# SOIL DYNAMICS AND MACHINE FOUNDATIONS (Dept.Elective-IV)

# **Course Learning Objectives:**

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

# This course on 'Soil Dynamics' discusses

- 1. About the fundamentals of vibrations
- 2. About the behaviour and properties/response of soil as a material which is subjected to various types of dynamic or cyclic time-dependent loadings.
- 3. 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.
- 4. 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.
- 5. Phenomena like liquefaction and lateral spreading of soil are also discussed.
- 6. Discusses about the laboratory and field tests to compute the dynamic soil properties of the soil mass.

# **Course Outcomes:**

On successful completion of this course, the student able to

- 1. Use theory of vibrations to find the behaviour of soil under dynamic loading
- 2. Design machine foundations under different loads and soil conditions
- 3. Understand the liquefaction phenomenon
- 4. Conduct various laboratory and field tests to determine the dynamic soil properties and its interpretation.
- 5. 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 Poison's 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 of 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
- 3. Publishing, New Delhi.
- 4. Foundations of Machines- Analysis and Design, Prakash and Puri
- 5. Analysis and design of Foundations for Vibrations, P J Moore
- 6. Dynamics of bases and Foundations, D DBarkar