Form A: Paper –Setting Blank Ref No. –Ex/PG/CE/T/129A/2024

M.C.E. 1ST YEAR 2ND SEMESTER EXAM 2024

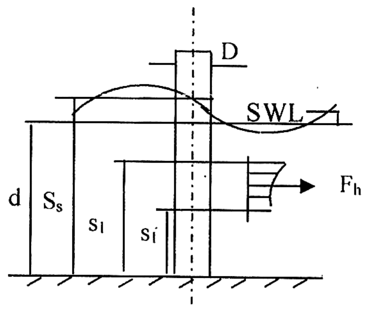
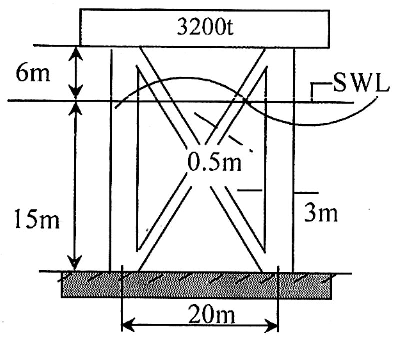
(~~1st~~/ 2nd Semester ~~/ Repeat / Supplementary / Annual / Bianual~~)

SUBJECT: Offshore Structures

Full Marks: 100

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

Use a separate Answer-Script for each part

No. of Question	PART – I (60 Marks)	No.
1.i.	Define drag force and inertia force. On which factors these forces depend?	5+3=8
ii.	What is the difference between fixed and compliant platform structures? Give two examples of each type.	4+2=6
iii.	Draw and explain S-N curve for fatigue strength for steel. Define endurance strength.	5+3=8
iv.	Explain Miner's law for cumulative damage.	4
2. i.	Explain dispersion relation.	2
ii.	Consider a particle initially 20m below SWL and 30m above sea bed. After the wave motion is established (Time period = 12sec , Wave height =6m) , what is the size and character of the orbit of the particle?	6
iii.	Find the maximum total wave force on a pile at water depth 0.8d. Given D=dia of pile = 1.2m, T=wave period = 12s, H= wave height = 2.0m, d=water depth = 30m. Take C_m= 1.25, C_d = 1.95. $\theta_{\max} = \cos^{-1}[-\frac{\pi D}{H}\frac{C_m}{C_d}(\frac{2\sinh^2 kd}{\sinh(2kd)+2kd})$	10
3.	A single storied fixed base jack up platform made of 22mm thick steel pipes is loaded with maximum wave height H_{max} = 3.5m with corresponding period of 8.0s. Modulus of elasticity = $2.1\text{X}10^6$ 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 <u>five</u> cycles using $\xi = 1.5\%$. Take Cd=2.0, Cm=1. F_h is given by $\pi\gamma_w D\frac{H^2 L}{T^2}\left[\frac{\pi D}{4H}c_m K_2 \sin 2\pi\left(\frac{x}{l}-\frac{t}{T}\right)+c_d K_1\left\lvert\cos 2\pi\left(\frac{x}{l}-\frac{t}{T}\right)\right\rvert\cos 2\pi\left(\frac{x}{l}-\frac{t}{T}\right)\right]$ $K_1 = \frac{4\pi s_2/L - 4\pi s_1/L + \sinh(4\pi s_2/L) - \sinh(4\pi s_1/L)}{16[\sinh(2\pi d/L)]^2}$, 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.  	16

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M.E. CIVIL ENGINEERING FIRST YEAR SECOND SEMESTER EXAMINATION 2024

OFFSHORE STRUCTURES (SE)

Time 3 hours Full marks 100

Answer two parts in two separate answer scripts

Part II: (40 Marks)

1. Narrate the necessity of computing spectral density function for structural displacement. Derive sequentially the spectral density function for the displacement of an N-legged jack-up platform if the spectral density function for ocean wave spectrum is given. 40