

GUJARAT TECHNOLOGICAL UNIVERSITY

CIVIL (STRUCTURAL ENGINEERING) (20) STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING SUBJECT CODE: 2722010 SEMESTER: II

Type of course: Core

Prerequisite: Mechanics of Solids, Structural Analysis, Matrix Methods of Structural Analysis and Engineering Mathematics

Rationale: 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-dependant 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 and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	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
2	Fundamental of Earthquake Engineering:	02	05
2.1	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		
2.2	Behaviour of floor diaphragms, effect of various structural irregularities, lateral force analysis of building - Torsionally uncoupled and coupled system	12	30
2.3	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
2.4	Structural controls: Passive Controls – Base isolation, various dampers, Active Controls	02	05

2.5	Earthquake resistant design of masonry structure as per IS 4326	04	10

Reference Books:

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 reinforced 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:

- (a) understand characteristics of earthquake and its effect on structures,
- (b) estimate lateral forces acting on symmetric as well as asymmetric buildings,
- (c) find mode shapes and natural frequency,
- (d) carry out seismic response analysis of a structure,
- (e) design and detail to enhance ductility,
- (f) understand various seismic response control strategies,
- (g) design earthquake resistant masonry structures.

List of Experiments/Tutorials:

Minimum 15 problems from above topics.

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 softwares.
2. Earthquake resistant design of masonry structure.
3. Development of models for ductile detailing of beam, column, beam-column joint etc.

Major Equipments: --

List of Open Source Software/learning website:

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

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website