Ref No. –Ex/PG/CIV/PE/T/122C/2025

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

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

SUBJECT: Offshore Structures

Full Marks : **100**

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

Use a separate Answer-Script for each part

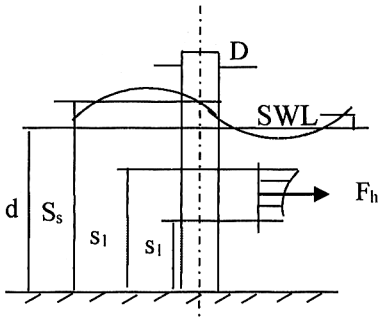
Use of wave table permitted

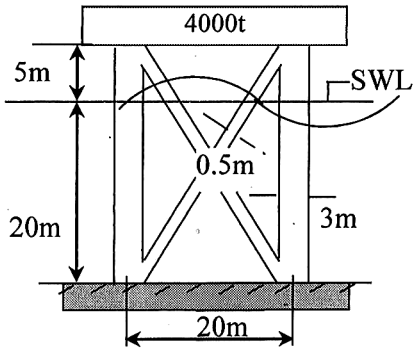
No. of Question	PART – I **(Marks : 60)**	No.
1.i.	Define drag force and inertia force. On which factors these forces depend?	6
ii.	On what principle the compliant structures are developed. Explain in terms of Time period and degrees of freedom.	4
iii.	What are fixed platform structures? Give two examples.	6
iv.	Explain working principle of Tension Leg Platform.	4
v.	Explain Fatigue strength of a material. On which factors do it depends.	4
vi.	Explain Miner's law for cumulative damage.	4
2. i.	Classify various types of ocean waves.	4
ii.	Develop the equation of pressure distribution below progressive wave.	4
iii.	Consider a particle initially 25m below SWL and 35m above sea bed. After the wave motion is established (Time period = 8sec, Wave height =6m), what is the size and character of the orbit of the particle?	8
3.	A single storied fixed base jack up platform made of 30mm thick steel pipes is loaded with maximum wave height H_{max} = 3.5m with corresponding period of 9.5s. Modulus of elasticity = 2.1X10^6 kg/cm^2, unit weight for steel is 7.8t/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 levels are 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 ξ = 1.0%. Take C_d=2.0, C_m=1. F_h is given by	16

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

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

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





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Ex/PG/CIV/PE/T/122C/2025

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

Offshore Structures

Time 3 hours Full marks 100

Answer two parts in two answer scripts
Part II: (40 Marks)

Answer all questions. All expressions hold their usual meanings.

1. Explain what weak and strong stationary and ergodic processes mean. Deduce the expression for spectral density function $S_{uu}(\omega)$ plot of a random process $u(t)$. Correlate the autocorrelation function, $R_{uu}(\tau)$ and spectral density function, $S_{uu}(\omega)$ of a random process $u(t)$. **6+7+6=20 CO2**

2. Deduce the expressions for $H(\omega)$ and $h(t)$. Correlate them. Develop a transfer function $G(\omega)$ relating wave elevation $\eta(t)$ to wave-generated force on the deck of a 3-legged jack-up offshore platform where the inertia regime governs. Use $\dot{u} = -\frac{H}{2}\omega^2 \frac{\cosh k(z+d)}{\sinh kd} \sin \omega t$. **3+5+6+6=20 CO3**