

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: GEOTECHNICAL ENGINEERING
SUBJECT NAME: GEOTECHNICAL EARTHQUAKE ENGINEERING
SUBJECT CODE: 3714314
M.E. Semester-I

Type of course: Programme Elective - II

Prerequisite: knowledge of Geotechnical Engineering

Rationale: Behavior of soil is modified greatly due to earthquake ground motion. Soil parameters get modified due to earthquake as compared to normal soil condition. Therefore effect of earthquakes shall be studied carefully. Seismic Hazard Analysis will become very important to study the effects of earthquakes. Liquefaction is an earthquake induced phenomenon & shall be dealt very carefully along with slope stability issues. Design of retaining wall & foundation becomes very important as they are highly affected due to ground motion.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Seismology: Causes of earthquake, Plate tectonics, Earthquake fault, Seismic waves, Elastic rebound theory, Quantification of earthquake, Intensity and magnitudes, Earthquake source models	4	10
2	Earthquake Ground Motion & Ground Response Analysis: Seismograph, Characteristics of ground motion, Effect of local site conditions on ground motions, Strong Ground Motion, Design earthquake, Design spectra, Development of site specification and code-based design spectra. One-dimensional ground response analysis: Linear approaches, Equivalent linear approximation of non-linear approaches,	8	20
3	Seismic Hazards Analysis: Mitigation of Seismic Hazards, Seismic Hazard Analysis; Probabilistic & Deterministic Approaches, Wave Propagation in unbounded media: in semi-infinite bodies, in layered soils and attenuation of stress waves; Dynamic soil properties	8	20
4	Liquefaction and Lateral Spreading: Liquefaction related phenomena, effects of liquefaction, Liquefaction susceptibility: Historical, Geological, Compositional and State criteria.	10	25

	Experimental and analytical evaluation of liquefaction potential: Evaluation of liquefaction by cyclic stress and cyclic strain approaches, Criteria for mapping liquefaction hazard zones, Preventive measures for the liquefaction, Case studies, Lateral deformation and spreading		
5	Design & Case Studies: Earthquake-induced slope failure: Case studies, Seismic slope stability analysis: Seismic design of foundations, design of retaining walls, Seismic soil-structure interaction	12	25

Reference Books:

1. Steven Kramer, "Geotechnical Earthquake Engineering", Pearson, 2008
2. Secoe Pinto, P., Seismic behaviour of ground and Geotechnical structure
3. Naeim, F., The Seismic Design Handbook, Kluwer Academic Publication, 2nd Edition, 2001
4. Ferrito, J.M, Seismic design criteria for soil liquefaction, Tech. Report of Naval Facilities service centre, Port Hueneme, 1997.

Course Outcome:

After learning the course the students should be able to:

1. know the causes and quantification of earthquake & its effects
2. understand the liquefaction phenomenon & slope stability issues
3. understand the design criterions to be followed for the design of different structures

List of Experiments:

1. Liquefaction potential of different types of soil using shake table
2. Effect of various types of foundation on liquefaction
3. Stability of slopes under harmonic motion
4. Improvement of slope stability using geo-textile material

Major Equipment:

1. Shake table
2. Data acquisition system
3. Models for liquefaction
4. Models for Slope Stability

List of Open Source Software/learning website: Computer code "SHAKE".

- <http://nptel.ac.in/>
- <http://ocw.mit.edu/courses/civil-and-environmental-engineering/>