GX481

Ollscoil na hÉireann

National University of Ireland, Galway

FIRST SEMESTER EXAMINATIONS, 2000

B.E. Degree

Offshore and Coastal Engineering I

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Time allowed: *Two* hours

Answer *all three* questions

Relevant set of graphs and formulas are available from the invigilator

1. (a) Evaluating the wavelength is an important part of almost every problem in coastal engineering. The governing equation is, however, nonlinear. Explain how this equation in dimensionless form can be solved using Excel.

   (b) Beneath a progressive wave in deep water each water particle describes a circular orbit. Relate the position of the particle along its orbit to the free surface position overhead by means of a set of sketches. Freeze the position at quarter-period intervals for a total duration of one period. Show the velocity and acceleration vectors on the same diagram.

   (c) A wave with a period T=9 seconds and height H=6 metres propagates over an area where the water depth d=20 metres. Find the local horizontal and vertical velocities and accelerations at an elevation 6 metres below the still-water level when $\theta=2\pi x/L - 2\pi t/T=\pi/4$ radians. Show where a water particle at this point is along its orbit and what part of the wave is overhead.

2. (a) Derive the following formula relating the wave height H in any depth to the wave height in deepwater H_o

   $$H=K_R K_S H_o$$

   where K_R = refraction coefficient and K_S = shoaling coefficient. In the derivation, find expression for K_R and K_S.

   (b) Relate the longshore volume transport rate of sand S_l to the immersed-weight transport rate I_l.

(c) Sketch on a graph the relationship between I_l and the longshore component of wave energy flux P_l. Why does field data give a different result from laboratory data.

(d) An east-facing coastline is subject to waves whose significant height is 1.5 metres in deepwater. The waves are incident from the north-east for 10% of the time. Evaluate the maximum yearly volumetric longshore transport of sediment due to these waves.

3. (a) List the possible sources and sinks of sand for a littoral sedimentary budget

(b) Describe the two rather distinct methods for estimating the sediment supplied to the beach by a particular river. How was the method we used in class summarised graphically?

(c) A groyne design is as follows. The horizontal shore section is to be built to the natural berm elevation of 2.5 metres above MLW and will extend from 40 metres shorewards to 50 metres seawards of the present berm crest. The outer section is to be built at MLW elevation and will extend to a depth of 1.5 metres below MLW. The beach can be approximated by a 1 on 10 slope from the berm crest to MLW and a 1 on 50 slope from MLW seawards. The beach alignment analysis predicts that the berm crest on the downdrift side of the groyne will erode 20 metres shorewards of the present position.
Evaluate the beach profile adjacent to the groyne on the downdrift side.

(d) Show with neat sketches how to evaluate the volume of an upstream groyne fillet.