Ex/CE/PC/H/T/424/2023

B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEM. EXAM. -2023

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

(50 Marks for each Part)
Use separate answer script for each Part

PART I (50 Marks)

Instructions : Use Separate Answer scripts for each part, Answer all questions

Questions 1 and 2 follows CO4 and Question 3 and 4 follows CO3

1. a) In similitude analysis what are different types of similarity that should be considered. Give a brief description of the same. (5)

1. b) Define (i) Euler's number (ii) Froude's number (iii) Mach number and obtain the expression for each one of the dimensionless parameter. (9)

2. A pipe of diameter *1.5 m* is required to transport an oil of specific gravity *0.90* and viscosity $3x10^{-2}$ *poise* at the rate of *2500litre/sec.* Tests were conducted on a *15 cm* diameter pipe using water at 20°C. Find the velocity and rate of flow in the model. (10)

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

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

with u(0) = 0 and u(3) = 0. Develop the necessary matrix equation for equally spaced three numbers of 2-noded linear element and solve for 'u' at intermediate points. (20)

4. Develop the shape functions (interpolation functions) for a quadratic Lagrangian element in natural coordinates. (6)

[Turn over

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PART-II (MARKS-50)

Use a separate Answer-Script for each part

No. of questions	**Answer all questions**	**Marks 10+15+15+10=50**
1.	Find the membrane forces in a cylindrical shell roof subjected to gravity load (self-weight) only.	CO2 10
2.	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 15
3.	Show that the maximum deflection at the center of a simply supported rectangular plate subjected to a single concentrated load 'P' at center point is $$w_{max} = \frac{4P}{\pi^4 abD} \sum_{m=1}^{\infty} \sum_{n=1}^{\infty} \frac{1}{\left(\frac{m^2}{a^2} + \frac{n^2}{b^2}\right)^2}$$ 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 15
4.	Deduce the relation between bending moments and curvature in pure bending of plates	CO1 10