GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Branch: Geotechnical Engineering

Subject Code: ME02076101

Subject Name: Geotechnical Earthquake Engineering

w.e.f.Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Courses

Prerequisite:	Geotechnical Engineering and Soil Dynamics
Rationale:	Geotechnical engineering plays a critical role in earthquake engineering by assessing and mitigating the geotechnical hazards associated with earthquakes. The field of earthquake engineering focuses on understanding and mitigating the effects of earthquakes on structures and infrastructure.

Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcomes
01	Identify the sources and reasons of earthquakes as well as various seismic hazards
02	Analyze strong ground motion parameters to characterize the earthquake motion and ground response analyses
03	Estimate seismic hazard and its probability
04	Develop the site design response spectrum.

Teaching and Examination Scheme:

Teaching Scheme(in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial/Practical		
L	T	PR	C	ESE (E)	PA/ CA (M)	PA/CA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No.of Hours	% of Weightage
1.	Earthquake Seismology – Causes of earthquake, Plate tectonics, Earthquake fault sources, Seismic waves, Elastic rebound theory, Earthquake, Intensity and magnitudes, Effects of earthquake, Modified Mercalis intensity scale and seismic instruments; protection against earthquake damage, layers of earth, theory of continental drift, hazards due to earthquakes.	08	22
2.	Earthquake Ground Motion – Characteristics of ground motion, Effect of local site conditions on ground motions, Design earthquake, Design spectra, Development of site specification and code-based design.	07	16
3.	Ground Response Analysis – One-dimensional ground response analysis: Linear approach, Nonlinear approach, Comparison of one dimensional ground response analyses. Two-dimensional ground response analysis: Equivalent linear approach, Nonlinear approach, Comparison of two dimensional ground response analyses.	10	25
4.	Liquefaction and Lateral Spreading - Liquefaction related phenomena, Liquefaction susceptibility: Historical, Geological, Compositional and State criteria. Evaluation of liquefaction by cyclic stress and cyclic strain approaches, Lateral deformation and spreading, Soil improvement for remediation of seismic hazards.	10	21
5.	Seismic Design of Foundations, Retaining Walls & Slopes - Seismic design requirements for foundation, Seismic bearing capacity, Seismic settlement, Design loads. Seismic slope stability analysis - Internal stability and weakening instability, Seismic design of retaining walls: Dynamic response of retaining walls, Seismic displacement of retaining walls.	10	16
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**20**	**25**	**25**	**10**	**10**

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asperRevise

dBloom'sTaxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Kramer S. L - Geotechnical Earthquake Engineering, Prentice Hall, 1996.
2. Bharat Bushan Prasad- Advanced Soil Dynamics and Earthquake Engineering, PHI Learning Pvt. Ltd., New Delhi, 2011.
3. R. W. Day - Geotechnical Earthquake Engineering Handbook, McGraw-Hill, 2002.
4. Naeim, F. - The Seismic Design Handbook, Kluwer Academic Publication, 2nd Edition, 2001.
5. Bolt, B. A. - Earthquakes, W. H. Freeman and Company, 4th Edition, 1999.
6. Lourie, W. - Fundamentals of Geophysics, Cambridge University press, 1997.
7. Kamalesh Kumar - Basic Geotechnical Earthquake Engineering – New Age International Publishers, 1st Edition, 2008
8. Dowrick - Earthquake Resistant Design, John Wiley & Sons.(2009)
9. Ansal, Recent Advances in Earthquake Geotechnical Engineering and Microzonation, Springer, 2006.
10. Towhata, Geotechnical Earthquake Engineering, Springer , 200
11. Indian Standard Codes and ASTM codes.

(b) Open source software and website:

1. https://nptel.ac.in/courses/
2. https://ocw.mit.edu/courses/civil-and-environmental-engineering/

List of Experiments/ Tutorials:

1. Cyclic Triaxial Test

2. Cyclic Plate load Test

3. Resonant Column Test

4. Liquefaction Analysis using spreadsheets/software

5. Tutorial on design of retaining structures

6. Seismic slope stability analysis spreadsheets/software

Suggested Project List: ---

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. Shake Table Test

Suggested Activities for Students: --- Visit to ISR-Gandhinagar or Research Organization pertaining to Earthquake simulation.

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