Κυματομηχανική

Tutorial Sheet 2
Regular Waves: Nonlinear Theory

1. If a deep water wave has a period of T = 15s and a wave height of H = 20m, use a second-order Stokes wave theory to calculate:

   (a) The maximum water surface elevation, η_{max}.
   (b) The maximum horizontal velocity, u_{max}.

   Compare these results with those obtained in Question 1 of Tutorial Sheet 1.

2. With the aid of an accurate plot, contrast the water surface elevation, $\eta(t)$, described by a linear and second-order solution for the waves described in Question 1 above.

3. If the waves described in Question 1 propagate into a region where the water depth is 30m, use the results from Question 2 on Tutorial Sheet 1 (i.e. $H = 2a$ = 18.88m and λ = 234.3m) to determine both the linear and the second-order approximation to:

   (a) The maximum water surface elevation, $\eta_{max.}$
   (b) The maximum horizontal velocity, u_{max}.

   Contrast the difference between the linear and second-order results with those obtained in deep water, Question 1 above. Why is the second-order correction to the velocity so much more significant?

4. For the wave conditions described in Question 3 above, use a second-order wave theory to determine:
   (i) The maximum unsteady water particle acceleration, $\partial u / \partial t$.
   (ii) The phase of the wave cycle at which it occurs.
   (iii) The elevation, relative to the mean water level, at which it occurs.

   What are the potential implications of these results relative to linear theory?

5. Comment on the validity of the second-order calculations for the wave conditions described in Question 3 above.