II SEMESTER M.TECH. (STRUCTURAL ENGINEERING)

END SEMESTER EXAMINATIONS, May/June 2023

SUBJECT: EARTHQUAKE RESISTANT DESIGN OF STRUCTURES (CIE- 5272)

REVISED CREDIT SYSTEM

(24/05/2023)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.
- *Use of IS -1893 – 2016, IS -1893 – 1984, SP:16 , IS 13920 & IS 456-2000 is permitted*

Q. No	Question	Marks	CO	BL
1	The mass of a 3 storey shear building together with its undamped vibration mode shape and frequencies are shown below. Using acceleration response spectrum values for $\zeta = 5\%$ and for soft soil (refer IS -1893 – 2016). Evaluate the response (displacement, elastic force vector, base shear and overturning moment) when subjected to earthquake ground acceleration of 0.15g. Height of each storey is 3.5 m. (Fig. Q1) $\omega = \begin{Bmatrix} 6 \\ 12 \\ 18 \end{Bmatrix}$ rad/sec $\quad \Phi = \begin{pmatrix} 1 & 1 & 1 \\ 0.7 & -0.4 & -1.1 \\ 0.2 & -0.5 & 1.4 \end{pmatrix}$ $m = \begin{pmatrix} 6 & 0 & 0 \\ 0 & 7 & 0 \\ 0 & 0 & 8 \end{pmatrix} 10^3$ kg	10	3	5
2A	Evaluate the earthquake response of a generalized SDOF system of uniform cantilever beam of height 20 m subjected to base displacement of Vg (t).The properties of the system are m = 20000 kg/m, EI = 200×10^8 N-m^2, $\zeta = 5\%$. Take Spv = 15 cm/sec $\psi(x) = 1 - \cos\frac{\pi x}{2L}$ Asses the maximum base shear and moment	5	2	5
2B	(i)Write a short note on Elastic Rebound theory of Earthquake.	2	1	3
	(ii) list the difference between Magnitude and Intensity of an earthquake?	3	1	4

<table>
<tr><td>3</td><td>Design the reinforcement for a column of size 400 mm ×600 mm, subjected to the following forces. The column has an unsupported length of 3.5 m and is braced against side sway in both directions. Use M -30 grade concrete and Fe415 steel.
<table>
<tr><td></td><td>Dead Load</td><td>Live Load</td><td>Seismic Load</td></tr>
<tr><td>Axial Load (kN)</td><td>1000</td><td>700</td><td>600</td></tr>
<tr><td>Moment (kN-m)</td><td>60</td><td>45</td><td>120</td></tr>
</table></td><td>10</td><td>5</td><td>6</td></tr>
<tr><td>4</td><td>A three storey shear building has five transverse and four longitudinal frames. The location of these frames is shown in Fig. Q4. The relative stiffness of these frames are $K_A = 4.0$, $K_B = 3.0$, $K_C = 2.0$, $K_D = 1.0$, $K_E = 1.0$, $K_F = 1.5$, $K_G = 2.0$, $K_H = 2.5$ and $K_I = 3$. If the design seismic force in transverse and longitudinal direction is 500 kN, evaluate the same for different frames. Assume center of mass at geometric center of the building.</td><td>10</td><td>5</td><td>5</td></tr>
<tr><td>5</td><td>A Reinforced concrete chimney of height 25 m is to be constructed in Patiala on hard soil. Let the outer diameter at the base and top be 4 m and 3 m respectively. Let the wall thickness of the structure shall be 0.3 m throughout the height. Let there be a lining 0.1 m thick. Evaluate earthquake forces on this chimney. Use I =1, R = 3 and $E_C = 2.0 \times 10^7$ kN/m^2</td><td>10</td><td>5</td><td>5</td></tr>
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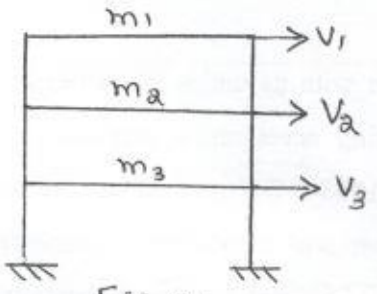

Fig Q1

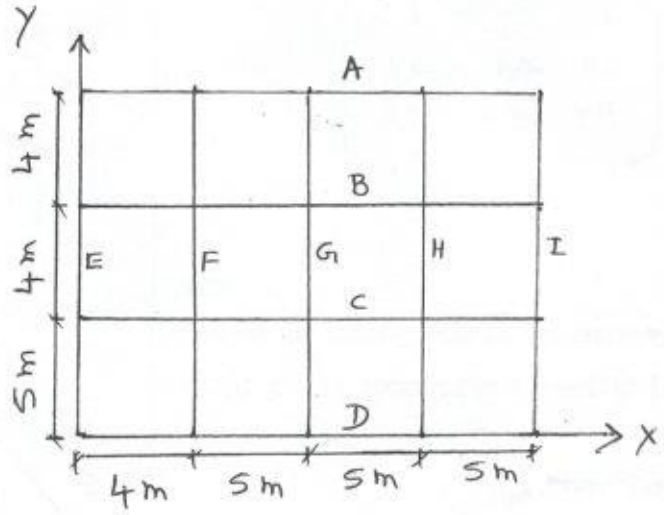

Fig. Q4