

Subject Code: 1ET2060202	Subject Title: STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING
Pre-requisite Subject	Mechanics of Solids, Structural Analysis, Matrix Methods of Structural Analysis and Engineering Mathematics

Course Objective:

Earthquakes are one of the most devastating natural hazards that cause great loss of life and livelihood because of collapse of structures. Earthquakes impose time-dependent lateral inertia forces on the structure. To make a structure earthquake resistant, it is to be designed for lateral loads in addition to gravity loads. The lateral loads acting on structure are calculated using theory of structural dynamics. Therefore, the understanding of structural dynamics, characteristic of earthquakes and its effect on structure is essential for safe design of civil engineering structures.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture	Tutorial	Practical	Credit	Theory		Practical		Total
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
3	-	2	5	60	40	30	20	150

Subject Contents				
Sr. No	Topic	Total Hours	Weight (%)	
01	Structural Dynamics: Response of SDOF to harmonic and general dynamic loading, Vibration of multiple degree of freedom systems, numerical techniques for finding natural frequencies & mode shapes, orthogonality relationship of principal modes, Rayleigh's & Dunkerley's principle, Evaluation of dynamic response by mode superposition method, Analysis by response spectrum theory	14	30	
02	Fundamental of Earthquake Engineering: Causes of earthquake and their characteristic, earthquake parameters, seismic zoning of India, Lessons from past earthquake and remedial measures, Response spectra & Combined D-V-A plot.	02	05	
	Behaviour of floor diaphragms, effect of various structural irregularities, lateral force analysis of building - Torsion ally uncoupled and coupled system	12	30	
	Ductile detailing of various structural elements, various lateral load resisting structural systems – MR frame with shear wall & bracing, Provisions of IS 1893& IS 13920	08	20	
	Structural controls: Passive Controls – Base isolation, various dampers, Active Controls.	02	05	
	Earthquake resistant design of masonry structure as per IS 4326	04	10	

List of Tutorials:

Minimum 15 problems from above topics.

List of References:

1. Dynamics of Structures - A. K. Chopra
2. Structural Vibrations - Theory and Computation - Mario Paz
3. Earthquake Resistant Design - Manish Shrikhande & Pankaj Agrawal
4. Design Structural Dynamics - Clough & Penzien
5. Elements of earthquake engineering - Jaikrishna & Chandrasekaran

6. Advanced reinforcement of concrete design – P.C.Vergesh
7. IS 1893-2002, IS 13920- 1993 & IS 4326

Course Outcome:

After learning the course, the students should be able to:

1. Understand characteristics of earthquake and its effect on structures,
2. Estimate lateral forces acting on symmetric as well as asymmetric buildings,
3. Find mode shapes and natural frequency,
4. Carry out seismic response analysis of a structure,
5. Design and detail to enhance ductility,
6. Understand various seismic response control strategies,
7. Design earthquake resistant masonry structures.

Open Ended Problems:

Apart from above tutorials/experiments a group of students has to undertake one open ended problem/design problem few examples of the same are given below:

1. Modelling and response of structure like high-rise buildings, water tanks and bridges subjected to earthquake loading using open-source/professional software's.
2. Earthquake resistant design of masonry structure.
3. Development of models for ductile detailing of beam, column, beam-column joint etc.

List of Open Source Software/learning website:

www.nicee.org
<http://www.earthquakeinfo.org/opensees.berkeley.edu/>
<http://neptel.ac.in/>
<http://ocw.mit.edu/courses/civil-and-environmental-engineering/>
www.eeri.org/
www.earthquakeengineering.com/
www.curee.org