CIEG 680 Homework 3 Due THURSDAY,

1. Write a Matlab code that will take as input, wave height, wave period and water depth and return as output the wave celerity, group speed, wave length, energy density, wave power, maximum orbital velocity and maximum orbital diameter at the bed. Test your code with a 5 m, 20 s wave in 40 m water. "store" in your Matlab Toolbox. Turn in code and results.

Wave Celerity	18.5 m/s
Group Speed	16.1 m/s
Wave Length	369.5 m
Energy Density	3.1×10^4 newtons/m^2
Wave Power (Energy Flux)	5.1×10^5 Watt/m^2
Max Orbital Velocity at Bed	1.1 m/s
Max Orbital Diameter at Bed	6.8 m

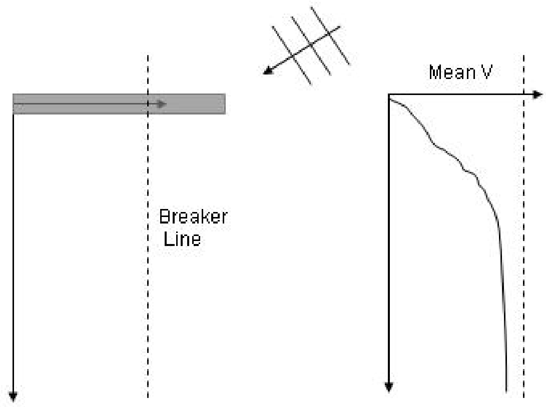
2. DD 5.1

Utilize Eq. 5.16 $H_{5m} = H_0 \sqrt{\frac{C_{g0}}{C_{g,5m}}} \sqrt{\frac{\cos\theta_0}{\cos\theta_{5m}}}$ and Snell'Law (Eq. 5.15) to obtain the answer. There are now 2 unknowns, the group speed and incidence angle in 5 m water depth. The latter relies on the phase speed so we must determine that first. In order to do so we need to determine the celerity in 5 m depth as $C = \frac{L}{T}$. Determine wave length in 5 m from Eq. 5.3 or 5.4 as 53.08 m (L_0 was 99.92m). Then $C = \frac{53.08m}{8s} = 6.64m/s$ (C_0=12.49 m/s). From Snell's Law, the incidence angle at 5 m is $\theta_{5m} = \arcsin\left[\frac{C_{5m}}{C_0}\sin\theta_0\right] = \arcsin\left[\frac{6.64}{12.49}0.5\right] = 15.41^\circ$. Now, the group velocities are determined from Eq. 5.8 as $C_{g,5m} = nC_{5m} = \frac{1}{2}\left(1 + \frac{2*0.118*5}{\sinh(2*0.118*5)}\right)6.64m/s = 5.98m/s$, C_{g0} is obtained from the deep water asymptote as $1/2C_0$.

Finally, $H_{5m} = 1\sqrt{\frac{6.25}{5.98}}\sqrt{\frac{0.87}{0.96}} = 0.97m$.

3. DD 5.6

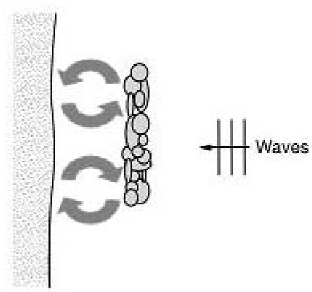
The mean current must be zero at the structure and then increase downdrift of the structure until it reaches a constant value (assuming an infinitely long beach).



Variation of the average alongshore current downdrift of the littoral barrier.

4. DD 5.10

(a) Sketch the current pattern you would expect behind the structure.

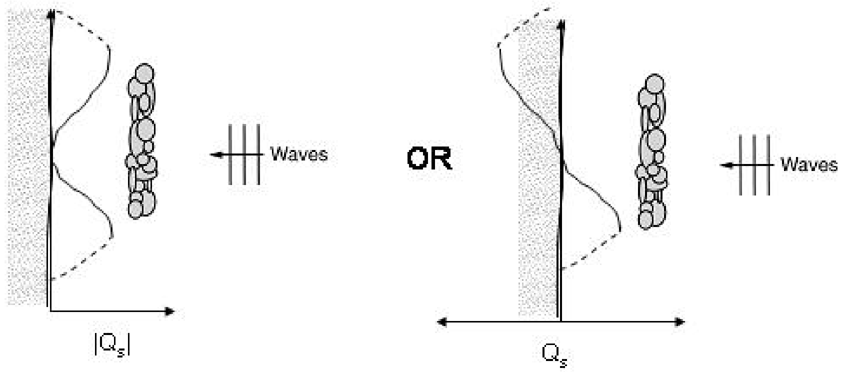


(b) Briefly describe a cause of this circulation pattern.

The interaction of the wave with the breakwater causes the wave form to diffract around the structure such that energy is transferred along the wave crest. In addition, the waves will be breaking on either side of the structure, but will not be breaking behind the structure, this induces an alongshore gradient in the radiation stresses that should drive currents toward the center of the breakwater. The motions converge and cause the circulation pattern.

(c) For the shoreline position shown, provide a qualitative sketch of the distribution of longshore sediment transport, $Q_s(y)$

The transport will be greatest near the edges of the structure and weakest near the center where the greatest sheltering occurs.



5. Infragravity motions on dissipative beaches typically have periods ranging from 50-200 s. If this energy is in the form of edge waves, what would be the ranges in wave lengths, L_e, for modes n=0, 1 and 2 on a beach with a slope of 1:50.

Using

$L_e = \frac{gT_e^2}{2\pi}\sin[(2n+1)\beta]$ yields

	L_e (50 sec) (m)	L_e (200 sec) (m)
n=0	78	1249
n=1	234	3745
n=2	390	6235

6. Komar chapter 5 problem 4

Long period waves travel faster than short period waves, so the 20 s wave should arrive sooner. Since it is assumed to be deep water the whole way, no need to use the whole equation, use simplification for deep water. Determine the wave length for 5-20 s waves using

$$L = \frac{gT^2}{2\pi}$$

and the phase speed is

$$C = \frac{L}{T} = \frac{gT}{2\pi}$$

BUT……..

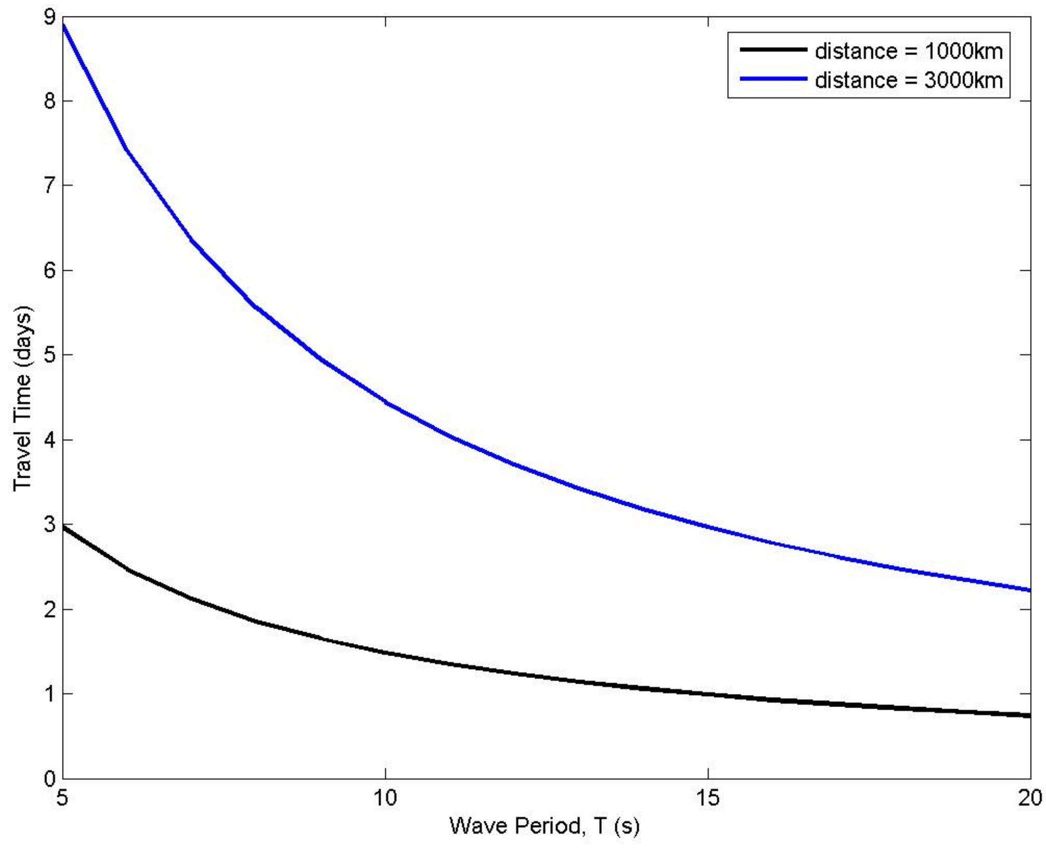
Be careful as the wave energy propagates at the group speed, not the wave celerity. In deep water, the group speed is one-half the celerity

So the wave are traveling at

$$C_g = \frac{1}{2}\frac{L}{T} = \frac{gT}{4\pi}$$

Now calculate the travel time by taking the distance and dividing by the group speed. See attached graphs.

Note that at 3000 km, the 5 s wave arrive about 160 hours later. For 1000 km, the 5 s wave arrive about 53 hours later.



7. Komar chapter 5 problem 5.

Waves arriving from a storm have differences in arrival time of 10 hours between the 10s waves and the 5 s waves. How far away was the storm assuming deep water?

Use the above equations to determine the group speeds as 7.8 m/s (10s wave) and 3.9 m/s (5 s wave).

From distance = rate * time we have

$time = \frac{dis\tan ce}{7.8}$ for 10 s waves

$time = \frac{dis\tan ce - 3.9(10)(3600)}{3.9}$ for 5 s waves (3600 to get to s and 10 for the additional 10 hours travel time)

set equations equal to each other and solve for distance

$dis\tan ce = \frac{3.9(10)(3600)(7.8)}{7.8 - 3.9} = 280800m = 280.8km$.