Ref. No. : Ex/CE/PE/B/T/422C/2023

B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER-2023
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. 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 0.25. Determine the stiffness of the isolator spring such that 15% of the unbalanced force is transmitted to the foundation. Further, determine the magnitude of the transmitted force. 15

C.O.1

2. Write a short note on block vibration test. 7

C.O.1

3. 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

4. A concrete block foundation of size 8.0m x 4.0m x 2.0m is to be used as a foundation for a reciprocating engine 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 1.6 sin ωt kN. The magnitude of elastic uniform compression is, Cu = 4.5 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. 8

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B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER EXAM 2023

SUBJECT: DYNAMICS IN GEOTECHNICAL ENGINEERING (CE/PE/B/T/422C)

Part – II

Time: 3 hours

Full Marks: 100

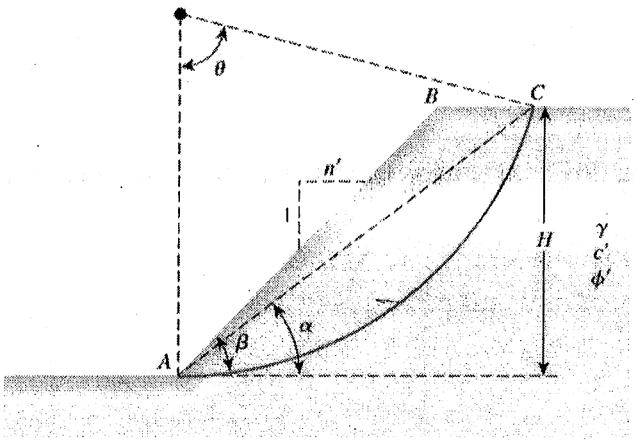
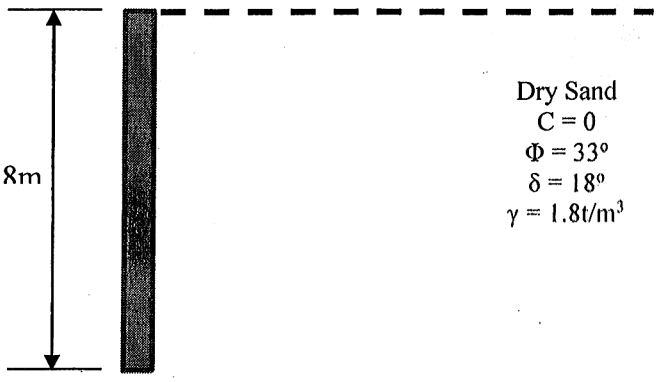
[50 marks for this Part]

Use Separate Answer Scripts for Each Part

[Answer all the questions]

[Assume any data reasonably if necessary]

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

Sl. No.	Question	CO	Marks
1.	Referring to the Fig. 1 and using the method of slices, calculate the factor of safety of the slope for the following cases. (i) Static case (ii) Seismic Case, $\alpha_h = 0.12$, $\alpha_v = 0.06$ [$\beta = 45°$, $\varphi' = 15°$, $c' = 18\ kN/m2$, $\gamma = 17.1\ kN/m3$, H = 5m, $\alpha = 30°$ and $\theta = 80°$]  **Fig. 1**	[CO4]	[20]
2.	Compute the static and dynamic active earth pressure for the wall shown below. Also calculate the location of total active thrust. [Take $k_h = 0.1$ & k_v=50% of k_h]  **Figure 2**	[CO4]	[15]

Given

K_A = active earth pressure coefficient

$$= \frac{\cos^2(\phi - \beta)}{\cos^2\beta\cos(\delta+\beta)\left[1+\left\{\frac{\sin(\delta+\phi)\sin(\phi-i)}{\cos(\delta+\beta)\cos(\beta-i)}\right\}^{1/2}\right]^2}$$

$$K_{AE} = \frac{\cos^2(\phi-\theta-\beta)}{\cos\theta\cos^2\beta\cos(\delta+\beta+\theta)\left[1+\sqrt{\frac{\sin(\phi+\delta)\sin(\phi-\theta-i)}{\cos(\delta+\beta+\theta)\cos(i-\beta)}}\right]^2}$$

where,

φ = soil friction angle,

β = slope of the back of the wall with vertical,

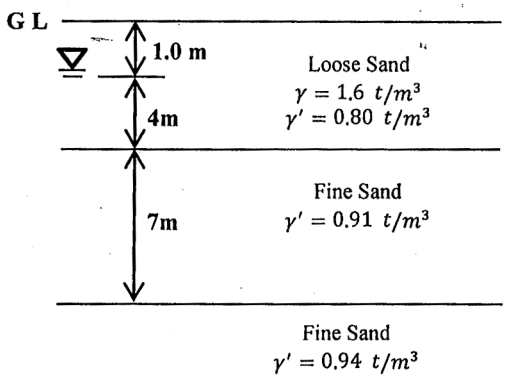
$$\theta = \tan^{-1}\left(\frac{k_h}{1-k_v}\right),$$

δ = angle of friction between the wall and soil

i = backfill inclination angle

3. The following are the results of a standard penetration test in sand. Calculate the corrected standard penetration numbers, $(N_1)_{60}$, at the various depths given in the table below. The soil profile is given in figure below. Assume Pa =100 kN/m^2. [Ignore the correction for non-standard hammer weight and height of fall. Assume safety hammer with rope and pulley, borehole diameter = 160 mm, and standard sampler without liners is used]

Depth (m)	N-value
1.5	3
3.0	5
4.5	7
6.0	15
7.5	21
9.0	25



[CO3] [10]

4. Discuss the steps involve in geotechnical design of shallow foundation under earthquake loading using Pseudo-Static method. [CO4] [5]