B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER-2024
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. Write the equation of motion of forced vibration of a single degree of freedom system. Derive the solution of this equation and present it graphically for both transient and steady-state condition. Also give the expression for dynamic magnification factor as a function of frequency ratio and damping ratio and show it graphically. 10

C.O.1

2. The moving component of an electric motor having a mass of 2.5 kg with an eccentricity of 160mm is running at a constant speed of 30 cps. The motor was mounted on an isolator with damping factor of 0.25. 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. 10

C.O.1

3. What are dynamic soil parameters used in the analysis and design of machine foundation? Give their expressions alongwith neat sketches. 10

C.O.1

4. Derive the equations of motion of a block foundation subjected to vertical and sliding vibrations (Give neat sketches). Solve these equations to obtain expressions for natural frequencies and maximum amplitude. 10

C.O.1

5. A concrete block foundation of size 8.0m(L) x 4.0m(B) x 2.5m(H) is to be used as a foundation for a reciprocating engine (mounted symmetrically with respect to foundation) operating at 500rpm. The weight of the engine is 10kN. The unbalanced vertical force acting on the machine will be 2.0 sin ωt kN. The magnitude of elastic uniform compression is, Cu = 5.0 x 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. 10

Ex/CE/PE/B/T/422C/2024

B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER EXAM 2024

DYNAMICS IN GEOTECHNICAL ENGINEERING

Part – II

Time: 3 hours (50 Marks) **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	Marks
1. (a)	Discuss 'Richter Local Magnitude Scale (M_L)' in brief.	5+5+5 [CO2]
(b)	During an earthquake the maximum amplitude recorded at a site by Wood-Anderson Seismograph is 23 cm. The maximum ground velocity recorded was 27 cm/sec. The site was found to be 78 km away from the epicenter. Determine the Magnitude and Intensity of the occurred earthquake.	
(c)	Differentiate between intensity and magnitude scale of earthquake measurement.	
2.	A retaining wall is 5.5m high with a vertical back. It has a horizontal cohesionless soil (dry) as backfill. Given: Unit weight of soil = 15 kN/m^3 Angle of internal friction (φ) = 30° Angle of wall friction (δ) = 15° Horizontal seismic coefficient, $k_h = 0.2$ Vertical seismic coefficient, $k_v = 0.1$ (i) Determine the active force P_{AE} per unit length of the retaining wall. (ii) Determine the location of the resultant force P_{AE} with the back face of the retaining wall. **Given** $$K_A = \frac{\cos^2(\phi-\beta)}{\cos^2\beta\cos(\delta+\beta)\left[1+\left\{\frac{\sin(\delta+\phi)\sin(\phi-i)}{\cos(\delta+\beta)\cos(\beta-i)}\right\}^{1/2}\right]^2}$$ $$K_{AE} = \frac{\cos^2(\phi-\theta-\beta)}{\cos\theta\cos^2\beta\cos(\delta+\beta+\theta)\left[1+\sqrt{\frac{\sin(\phi+\delta)\sin(\phi-\theta-i)}{\cos(\delta+\beta+\theta)\cos(i-\beta)}}\right]^2}$$ where, φ = soil friction angle, β = slope of the back of the wall with vertical, $\theta = \tan^{-1}\left(\frac{k_h}{1-k_v}\right)$, δ = angle of friction between the wall and soil i = backfill inclination angle	[15] [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 7.5 with a_{max} of '0.25g' under the expected earthquake. Compute:

(i) FS against liquefaction with depth.
(ii) Estimate the free-field settlement that the site would experience using Tokimatsu and Seed (1987) Approach.

[12+8] [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	8.25	9	9.75
N-value	5	3	4	5	8	7	11	12	15	18	22	25	30

0m	$\gamma_{sat} = 18\ kN/m3$	Sand
2m	$\gamma_{sat} = 19.2\ kN/m3$	Sand
5m	$\gamma_{sat} = 20.1\ kN/m3$	Silty Sand
10m		

Given:

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

Figures Given