

**BENGAL ENGINEERING AND SCIENCE UNIVERSITY, SHIBPUR**  
**B.E. 7<sup>TH</sup> SEMESTER (CIVIL) FINAL EXAMINATIONS, 2012**  
**Structural Analysis III (CE 701)**

**Full Marks: 70**

**Time: 3 hrs**

Answer any **three** questions from each half. Two marks kept for neatness in each half.

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FIRST HALF

1. The state of stress with respect to a reference frame is given in the following matrix. Calculate the stress invariants and principal stresses. Also obtain the associated direction of maximum principal stress.

$$\begin{bmatrix} 1 & 2 & 0 \\ 2 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

2. a) The displacement state in a three dimensional body is given as:

$u = kz, v = k(y + 4z), w = k(4\sqrt{2}x + 3z)$ . Obtain strain components. 6

b) Show that octahedral shear stress,  $\tau_{\text{oct}} = \frac{\sqrt{2}}{3}(I_1^2 - 3I_2)^{1/2}$  5

3. Stating the assumption clearly, derive the governing equilibrium equation of a thin plate under transverse load. Also explain the simply supported boundary condition. 11

4. a) Derive the equilibrium equation of a cylindrical shell considering membrane effect only. 6

b) Find the expression for membrane forces in a spherical shell roof subjected to self-weight. 5

5. a) What do you mean by displacement, velocity and acceleration response spectra for earthquake load? 6

b) Explain the steps to obtain response spectra under earthquake load. 5

## SECOND HALF

6. a) Explain clearly the over damped, under damped and critically damped system.

5

b) A tower of weight 150000 N is subjected to a force 50000 N at the top and produces a deflection of 15 mm. Assume damping of structure is 5% of critical damping. Determine a) undamped natural frequency, b) absolute damping co-efficient, c) logarithmic decrement, d) no. of cycles and time requirement for amplitude motion to be reduced to 5 mm to 0.5 mm.

6

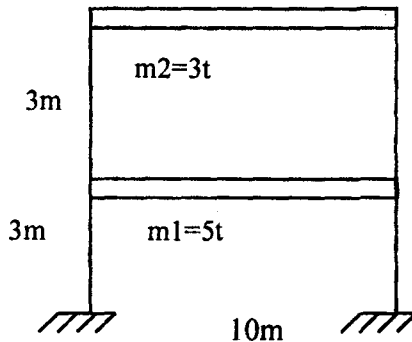
7. a) For SDOF system acted by a force  $P_0 \cos \omega_1 t$ , show that when  $\omega_1 = \omega$ , a displacement may occur excessively (resonance) when t is finite.

6

b) A SDOF system is subjected to a harmonic force of amplitude 200N and frequency 5Hz. Assuming  $m=10\text{kg}$ ,  $k=2000\text{N/m}$ ,  $c=50\text{N-s/m}$ , determine the displacement if the initial velocity of the mass is 5m/s and initial displacement is 10mm.

5

8. Obtain the frequencies and first mode shape of the two-storied building as shown in the Figure. Given,  $EI=4.5 \times 10^3 \text{ kN-m}^2$ .



11

9. Explain orthogonality property. Hence show, how you can obtain N numbers of uncoupled SDOF equations using couple N-DOF dynamic equilibrium equation. In this regard explain modal superposition method of dynamic analysis.

11

10. Find the general free flexural vibration of simply supported beam and draw first three mode shapes. You need not require to derive the equation of flexural vibration of beam.

11