GUJARAT TECHNOLOGICAL UNIVERSITY

Programme Name: Master of Engineering

Level: PG

Subject Code : ME02000211

Course / Subject Name: Design of High-Rise Building Structures

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

Prerequisite:	Design of Structures, Advanced Design of Reinforced Concrete Structures
Rationale:	Due to urbanization and lack of land, it has become inevitable to construct high rise structures. This subject will make the students aware about the various structural systems for high rise structures and the suitability of each towards various varying parameters. Advanced method of analysis of such structures and modelling these structures in various softwares with the pros and cons will be dealt in detail.

Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcomes
01	Develop design basis report
02	Choose & apply appropriate structural systems for different size & height of building structure
03	Use of computational software for analysis and design of high-rise structures.
04	Analyse, design and detail High Rise Building Structures under different loading conditions by static and dynamic method of analysis.

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.	**Essentials of Tall Buildings**	**11**	**25**
	Introduction: Need of Tall Buildings, Factors affecting growth, Height and structural form. **Design Criteria:** Design philosophy, Codal provisions for Loading, Sequential loading, Strength and Stability, Stiffness and drift limitations, Human Comfort criteria, Creep, Shrinkage and temperature effects, Fire. Foundation settlement and soil structure interaction. **Loading On Tall Structures:** a. Gravity loading:-Methods of live load reduction, Impactgravity loading, Construction loading. b. Wind loading:- Static loading, Dynamic loading. c. Earthquake loading:-Equivalent lateral force procedure, Modal analysis procedure. d. Combination of loading:- Limit Satedesign; **Structural Form:** Braced frame structures, Rigid Frame structures, Infilled-Framestructures, Flat plate- Flat slab structures, Shear wall structures,Wall frame structures, Framed tube structures, Outrigger-Braced Structures, Suspended structures, Core Structures, Space Structures, Hybrid Structures, Different Floor systems.		
2.	**Modeling Approaches for Analysis of Tall Buildings**	**16**	**40**
	Approaches to analysis: Preliminary analyses, Intermediate andfinal analysis,Hybrid Approach to Preliminary and Final Analyses. **Assumptions:** Materials, Participating components, Floor slabs,Negligible stiffness, Negligible deformations, Cracking, High-RiseBehavior. **Modeling for Approximate analyses:** ApproximateRepresentation Bents, Approximate modeling of slabs, Modeling forcontinuum analyses.		

	Modeling for Accurate analyses: Plane frames, Plane shear walls,Three-dimensional frame and wall structures, P-Delta effects, Theassembled model, Reduction Techniques. **Modeling and Analysis of Braced Frames, Rigid-Frame Structures, lnfilled-Frame Structures, Shear Wall Structures, Coupled Shear Wall Structures, Wall-Frame Structures.**		
3.	**Stability Calculations and Dynamic Analysis**	**11**	**25**
	Stability of Tall Buildings: Overall Buckling Analysis, Second-Order Effect, Simultaneous First-Order and P-Delta Analysis, Translational-Torsional Instability, Out-of-Plumb Effects, Stiffness of Members in Stability Calculations,Effects of Foundation Rotation. **Dynamic Response to Wind Loading:** Sensivity of structures windforces, Dynamic structural response due to wind forces, Along windresponse, Cross wind response, worked examples, **Dynamic response to Earthquake motions:**Response of Tallbuildings to ground accelerations, response spectrum analysis,Time-History Analysis, Empirical relationships for fundamental natural frequency, Structuraldamping ratios. **Comfort criteria:** Human perception of building motion,Perception thresholds, Use of comfort criteria in design **Consideration of Time-dependent Effects – Creep, Shrinkage and Temperature in Analysis.**		
4.	**Overview of Performance-Based Seismic Design of Buildings**	**07**	**10**
	Introduction to performance-based design approach, Overview of Non-Linear Seismic Analysis procedures, Non-Linear Static and Dynamic Analysis – PO Analysis and Non-linear Time History Analysis, Demand Curve and Capacity Curve, Performance Evaluation of Individual Components, Structural Performance, Presentation of Results of Performance-based Seismic Evaluation.		
	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**
05	**15**	**15**	**25**	**20**	**20**

WhereR:Remember;U:Understanding;A:Application,N:AnalyzeandE:EvaluateC:Create(asperRevisedBloom'sTaxonomy)

References/SuggestedLearningResources:

(a) Books:

1. Tall Building StructuresAnalysis and Design –Bryan Stafford Smith and Alex Coull, John Wiley and Sons.
2. Structural Analysis and Design of Tall Buildings, Taranath B. S., Mc Graw Hill, 1988
3. Reinforced Concrete Design of Tall Buildings – Taranath B. S., CRC Press
4. High Rise Building Structures, Wolfgang Schueller, Wiley
5. Design and Analysis of Tall and Complex Structures, Feng Fu, Butterworth-Heinemann, Elsevier
6. Tall Building Structures on Elastic Subgrade and Research of Semi-Analytical method by Gong
7. Yaoqing. Beijing: Tsinghua University
8. Seismic Design Aids for Nonlinear Analysis of Reinforced Concrete Structures, Srinivasan Chandrasekaran Luciano Nunziante Giorgio Serino Federico Carannante, CRC Press
9. Outrigger Design for High-Rise Buildings, Hi Sun Choi, Goman Ho, Leonard Joseph & Neville Mathias, Routledge, Taylor & Francis Group
10. Advanced Design of Concrete Structures – Krishana Raju N., Tata Mc-Graw Hill, Delhi
11. Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications.
12. Illustrated Design of Reinforced Concrete Buildings Design of G+3 Storeyed Buildings and Earthquake Analysis and Design, V. L. Shah and S. R. Karve, Structures Publication
13. Structural Design of Multi-StoreyedBuildings, Varyani U. H., South Asian Publishers
14. IS Codes: IS:456, IS:875, IS:1893, IS:4326, IS:13920, IS16700, SP:16, SP:34.

(b) Opensourcesoftwareandwebsite:

https://ndl.iitkgp.ac.in/
https://nptel.ac.in/

Suggested Course Practical List:

Practical work shall consist of hands-on training of finite element software and verification with manual calculations. A design project shall be given to bridge the theory and practice.

List of Laboratory/Learning Resources Required:

Professional Software: STAAD-Pro, ETABS, Midas Gen, Sofistik.

Suggested Project List: ---Analysis and Design of a Multi-storey Residential / Commercial Building using available computer packages and verify with manual calculations. Use of approximate methods for manual calculations.The report shall consist of design basis report, load calculations, finite element model, manual verification and all necessary drawings in the form of neat dimensioned sketches.

Suggested Activities for Students: ---Detailing of reinforced concrete building using CAD tools

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