CE-842 Performance-Based Seismic Design of Structures

Code	Credit Hours	Category
CE-842	3	Elective

Course Description:

Performance-Based Seismic Design of Structures is a course designed to provide students with advanced knowledge in seismic structural design philosophies and state-of-the-art analysis techniques. The course focuses on enhancing skills in nonlinear modeling, dynamic analysis, and interpreting seismic performance using modern computational tools. Students will gain proficiency in applying performance-based design principles to evaluate and enhance the seismic resilience of structures.

Text Book:

- T. Pauley, and M. J. N. Priestley, (1992): Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley and Sons, New York.

Reference Books:

- A. K. Chopra, (1995): Dynamics of Structures-Theory and Applications to Earthquake Engineering, Prentice Hall, New Jersey.
- R. W. Clough, and J. Penzien, (1993): Dynamics of Structures, McGraw-Hill, New York, 2nd Edition.
- J. W. Smith, (1988): Vibration of Structures: Applications in Civil Engineering Design, Chapman and Hall, London.
- W. F. Chen and C. Scawthorn (2003), Earthquake Engineering Handbook.
- T. Y. Lin and S.D. Stotesbury (1988): Structural Concepts and Systems for Architects and Engineers, 2nd edition, Van Nostrand Reinhold.
- Graham H. Powell (2010): Modeling for Structural Analysis, Computers & Structures Inc.
- Edward L. Wilson (2000): Three-Dimensional Static and Dynamic Analysis of Structures, Computers & Structures Inc.
- Tall and Super-tall Buildings: Planning and Design (2014): Editor: Akbar Tamboli, Publisher: McGraw-Hill Professional, with CTBUH and ICC, ISBN13: 978-0071818711 ISBN: 0071818715
- James K. Wight (2016): Reinforced concrete: Mechanics and design, 7th edition, Prentice Hall.
- E. G. Nawy (2009): Reinforced concrete: A Fundamental Approach, 6th edition, Prentice Hall International
- Arthur H. Nilson, David Darwin, Charles W. Dolan (2005): Design of Concrete Structures, 13th Edition.
- Bungale S. Taranath (2010): Reinforced Concrete Design of Tall Buildings, Taylor and Francis Group, LLC.

Prerequisites:

- BE (Civil, Architecture, Construction Engineering & Management)

Assessment System

Component	Percentage Range
Quizzes	10-15%
Assignments	10-15%
Mid Terms	20-30%
ESE	40-50%
Project (optional)	10-15%

Teaching Plan:

Week No	Topic	Learning Outcomes
1	Introduction to Performance-based Design Approach	• Understand seismic design philosophies • Introduction to code-based seismic design
2	Classical Modal Analysis Procedure	• Apply modal analysis in structural dynamics
3	Equivalent Lateral Force Procedure	• Use equivalent lateral force method in seismic analysis
4	Response Spectrum Analysis Procedure	• Perform response spectrum analysis
5	From Code-based Design to PBD: Basics and Methodology	• Transition from code-based to performance-based design
6	Structural Performance Levels and Acceptance Criteria	• Define performance levels and criteria
7	Nonlinear Modeling Overview	• Understand linear elastic modeling • Hands-on with ETABS 2016
8	Fundamentals of Nonlinear Modeling	• Implement distributed and lumped plasticity approaches
9	**Mid Term Exam/ OHT, (As per NUST Exam Policy)**	
10	Hysteretic Behaviors, Strength Loss, Cyclic Degradation	• Analyze nonlinear structural behavior
11	**Case Study Presentation**	• Present findings from case studies

	Session	
12	Static Pushover Analysis	• Perform static pushover analysis
13	Single-mode Pushover Analysis	• Perform single-mode pushover analysis
14	Multi-mode Pushover Analysis	• Perform multi-mode pushover analysis
15	Selection of Seismic Input for Dynamic Analysis	• Choose seismic input for dynamic analysis
16	Nonlinear Time History Analysis	• Perform nonlinear time history analysis
17	Interpreting Analysis Results	• Interpret results from pushover and time history analyses
18	Service-level and MCE-level Evaluation of Structural Performance	• Evaluate structural performance at different seismic intensities
	End-Semester Examination (ESE)	• Demonstrate comprehensive understanding
	Term Project Presentation Session	• Present performance-based seismic evaluation of a real case study building