Ref. No. : Ex/CE/PC/H/T/424/2023(S)

Name of the Examinations: B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER SUPPLEMENTARY EXAM - 2023

Subject : THEORY OF STRUCTURES IV(HONS.) **Time : 3 hours** **Full Marks : 100**

Use separate answer script for each Part

PART I (50 Marks)

1. Define (i) Reynold's Number (ii) Weber Number (2.5 + 2.5)

2. A ship 300m long moves in sea water, whose density is 1030 kg/m^3. A 1:100 model of this ship is to be tested in a wind tunnel. The velocity of air in the wind tunnel around the model is 30m/s and the resistance of the model is 60N. Determine the velocity of ship in sea water and also the resistance of ship in sea water. The density of air is given as 1.24kg/m^3. Take the kinematic viscosity of sea water and air as 0.012 stokes and 0.018 stokes respectively. (15)

3. Develop the governing Matrix Finite Element equation (in local coordinate) using weak variational principle for the differential equation given below –

$$-\frac{d^2u}{dx^2} - u + x^3 = 0 \quad for \ 0 < x < 2$$

with u(0) = 0 and u(2) = 0. Develop the necessary matrix equation for equally spaced two numbers of 2-noded linear element and solve for 'u' at intermediate points. (20)

4. (a) Write the properties of Lagrange interpolation function used in finite element model.

(b) Develop Lagrange Interpolation Functions for 4-node one dimensional element. (2 + 8)

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PART-II (MARKS-50)

Use a separate Answer-Script for each part

No. of questions	Answer all questions	Marks 18+18+14=50
1.	A simply supported rectangular plate subjected to sinusoidal loading distributed over the plate surface is given by the expression. $q = q_0 \sin\frac{\pi x}{a} \sin\frac{\pi y}{b}$. '$q_0$' is the intensity of loading at center of the plate. 'a' and 'b' are the length of and breath of the plate. Deduce the expressions for deflection (w) and moments M_x, M_y, M_{xy}.	CO1 18
2.	Show that the maximum deflection at the center of a simply supported rectangular plate subjected to a single concentrated load 'Q' at center point is $$w_{max} = \frac{4Q}{\pi^4 abD} \sum_{m=1}^{\infty} \sum_{n=1}^{\infty} \frac{1}{\left(\frac{m^2}{a^2} + \frac{n^2}{b^2}\right)^2}$$ Use Navier Solution. 'a' is the length of plate and 'b' is the width of plate. D is the flexural rigidity. 'm' and 'n' are no. of terms.	CO1 18
3.	Find the membrane forces in a cylindrical shell roof subjected to gravity load (self-weight) only.	CO2 14