

# Soil Dynamics - Video course

## COURSE OUTLINE

The first course in soil mechanics/geotechnical engineering generally introduces the fundamental concepts, principles and applications of soil as engineering material with properties under static loading.

This course "Soil Dynamics" discusses about the behaviour and properties/response of soil as a material subjected to the dynamic or cyclic time-dependent loading.

Also the design and principle for machine foundations comes along with this course to consider the dynamic properties of both soil and foundation as combined mass.

Behaviour of various geotechnical structures such as shallow and deep foundations, retaining structures, slopes, subgrade soil below railway, pavement, runway due to various types of time-dependent dynamic loading are discussed here with reference to codal provisions.

The advanced course material on soil dynamics will be very useful to undergraduate students, post-graduate students, researchers, teachers and practitioners. A number of selected problems will be solved to illustrate the concepts clearly.

### Contents:

Introduction to soil dynamics, Fundamentals of vibration, Wave propagation, Dynamic soil properties, Machine foundation, Dynamic soil improvement techniques, Dynamic soil-structure interaction.

## COURSE DETAIL

Sl.No.	Topic	No. of Hours
1.	<b>Introduction:</b> Scope and objective; Nature and types of dynamic loading; Importance of soil dynamics.	01
2.	<b>Vibration theory:</b> Vibration of elementary systems; Degrees of freedom; Undamped and damped free and forced vibrations; Forced vibrations due to support motions;  Rotating mass and constant force oscillators; Non harmonic forced vibrations; Duhamel's integral; Introduction to Fourier transform; Introduction to two and multi degrees of freedom systems; Response spectra.	08
3.	<b>Wave Propagation:</b> Elastic response of continua (one, two and three dimensional wave equations); Waves in unbound	04



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## Civil Engineering

### Pre-requisites:

1. Soil Mechanics (Geotechnical Engineering I).

### Additional Reading:

1. Journal and Conference papers in the area of Soil Dynamics and Machine Foundations.

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	media; Waves in semiinfinite media; Waves in layered media.	
4.	<p><b>Dynamic Soil Properties:</b></p> <p>Stiffness, damping and plasticity parameters of soil and their determination (laboratory testing, intrusive and non intrusive in-situ testing); Correlations of different soil parameters; Liquefaction (basics, evaluation and effects)</p>	06
5.	<p><b>Machine Foundations:</b></p> <p>Types of motion; MSD model and EHS theory; Vertical, sliding, torsional and rocking modes of oscillations; Coupled motion; Vibration control; Practical design considerations and codal provisions</p>	10
6.	<p><b>Soil Improvement Techniques:</b></p> <p>Basic concept of soil improvement due to dynamic loading; Various methods; Mitigation of liquefaction.</p>	03
7.	<p><b>Dynamic Soil-Structure Interaction:</b></p> <p>Behaviour of shallow underground foundations due to dynamic loads; Response of pile foundations under dynamic loads;</p> <p>Design aspects for earth retaining structures subjected to dynamic loads; Slope stability due to dynamic loads; Behaviour of subgrade soil due to cyclic loads of railway, runway.</p>	08
8.	<p><b>Generalized Single Degree of Freedom Systems:</b></p> <p>Basic concepts, mass-spring system; Lumped mass systems; Systems with distributed mass and elasticity; Rayleigh's method, shape function selection.</p>	04
9.	<p><b>Introduction to Dynamics of Continuous Systems:</b></p> <p>Equations of motions for axial vibration of a beam; Equations of motion for flexural vibration of a beam;</p> <p>Free vibration analysis; Introduction to forced vibration analysis using modal superposition method.</p>	06

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**References:**

1. Shamsheer Prakash, "Soil Dynamics", McGraw-Hill Book Company.
2. Braja M. Das, "Principles of Soil Dynamics", PWS-KENT Publishing Company.
3. Steven L. Kramer, "Geotechnical Earthquake Engineering", Prentice Hall Inc.

4. D. D. Barkan, "Dynamics of Bases and Foundations", McGraw-Hill Book Company.
5. E. E. Richart et al. "Vibrations of Soils and Foundations", Prentice Hall Inc.