

## **SOIL DYNAMICS AND FOUNDATIONS**

### **Course Learning Objectives:**

The basic 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 on 'Soil Dynamics' discusses

- About the fundamentals of vibrations
- about the behaviour and properties/response of soil as a material which is subjected to various types of dynamic or cyclic time-dependent loadings.
- the design and analysis for machine foundations come 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 due to various types of time-dependent dynamic loading are discussed here along with the reference to design code provisions.
- Phenomena like liquefaction and lateral spreading of soil are also discussed.
- Discusses about the laboratory and field tests to compute the dynamic soil properties of the soil mass.

### **Course Outcomes:**

- On successful completion of these course, the student able to
- Use theory of vibrations to find the behavior of soil under dynamic loading
- Design machine foundations under different loads and soil conditions
- Understand the liquefaction phenomena
- Conduct various laboratory and field tests to determine the dynamic soil properties and its interpretation.
- Design vibration isolators under any vibratory machines.

### **SYLLABUS:**

**UNIT-I** Introduction: Types of motion- SHM- Fundamental definitions- SDOF systems- Free and forced vibration with and without damping - Constant force and rotating mass type excitation –Types of damping-Equivalent stiffness of springs in series and parallel. – Resonance and its effect - magnification-logarithmic decrement –Transmissibility.

**UNIT-II** Theories of Vibration Analysis- EHS Theory and lumped parameter model- Different modes of vibration- Natural frequency of foundation soil system – Barkan and IS methods – Pressure bulb concept – Reisner Theory – Limitations of Reisner theory – Sung’s solutions -- Pauw’s Analogy – Heigh’s Theory.

**UNIT-III** Dynamic properties of soils, Determination of E, G and Poisons ratio from field and laboratory tests, recommendations of Indian codes- Stress waves in bounded elastic medium- Use of wave theory in the determination of elastic properties, Elastic coefficients of soils and their determination- damping factor from free and forced vibration tests.– Block vibration test – Determination of Damping factor.

**UNIT-IV** Types of machine foundations – general requirements design – criteria for machine foundations, permissible amplitudes and bearing pressure  
Design data, design criteria, IS code provisions for the design foundations of reciprocating machines.

**UNIT-V** Design data, design criteria, IS code provisions for the design foundations of Impact type of machines.

**UNIT-VI** Vibration Isolation: Transmissibility, Principles of isolation- Methods of isolation- Vibration isolators- Types and their characterizes

Special Topics: Liquefaction of soils, CSR, CRR, Factor of safety against liquefaction -

Dynamic bearing capacity, Earth retaining structures under dynamic loads

**Text Book:**

1. Soil Mechanics and Machine foundations, Swami Saran, Galgotia Publications.
2. Fundamentals of Soil Dynamics, B M Das, Centage Learning

**References:**

1. Vibrations of Soils and Foundations, Richart Hall and Woods
2. Vibration Analysis and Foundation Dynamics, NSV Kameswara Rao, Wheeler Publishing, New Delhi.
3. Foundations of Machines- Analysis and Design, Prakash and Puri
4. Analysis and design of Foundations for Vibrations, P J Moore
5. Dynamics of bases and Foundations, D D Barkar