

Structural Dynamics
01ST2202 (PCC)

Objective of the Course: Objectives of introducing this subject at first year level in Masters of structural engineering are:

- To understand the basics of structural dynamics for seismic analysis of structures
- To understand the behavior of the structure subjected to earthquake forces.

Credit Earned: 3

Students learning outcomes:

After successful completion of the course, it is expected that student will be able to,

1. Formulate the mathematic modelling & equations of motions for SDOF & MDOF systems.
2. Identify the response of SDOF structures using various approach.
3. Evaluate the response of MDOF structures using various approach.
4. Identify the suitable structural control systems.

Teaching and Examination Scheme

| Teaching Scheme (Hours) | | | Credits | Theory Marks | | | Tutorial/ Practical Marks | | Total Marks |
|-------------------------|----------|-----------|---------|--------------|---------|--------|---------------------------|----------------|-------------|
| Theory | Tutorial | Practical | | ESE (E) | CSE (I) | IA (M) | Viva (V) | Term Work (TW) | |
| 03 | 00 | 00 | 03 | 50 | 20 | 30 | 25 | 25 | 150 |

Detailed Syllabus

| Sr No. | Title of the unit | Number of hours |
|----------|--|-----------------|
| 1 | Response of Single Degree of Freedom System | 18 |
| | Introduction to Structural Dynamics, Application of Structural Dynamics, Mathematical Modelling of SDOF & MDOF structures, Free & Forced Vibration Response of SDOF; Concept of Damping & Various Types of Damping; Free & Forced Damped Vibration Response of SDOF; Response of SDOF system to general dynamic loading using Duhamel's Integration, Numerical Techniques for SDOF subjected to general dynamic loading. Introduction to Nonlinear Response of Structures. | |

| | | |
|----------|--|-----------|
| 2 | Response of Multi-Degree of Freedom System | 18 |
| | Equation of Motion of Symmetrical & Unsymmetrical MDOF System, Mode Shapes & Natural Frequency of MDOF System, Orthogonality of Mode Shapes; Normalization of Mode Shapes, Numerical Techniques for determination of Natural Frequencies, Derivation of Damping Matrix, Modal Damping Matrix & Rayleigh's Damping Matrix, Dynamic Response using Modal Superposition Technique, Free & Forced Vibration of MDOF, Concept of Response Spectrum Analysis; Response Spectrum Analysis of MDOF as per IS Standard. Concept of Generalized SDOF System. | |
| 3 | Recent Advancement in Structural Dynamics | 06 |
| | Active & Passive Controls systems & Their Suitability; Base isolations – Principles, Types, Design Consideration, Feasibility. Dampers - Principles, Types, Design Consideration, Feasibility. Active, Semi-active & Hybrid Control Systems Application of structural control systems. Dynamics effects of wind loading, Introduction of Blast Loading and Pile driving, Foundations for industrial machinery. | |

Suggested Theory Distribution

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

| Distribution of Theory for course delivery and evaluation | | | | | |
|---|------------|-------|---------|----------|--------|
| Remember | Understand | Apply | Analyze | Evaluate | Create |
| 5% | 5% | 20% | 25% | 25% | 20% |

Instructional Method and Pedagogy:

1. Use of Learning Management system like canvas
2. Demonstration through ppt and videos and lectures
3. Brainstorming and group discussion sessions
4. Collaborative learning

Recommended Study Material:

Reference Book:

1. A.K. Chopra; Dynamics of structures, Pearson, New Delhi.
2. Clough & Penzin; Dynamics of structures.
3. Biggs, J. M. "Introduction to structural dynamics." Edition, McGraw Hill, New York, NY.
4. Craig, Roy R., and Andrew J. Kurdila. "Fundamentals of structural dynamics." John Wiley & Sons, 2006
5. S S Rao; Mechanical Vibration; Pearson, New Delhi
6. Manish Shrikhande & Pankaj Agrawal; Earthquake resistant design of structures, PHI Publication, New Delhi

7. S.K. Duggal; Earthquake resistance design of structures; Oxford University Press, New Delhi.
8. Park & Pauly; Behaviour of RC structure
9. C V R Murthy - Earthquake Tips, NICEE
10. IITK-GSDMA EQ26 – V -3.0 Design Example of a Six Storey Building.

MOOC Courses:

1. **Structural Dynamics-NPTEL Course**
<https://nptel.ac.in/courses/105/106/105106151/>
2. **Structural Dynamics-NPTEL Course**
<https://nptel.ac.in/courses/105/101/105101006/>
3. **Dynamics of Structures-NPTEL Course**
<https://nptel.ac.in/courses/105/101/105101209/>
4. **Structural Dynamics for Civil Engineers**
<https://nptel.ac.in/courses/105/104/105104189/>

Web Resource

1. <https://www.nicee.org/EQTips.php>
2. <https://www.nicee.org>
3. <https://www.eeri.org>
4. <https://www.gsdma.org>
5. <https://www.ndma.gov.in>
6. <https://www.nptel.iitm.ac.in/courses>
