

Test paper 5 Dynamics of Ocean Structures

Maximum marks: 25

Time: 50 minutes

Answer all questions from Part A and any 3 questions from Part B

Part A (answer all questions)

1. Offshore structures are generally classified either by _____ or by _____ (1)
2. Explain briefly why fluid-structure becomes vital when structures are placed in flowing fluid? (2)
3. Explain with a neat sketch, what is a *wake region*? (2)
4. What do you understand by Blockage factor? Give the relationship used to enhance the load caused due to blockage (2)
5. Draw neat sketches of few vertical frame bracing systems used in Jacket structures (1)
6. Damping arise broadly from two sources namely _____ and _____ (1)
7. For P being a weighted modal matrix, $[P]^T[K][P]$ will result in _____ (1)

Part B (Answer any three)

1. For equation of motion in x coordinate system, transform the equations of motion into y coordinate system using weighted modal matrix and solve for the following system (5)

$$[M] = \begin{bmatrix} m & 0 \\ 0 & m \end{bmatrix}; [K] = \begin{bmatrix} 2k & -k \\ -k & 2k \end{bmatrix}; \lambda_1 = \omega_1^2 = (k/m); \lambda_2 = \omega_2^2 = 3(k/m); \{\phi_1\} = \begin{Bmatrix} 1 \\ 1 \end{Bmatrix} \quad \{\phi_2\} = \begin{Bmatrix} -1 \\ 1 \end{Bmatrix}$$

2. Derive Rayleigh damping matrix [C] for 5% damping ratio uniformly distributed in all the modes (5)
3. Determine [C] by superimposing damping matrices of first two modes, each with 5%
 $m = 3500\text{kg}$; $k = 1500\text{ kN/m}$; $\{\omega\} = \{11.8, 29.27, 44.8\}\text{ rad/sec}$ (5)

$$[\Phi] = \begin{bmatrix} 1 & 1 & 1 \\ 0.68 & -1 & -3.68 \\ 0.32 & -1 & 4.68 \end{bmatrix}$$

4. Derive [C] using Caughey series of classical damping for the system given in Question B-2 (5)
5. Explain how seismic forces are incorporated in the dynamic analysis of compliant structures? write the relevant equations of motion explaining the terms clearly (5)
6. How do you incorporate response control mechanisms in a compliant structure using secondary spring-mass system? Explain the procedure with an appropriate example and derive the equations of motion to solve (5)