

M. Tech. I Semester II

Subject Name: Structural Dynamics

Subject Code: MTST13202

Type of course: Core - IV

Prerequisite: Engineering Mechanics, Strength of Materials, Structural Analysis & Engineering Mathematics

Rationale: During the lifespan of any structure, there is every chance of its subjection to Earthquake, wind, traffic, blasting etc. load condition which is known to be time dependent forces. These forces causes vibrations in structures and hence it is important to study structural dynamics course which will help understanding the behavior of structure under such dynamic loading condition and to arrive at safe design solutions for Civil Engineering Structures.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction: Overview of Structural Dynamics, Basic terminology – Natural Frequency, Natural Period, Resonance etc, Types of Analysis, Degrees of Freedom, Assumption to reduce dynamic DoF, Mathematical modeling of dynamic systems.	06	15%
2	Single Degree of Freedom System: Free and forced vibration with and without damping, Response to Harmonic Loading, Response to general dynamic loading using Duhamel's integral, Numerical solution of response using Newmark's method & Direct Integration, Concept of response spectrum.	12	25%
3	Multiple Degree of Freedom System: Equation of motion of symmetrical and un-symmetrical structures in plan, Natural frequencies and mode shapes of vibrating system, Orthogonality of modes, Dynamic response by Modal Superposition Method, Response Spectrum Analysis, Introduction to multiple degree of freedom system with distributed mass and loading	20	45%
4	Special Topics in Structural Dynamics(Concepts only): Dynamic effects of Wind loading, Vibrations caused by Construction, Demolition, High Speed Traffic, Blasting and Pile driving	07	15%

Core - IV: Core Course - IV

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	25	25	15	15	10

Legends: R: Remembrance, U: Understanding; A: Application, N: Analyze, E: Evaluate C: Create and above Levels (**Revised Bloom's Taxonomy**)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of Publication	Publication Edition
01	Dynamics of Structures	Clough R. W. and Penzien J	McGraw Hill	1995	3 rd Edition
02	Structural Dynamics - Theory and Computation	Paz Mario	CBS Publication	2004	2 nd Edition
03	Structural Dynamics and Introduction to Earthquake Engineering	Chopra A. K.	Prentice Hall	2012	4 th Edition
04	Structural Dynamics – Vibrations and Systems	Madhujit Mukhopadhyay	Ane Books Pvt. Ltd.	2006	1 st Edition
05	Dynamics of Structures	Humar J. L	Prentice Hall	2012	3 rd Edition

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % Weightage
CO-1	Understand the differences between Static and Dynamic Load System acting on structures and its relative effects on structures (<i>R, U, A – Cognitive Level</i>)	10%
CO-2	Understand the Components involved in Dynamic Analysis of Structure and its importance	10%
CO-3	Understand and analyze the dynamic response of single degree freedom system using fundamental theory (<i>U, A, N, E, C – Cognitive Level</i>)	30%
CO-4	Understand and analyze the dynamic response of multi degree freedom system using fundamental theory (<i>U, A, N, E, C – Cognitive Level</i>)	35%
CO-5	Understand the fundamentals of Vibrations caused by Wind, Blast and High Speed Traffic, Construction, Demolition (<i>U, A, C – Cognitive Level</i>)	15%

FOR TUTORIAL SESSIONS:

List of Tasks:

- Group of Students have to prepare presentation based on topics of subject as well as individually students have to write / solve assignments
- Group of Students have to model application problem based on Structural Dynamics in Computer Software and undergo analysis / behavior study
- Group of Students have to perform Experiments on Vlabs platform as provided by IITs

List of Open Source/learning website:

- <https://nptel.ac.in/courses/105/104/105104189/>
 - Lecture Series on Structural Dynamics by Prof. Riya George, IIT Kanpur
- <https://nptel.ac.in/courses/105/106/105106151/>
 - Lecture Series on Structural Dynamics by Prof. R. Pradeep Kumar, IIIT Hyderabad
- www.nicee.org
 - National Information Centre for Earthquake Engineering, IIT Kanpur.
- www.eeri.org
 - Earthquake Engineering Research Institute

List of Open Source Software:

- <https://sd-iiith.vlabs.ac.in/>