M. E. Civil Examination, First Year, Second Semester, 2019

Offshore Structures

Time 3 hours | Full marks 100

Answer two parts in two answer scripts

Part I

Answer Q1 and any one from the rest.

1. Deduce expressions for Harmonic- and impulse response functions and correlate them. Develop a transfer function relating wave elevation $\eta(t)$ to wave-generated force on the deck of an N-legged jack-up offshore platform where the inertia regime governs. Use
$$\dot{u} = -\frac{H}{2}\omega^2 \frac{\cosh kd}{\sinh kd}\sin\omega t.$$

25

2. State and prove Parseval's theorem. Prove that $\int_{-\infty}^{\infty} S_{uu}(\omega)d\omega = \sigma_u^2$. Correlate autocorrelation function for force, $R_{pp}(\tau)$, to that of structural response, $R_{vv}(\tau)$. Hence deduce the spectral density function for structural response, $S_{vv}(\omega)$.

7+8+10=25

3. What is the utility of using a zero-mean process? How the probability density function is developed from the time-amplitude record of a wave data? What is a cumulative distribution function? Define weak and strong stationary and ergodic processes. Correlate the autocorrelation function, $R_{uu}(\tau)$ and spectral density function, $S_{uu}(\omega)$ of a random process $u(t)$.

2+3+3+5+12=25

Form A: Paper –Setting Blank

Ref No. –Ex/PG/CE/T/129A/2019

M.C.E. 1ST YEAR 2ND SEMESTER EXAM 2019

(1st/ 2nd Semester

SUBJECT: Offshore Structures

Time: Three hours/

Full Marks 50

Use a separate Answer-Script for each part

No. of Question	PART – II	No.

1. Write short note
   i. Fatigue Limit.
   ii. Classification of ocean waves as per water depth — **10**

2. i. Write assumptions of linear wave theory.
   ii. Consider a particle initially 8m below SWL and 22m above sea bed. After the wave motion is established (Time period = 9sec , Wave height =3.5m) , what is the size and character of the orbit of the particle? — **5+15=20**

3. i. Explain the Morrison Equation? — **4**
   ii. A single storied fixed base jack up platform made of 25mm thick steel pipes is loaded with maximum wave height H_{max} = 4.0m with corresponding period of 8.1s. Modulus of elasticity = 2.1X10^6 kg/cm^2, unit weight for steel is 7.83t/m^3, and that of seawater is 1.03 t/m^3. Add upper quarter of the column mass with deck mass. The structure and sea level is shown below. Use Morison's equation to estimate the wave loading and find deterministic response with a time interval of 0.01s for five cycles using $\xi = 1.0\%$. Take Cd=2.0, Cm=1. F_h is given by — **16**

$$\pi\gamma_w D\frac{H^2L}{T^2}\left[\frac{\pi D}{4H}c_m K_2 \sin 2\pi\left(\frac{x}{l}-\frac{t}{T}\right)+c_d K_1\left|\cos 2\pi\left(\frac{x}{l}-\frac{t}{T}\right)\right|\cos 2\pi\left(\frac{x}{l}-\frac{t}{T}\right)\right]$$

$$K_1=\frac{4\pi s_2/L-4\pi s_1/L+\sinh(4\pi s_2/L)-\sinh(4\pi s_1/L)}{16[\sinh(2\pi d/L)]^2}$$, and

$$K_2=\frac{\sinh(2\pi s_2/L)-\sinh(2\pi s_1/L)}{\sinh(2\pi d/L)}$$, where all terms have their usual meaning.