Form A: Paper –Setting Blank Ref No. –Ex/PG/CE/T/129A/2025

M.C.E. 1ST YEAR 2ND SEMESTER EXAM 2025

(~~1st~~/ 2nd Semester ~~/ Repeat / Supplementary / Annual / Bianual~~)

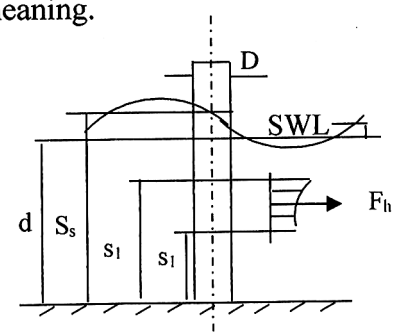
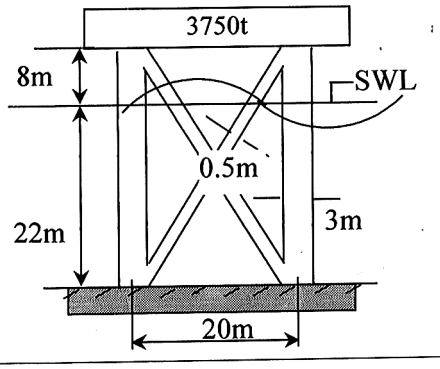
SUBJECT: Offshore Structures

Full Marks 60

Time: ~~Two hours~~/Three hours/~~Four hours/ Six hours~~

Use a separate Answer-Script for each part

Use of wave table permitted

No. of Question	PART – I	No.
1.i.	From Airy's linear wave theory derive the velocity potential φ.	10
ii.	Explain the term Endurance strength. Name the factors on which the endurance strength of a material depends.	6
iii.	Explain Miner's law for cumulative damage.	4
iv.	What is dispersion relation? Explain.	5
2.i.	Explain working principle of Tension Leg Platform.	4
ii.	Explain Morison Equation. In this context define drag force and inertia force.	4
iii.	Find the wave force (Drag force, Inertia force and Maximum Total force) on a pile at water depth 0.2d and 0.8d respectively. Given D=dia of pile = 0.8m, T=wave period = 8s, H= wave height = 1.5m, d=water depth = 30m. Take C_m= 1.25, C_d = 1.85. $\theta_{max} = \cos^{-1}[-\frac{\pi D}{H}\frac{C_m}{C_d}(\frac{2\sinh^2 kd}{\sinh(2kd)+2kd})$	12
3.	A single storied fixed base jack up platform made of 22mm thick steel pipes is loaded with maximum wave height H_{max} = 4.2m with corresponding period of 9.50s. Modulus of elasticity = 2.1 X 10^6 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 are shown below. Use Morison's equation to estimate the wave loading and find deterministic response with a time interval of 0.01s for four cycles using $\xi = 1.5\%$. Here F_h is given by $\pi\gamma_w D\frac{H^2L}{T^2}\left[\frac{\pi D}{4H}c_m K_2 \sin 2\pi\left(\frac{x}{l}-\frac{t}{T}\right)+c_d K_1\left\lvert\cos 2\pi\left(\frac{x}{l}-\frac{t}{T}\right)\right\rvert\cos 2\pi\left(\frac{x}{l}-\frac{t}{T}\right)\right]$ $K_1 = \frac{4\pi s_2/L - 4\pi s_1/L + \sinh(4\pi s_2/L) - \sinh(4\pi s_1/L)}{16[\sinh(2\pi d/L)]^2}$, 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.  	15

Ex/PG/CE/T/129A/2025

M. E. Civil Engineering Examination, 2025
(First Year, 2nd Semester)

Offshore Structures (SE)

Time 3 hours Full marks 100

Answer two parts in two answer scripts

Part II: (40 Marks)

Answer all questions. Each question carries 10 marks. All expressions hold their usual meanings.

1. Correlate a continuous random variable, $u(t)$, and its Fourier transform, $\bar{U}\ (\omega)$.
2. Correlate $R_{uu}(\tau)$ and $S_{uu}(\omega)$.
3. Deduce Parseval's theorem and show $\int_0^\infty S_{uu}(\omega)\, d\omega = \sigma_u^2$ for a zero-mean random process.
4. Deduce the transfer function $|G(\omega)|$ using $\dot{u} = -\frac{H}{2}\omega^2 \frac{\cosh k(z+d)}{\sinh kd} \sin \omega t$.