M.E. CIVIL ENGINEERING FIRST YEAR SECOND SEMESTER EXAM 2025

SOIL DYNAMICS AND MACHINE FOUNDATION (SMFE)

PART-I

FM: 60 for this part (Total: 100)

[Answer all questions]

[*Assume any data reasonably wherever necessary*]

1. (a) Derive the expressions for displacement and stress amplitudes of transmitted and reflected waves due to the propagation of a harmonic stress wave $\sigma_I(x,t) = \sigma_i e^{i(\omega t - k_1 x)}$ in the +x direction and approaching an interface of two different materials as shown in the figure (Fig. 1) below. [Symbols used carry the usual meaning].

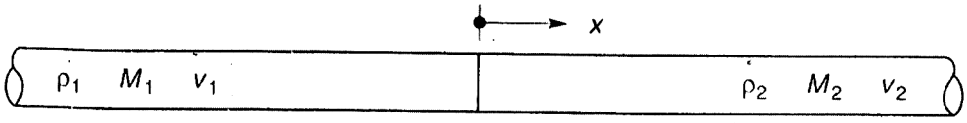

Fig. 1

(b) From the above derivation, discuss the impedance ratio cases of 'zero' and 'infinity'.

[11+4]

2. (a) Discuss Spectral Analysis of Surface Wave (SASW) test in connection with the determination of shear wave velocity of soil.

(b) The results of a subsoil exploration by steady-state vibration technique are given in Table 1.

Table 1

Distance from the plate vibrated x (m)	Number of waves for the distance	Frequency of vibration of the plate (Hz)
10	41	900
10	18	400
10	9	200
10	4.55	100
10	2.65	90
10	2.3	75
10	1.77	60
10	1.47	50

Make necessary calculations and plot the variation of: (i) Rayleigh wave phase velocity vs Frequency and (ii) the variation of shear wave velocity with depth.

[9+6]

3. (a)The results of a refraction survey in terms of time of first arrival (in milliseconds) and distance in meters is given below in tabular form. Assuming that the soil layers are perfectly horizontal, determine the P-wave velocities of the underlying soil layers and their thicknesses.

Distance (m)	10	15	20	30	40	50	60	70	80	90	100	120
First arrival Time (ms)	41.7	62.5	83.4	91.8	101.2	110.2	119.2	128.1	136.2	141	143.8	152

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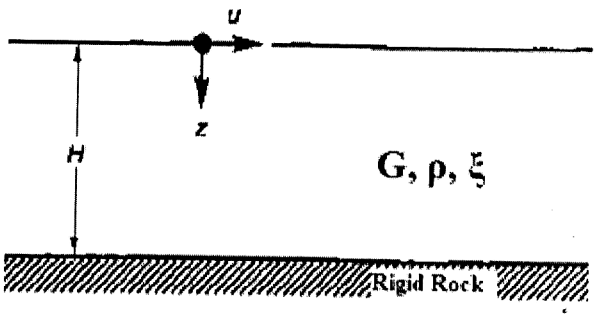
[15]

4. (a) Derive an expression of transfer function for '***Uniform damped Soil on Rigid Rock***' case for the uniform soil layer with thickness H as shown in the figure below due to vertically propagating shear waves. Then, plot the variation of transfer function and also plot the mode shapes for first three natural frequencies.



(b) A soil stratum of 30 m thickness that lies over bedrock has an average shear wave velocity of 250 m/s. Compute the amplification at the ground level for maximum considered earthquake for the first two modes. Consider material damping of soil as 5%.

[10+5]

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M.E. CIVIL ENGINEERING FIRST YEAR SECOND SEMESTER – 2025
SUBJECT: SOIL DYNAMICS AND MACHINE FOUNDATION (SMFE)
Time: 3 HOURS Full Marks: 40
PART II
Use Separate Answer scripts for each PART
Assume reasonable values of data not supplied

1. What is block vibration tests? Discuss with a neat sketch the methodology of the tests and how the coefficient of elastic uniform compression is determined from the test. 10

2. 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 450rpm and mounted symmetrically with respect to foundation. The weight of the engine is 10kN. Maximum unbalanced vertical force acting on the machine is 1.7 kN. Maximum unbalanced horizontal force = 2.5 kN. The magnitude of elastic uniform compression is, $Cu = 5.0 \times 10^4$ kN/m^3. Take unit weight of concrete = 24kN/m^3. Determine the natural frequencies and amplitude of the block by weightless spring approach. 20

3. Draw a neat sketch of foundation for Impact type machine.
Write the equations of motion for hammer foundation considering Two-mass-spring analogy. Then derive the expressions for displacement for foundation and anvil. 10