B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER-2025
SUBJECT: DYNAMICS IN GEOTECHNICAL ENGINEERING
Time: 3 HOURS Full Marks: 100
(PART I – 50 MARKS)
Use separate Answerscript for each part
Assume reasonable values of data not supplied

C.O.1

1. A machine of mass 100kg is supported on springs of stiffness 784 N/mm. The machine produces an unbalanced disturbing force of 392 N at a speed of 50 c/s. Assuming a damping factor of 0.20, determine (i) the amplitude of motion due to unbalanced force, (ii) the transmissibility and (iii) the transmitted force. 7
2. The moving component of an electric motor having a mass of 2.5 kg was running at a constant speed of 30 cps with an eccentricity of 160mm. The motor was mounted on an isolator with damping factor of 0.30. Determine the stiffness of the isolator spring such that 20% of the unbalanced force is transmitted to the foundation. Further, determine the magnitude of the transmitted force. 8

C.O.1

3. What is the purpose of conducting a block vibration test – Discuss with a neat sketch showing the position of eccentric mass on the PCC block during the test. 7

C.O.1

4. Derive the equations of motion of a block foundation subjected to simultaneous sliding and rocking vibrations (Give neat sketches). Solve these two equations to obtain expressions for natural frequencies. Also derive the expressions for amplitudes of coupled rocking and sliding if only horizontal exciting force is acting on the block foundation. 20

C.O.1

5. A concrete block foundation of size 8.0m x 4.5m x 2.5m is to be used as a foundation for a reciprocating machine operating at 500rpm and mounted symmetrically with respect to foundation. The weight of the engine is 10kN. The unbalanced vertical force acting on the machine is 2.0 sin $\omega t$ kN. The magnitude of elastic uniform compression is, Cu = $4.5 \times 10^4$ kN/m$^3$. Take unit weight of concrete = 24kN/m$^3$. Determine the natural frequencies and amplitude of the block by linear elastic spring-mass approach. 8

Ex/CE/PE/B/T/422C/2025

# B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER EXAM 2025

## DYNAMICS IN GEOTECHNICAL ENGINEERING

**Part – II**

**Time: 3 hours** **Full Marks: 100**

[50 marks for this Part]

**Use Separate Answer Scripts for Each Part**

[Assume any data reasonably if necessary]

[Use code: IS 1893 (Part-I): 2016]

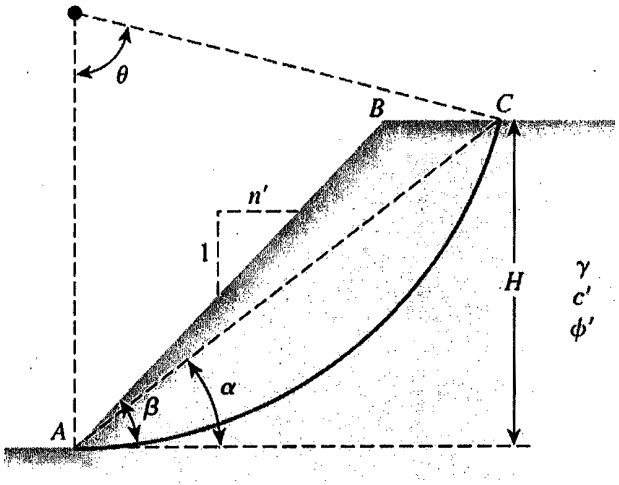
| Sl. No. | Question [Answer all questions] | Marks |
|---|---|---|
| 1. (a) | A Seismograph which is located 1200 km away from an earthquake epicenter, records a maximum ground displacement of 15mm for surface wave. Calculate the surface wave magnitude of the earthquake. | 5+5 [CO2] |
| (b) | Write a short note on '***Richter Local Magnitude ($M_L$)***' scale. | |
| 2. | Referring to the Fig. 1 and using the method of slices, calculate the factor of safety of the slope for the following cases.<br>(i) Static case<br>(ii) Seismic Case, $\alpha_h = 0.15$, $\alpha_v = 0.075$<br>[ $\beta = 45°$, $\varphi' = 18°$, $c' = 19\ kN/m2$, $\gamma = 18.1\ kN/m3$, H = 5m, $\alpha = 30°$ and $\theta = 80°$ ]<br>  <br><br>**Fig. 1** | [20] [CO4] |
| 3. | At a project site SPT tests have been carried out at every 0.75m depth. The measured penetration resistance with depth is given in the table (Table 1) and the soil profile obtained is also shown below. The region is expected to experience an earthquake of magnitude 8.1 with $a_{max}$ of '0.21g' under the expected earthquake. Compute and plot:<br>(i) CSR/ CRR variation with depth.<br>(ii) Variation of FS against liquefaction with depth. | [20] [CO3] |

**Table 1**

| Depth (m) | 0.75 | 1.5 | 2.25 | 3.0 | 3.75 | 4.5 | 5.25 | 6.0 | 6.75 | 7.5 |
|---|---|---|---|---|---|---|---|---|---|---|
| N-value | 4 | 2 | 3 | 6 | 8 | 9 | 12 | 16 | 13 | 18 |

| | | |
|---|---|---|
| **0m** | $\gamma_{sat} = 18\ kN/m3$ | Silty Sand, FC = 6% |
| **2m** | $\gamma_{sat} = 19.2\ kN/m3$ | Silty Sand, FC = 12% |
| **5m** | $\gamma_{sat} = 20.1\ kN/m3$ | Silty Sand FC = 36% |
| **10m** | | |

***Given:***

- SPT was conducted following IS standard
- Use unit weight of water, $\gamma_w$ = 10 kN/m$^3$ in the calculations]
- Assume Water Table at GL]