Homework5. Solution

1.(1)

$$S_\eta(\omega) = \frac{A}{\omega^5} e^{-B/\omega^4}$$

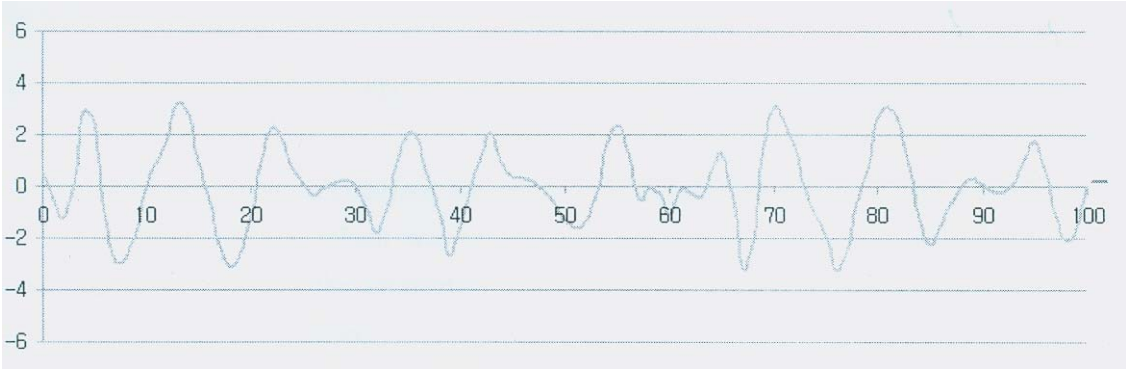
$$A = 173 \times \frac{H_{1/3}^2}{T_1^4}, \qquad B = \frac{691}{T_1^4}$$

$$A_k = \sqrt{2 S_\eta(\omega_k) \Delta\omega_k}$$

freqency	S(w)	A_k	freqency	S(w)	A_k
0.1	0	0	2.6	0.01275	0.050498
0.2	7.68E-43	3.92E-22	2.7	0.010563	0.045963
0.3	5.64E-07	0.000336	2.8	0.008811	0.041978
0.4	0.204051	0.202015	2.9	0.007395	0.038459
0.5	3.272533	0.809016	3	0.006244	0.035339
0.6	5.319968	1.031501	3.1	0.005301	0.032562
0.7	4.480753	0.946652	3.2	0.004524	0.03008
0.8	3.073738	0.784058	3.3	0.00388	0.027856
0.9	1.991165	0.631057	3.4	0.003342	0.025855
1	1.284467	0.506846	3.5	0.002892	0.024049
1.1	0.841364	0.410211	3.6	0.002512	0.022415
1.2	0.563313	0.335652	3.7	0.002191	0.020932
1.3	0.386029	0.277859	3.8	0.001917	0.019583
1.4	0.270568	0.232623	3.9	0.001684	0.018352
1.5	0.193669	0.196809	4	0.001484	0.017227
1.6	0.141322	0.16812	4.1	0.001312	0.016196
1.7	0.104947	0.144878	4.2	0.001163	0.01525
1.8	0.079186	0.125846	4.3	0.001034	0.014379
1.9	0.060618	0.110107	4.4	0.000922	0.013576
2	0.047018	0.096972	4.5	0.000824	0.012835
2.1	0.036908	0.085917	4.6	0.000738	0.012149
2.2	0.029292	0.07654	4.7	0.000663	0.011513
2.3	0.023482	0.06853	4.8	0.000597	0.010923
2.4	0.018999	0.061642	4.9	0.000538	0.010374
2.5	0.015503	0.055683	5	0.000486	0.009863

(2) $\overline{E} = \sum_{k=1}^{49} \frac{1}{2} \rho g A_k^2 = \frac{1}{2} \rho g \sum_{k=1}^{49} A_k^2 = \frac{1}{2} \rho g * (4.50612) = 22102$

(3)



2.(1)

$$H_{1/3} = 9m, \quad \mathrm{T}_{\mathrm{modal}} = 20\,\mathrm{sec}$$

$$H_{1/3} = 4\sqrt{m_0} \qquad m_0 = \left(\frac{9}{4}\right)^2 = 5.0625$$

$$A = \sqrt{2m_0 \ln N} = 6.8284m$$

$$\therefore H = 13.6568m$$

(2)

$$H_{1/3} = 4m, \quad \mathrm{T}_{\mathrm{modal}} = 10\,\mathrm{sec}$$

$$H_{1/3} = 4\sqrt{m_0}, \quad m_0 = 1, \quad \mathrm{T}_{\mathrm{mean}} = \frac{\mathrm{T}_{\mathrm{modal}}}{1.408} = 7.1023$$

$$N = \frac{3.1536 \times 10^7 \times M}{\mathrm{T}_{\mathrm{mean}}} = 444026880$$

$$A = \sqrt{2m_0 \ln N} = 6.3105m$$

$$\therefore H = 12.6211m$$

(3)

$$\overline{T}_{\mathrm{mean}} = \sum_{\mathrm{i}=1}^{10} \frac{\mathrm{T}_{\mathrm{modal,i}}}{1.408} \times \frac{N_i}{N_{Tatal}} = 8.6701\,\mathrm{sec}$$

① 100 year period

$$Q = \frac{8.6701}{3.1536 \times 10^7 \times 100} = \sum_i e^{-2\left(\frac{H_0}{H_{1/3}}\right)^2} P(H_{1/3,i})dH$$

$$Q = 2.74924 \times 10^{-9} = \sum_i e^{-2\left(\frac{H_0}{H_{1/3}}\right)^2} P(H_{1/3,i})dH$$

위의 우변에 H_0을 iteration을 통해 값을 변화시켜 가면, 좌변과 우변의 값이 갖게 될 때의 H_0을 근사하게 구할 수 있다.

$$H_0 = 37.6m$$

② 200 year period

$$Q = \frac{8.6701}{3.1536 \times 10^7 \times 200} = \sum_i e^{-2\left(\frac{H_0}{H_{1/3}}\right)^2} P(H_{1/3,i})dH$$

$$Q = 1.37465 \times 10^{-9} = \sum_i e^{-2\left(\frac{H_0}{H_{1/3}}\right)^2} P(H_{1/3,i})dH$$

1)번과 같은 방법으로 H_0을 구하면 $H_0 = 38.49m$을 얻을 수 있다.