

Quiz #2

Nov.21, 2013

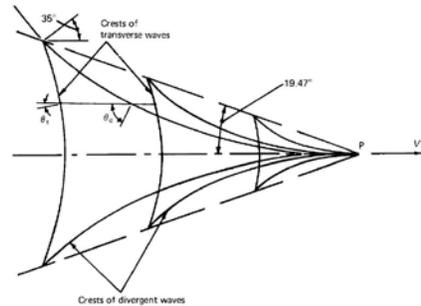
2:00~3:30

1. (20%) Describe shortly the followings:

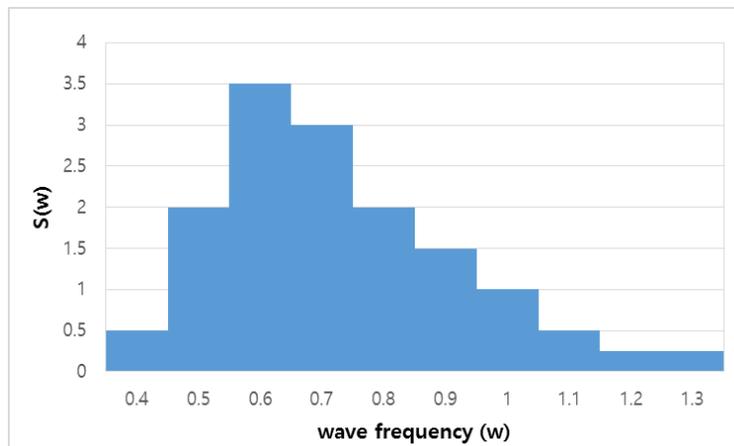
- (1) (5%) Basic assumptions that we consider irregular ocean waves as Gaussian random process
- (2) (5%) The reason why wave spectrum is called “energy spectrum”
- (3) (5%) Difference between phase velocity and group velocity. (No need to derive equations.)
- (4) (5%) Group velocities in deep water and shallow water.

2. (25%) Consider waves around a ship moving with a constant speed U .

- (1) (10%) Derive the linearized free surface boundary condition in a coordinate moving with the ship. Describe about two cases when the ship speed is very slow and very high.
- (2) (15%) Show that the Kelvin angle around a ship is $\sin^{-1}(1/3)$.



3. (30%) In a certain ocean region, you want to install floating wind turbines. Ocean waves in this region can be represented as the following wave spectrum:



- (1) (10%) If you represent this wave condition with five wave components, select your wave frequencies and amplitudes of the five components.
- (2) (10%) If you represent this spectrum with only one component, what is the wave amplitude?

(3) (10%) You want to predict the wave amplitude of 50-year return period for the design of wave turbines. (assume that the mean wave period is 5.68 sec.)

4. (25%) The following table is a simplified wave scattered diagram in a certain area of ocean. Obtain design wave height of long-term prediction for 100-year return period.

$H_{1/3} \backslash T_{\text{mean}}$	3.0 sec	5.0 sec	7.0 sec	sum
2.0 m	150	200	140	490
5.0 m	50	400	50	500
7.0 m	0	10	0	10
sum	200	610	190	1000

Formula: Probability of exceedance, $Q(H_0) = \sum_i P(H_{1/3,i}) \exp\left(-2\left(\frac{H_0}{H_{1/3,i}}\right)^2\right)$

Good Luck!!