random wave theory and an empirical (or stretched) wave solution, determine two estimates for the maximum horizontal water particle velocity associated with this wave. Explain why these solutions differ, and discuss which result should be applied as an appropriate design solution. Comment on the usefulness of other possible solutions.

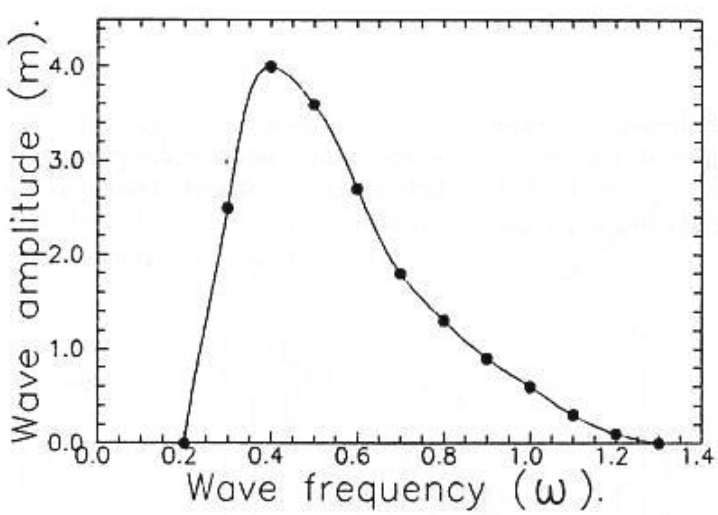

Figure 1 : Amplitude spectrum.

3(a). If a sea state consists of long waves interacting with short waves, provide a physical explanation for:

(i) The non-linear change in the wave height.

(ii) The non-linear change in the wave length.

3(b). If the short waves outlined in part (a) above have an amplitude of a_1 = 2m and a period of T_1 = 4s; while the long waves have an amplitude of a_2 = 10m and a period of T_2 = 12s, obtain an estimate for the maximum water surface elevation.

(4) Use and appropriate wave theory to describe the maximum unsteady water particle acceleration (du/dt) arising beneath the waves described in Figure 2. Table 2 gives a description of the wave frequencies, the wave amplitudes and the relative phasing. Note: It may be assumed that the water is deep and that the steepest section of the profile occurs at t = -1.5sec.

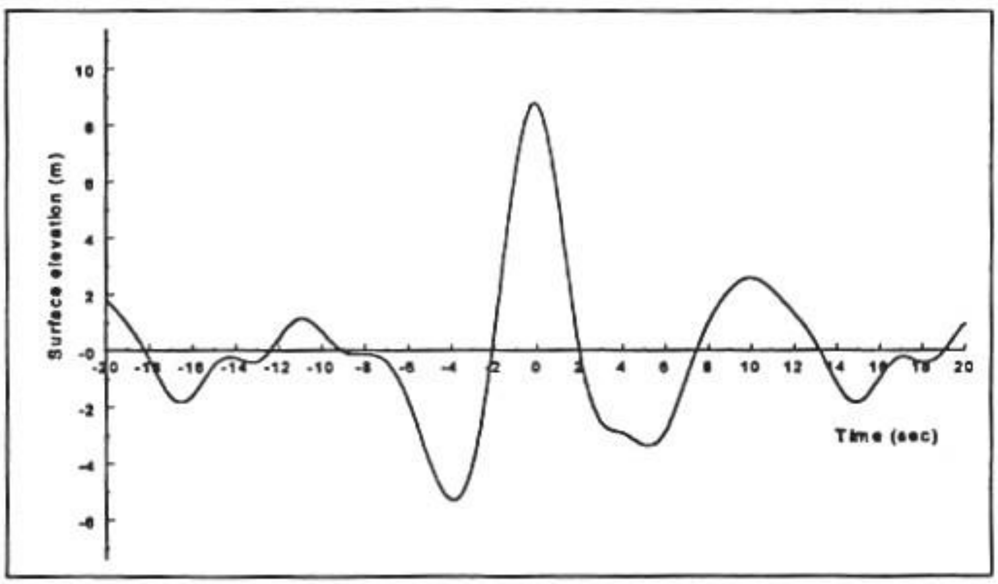

Figure 2. Surface elevation, $\eta(t)$

Wave frequency (rads/sec)	Wave amplitude (m)	Relative phasing (rads)
0.2	0.5	-1.2
0.4	1	-0.1
0.6	3.2	0
0.8	1.8	+0.2
1.0	1.2	-0.3
1.2	0.8	-0.5
1.4	0.5	-0.9

Table 2: Spectral content and relative phasing.