ME (Civil) 2ND Semester Examination, April 2013

Sub: Dynamics of Soils and Foundations (CE – 1012)

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

Answer any FIVE questions

1. (i) Derive an expression for the wave propagation velocity of a longitudinal wave in an infinitely long elastic rod with Young's modulus, E, Poission's Ratio, ν, and density, ρ. State the characteristics of wave propagation velocity and particle velocity in a stressed zone

   (ii) A constrained steel rod subjected to a harmonic axial stress at a frequency 10 Hz. Calculate the wave propagation velocity and the wave length of the axial displacements of the rod. Specific gravity and constrained modulus of the steel rod are 7.85 and 2.1×10^8 kPa respectively.

   (15+5)

2. (i) Define transmissibility. Explain how the frequency ratio and the static deflection affect transmissibility value.

   (ii) Enumerate the design steps of a block type machine foundation using Tschebotarioff's 'Reduced Natural frequency' method.

   (10+10)

3. i) A machine weighing 850 N is supported on springs of total stiffness 35000 N/m. If a harmonic disturbing force of magnitude 45 N acts on the machine, determine the resonant frequency and resonant amplitude assuming a viscous damping coefficient of 1000 Ns/m. Also determine the peak amplitude and the phase angle corresponding to the peak amplitude.

   ii) A seismic refraction survey was carried out on a stratified soil deposit. The measured P-wave velocities are 400 m/s, 1600 m/s, and 2400 m/s for the Layer – I, II, and III respectively. The thickness of Layer – I and II measured 5 m and 10 m respectively. Determine the time of first arrival wave at geophone (G). The distance between the shot point and geophone is 30 m.

   (12+8)

4. A single degree of freedom undamped system is subjected to a forced vibration with a constant amplitude harmonic loading of $P \cos \omega t$. If the system had started vibrating from absolute stationary state, derive the expression (from first principle) for the final displacement response of the the system. Also draw the displacement response profile for a limiting case when the exciting frequency approaches the natural frequency of the system.

   (20)

5. (i) Following are the results of a cyclic plate load test. The size of the plate used for the test was 300 mm x 300 mm. Calculate subgrade modulus, spring constant and shear modulus (Assume Poission's ratio = 0.35).

Load intensity (kN/m^2)	0.0	70.0	0.0	140.0	0.0	210.0	0.0	280.0	0.0
Settlement (mm)	0.0	2.1	1.6	3.9	2.8	5.7	4.2	7.3	5.2

   Also determine the coefficient of uniform elastic compression of a foundation of base size 2m x 2m.

   (ii) Two linear spring constants K_1 and K_2 are connected in series to a rigid block of mass M and subjected to free vibration with natural period of 5 sec. The same springs, when connected in parallel, with the same rigid block, gives a natural period of 2 sec. under free vibration. Compute the ratio of the spring constants.

   (10+10)

6. In a test, seismic waves were generated by the impact of a hammer falling through a height of 2.0 m. Two geophones were placed on the ground at 1.0 m and 5.0 m from the source. The analysis of data gave the velocity of shear wave as 200 m/s. Estimate P-wave and Rayleigh wave velocities propagating through the soil layer. Assuming Poission's ratio and density of soil as 0.35 and 18.0 kN/m^3 respectively, determine the maximum shear modulus and Young's modulus of the soil.

(20)

7. Write short notes on any TWO of the following.
   i) Design criteria of machine foundation according to IS: 2974 (Part-1).
   ii) Characteristics of Spectral Analysis of Surface Wave Test.
   iii) Rotating mass type excitation.
   iv) Determination longitudinal wave velocity and modulus of elasticity from resonant column test?

(10+10)