

GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: ME (Structural Engineering)

SUBJECT NAME: Theory of Structural Stability

SUBJECT CODE: 3712015

1st Year

Type of course: Elective

Prerequisite: Theory of Structures & Structural Analysis

Rationale: Various loads are acting on structures. Behavior of structure under these loads is very important to understand. Stability is the prime importance for any structures. Therefore various design criteria for the design of structures need to be studied. Instability in any of the structural member leads to failure of the structures. Therefore instability in the individual members is required to be studied due to various structural actions. Instability of the frames to be studied as a whole at the end.

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	Unit I: Fundamental Concepts & Criteria for Design of Structures: Concept of stability - Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, instability and bifurcation, different forms of structural instability, approaches of stability analysis, Linear and nonlinear behavior	6	15
2	Unit II: – Stability of Columns: Governing differential equation- Euler formulas for column – Eigenvalue problem; buckling modes and critical load; elastically restrained column, column with geometric imperfections, eccentrically loaded column, and large deflection analysis. Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling.	8	20
3	Unit III: Stability of Beams: Introduction lateral buckling of beams in pure bending; torsional buckling; combined flexural-torsional buckling.	6	15
4	Unit IV: Stability of Frames: Beam columns: Standard cases of beam columns, beam-columns with elastic restraints; effect of initial curvature Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members, Buckling analysis of single-storey frames with sway and no-sway condition using stiffness method	10	20
5	Unit V: Stability of Plates: Differential equation of plate buckling and boundary conditions,	8	20

	rectangular plates under uniaxial and biaxial compression; axial-flexural buckling; shear-flexural buckling, application of energy methods for calculation of buckling loads and modes.		
6	Introduction to Inelastic Buckling and Dynamic Stability.	4	10

Reference Books:

1. Theory of elastic stability, Timoshenko and Gere, Tata Mc Graw Hill, 1981
2. Principles of Structural Stability Theory, Alexander Chajes, Prentice Hall, New Jersey.
3. Structural Stability of columns and plates, Iyengar, N. G. R., Eastern west press Pvt. Ltd.
4. Chen, W.F. & Lui, E.M.: Structural Stability, Elsevier (1987).
5. Gambhir, M.L.: Stability Analysis and Design of Structures, Springer- Verlag (2004).
6. Strength of Metal Structures, Bleich F. Bucking, Tata McGraw Hill, New York

Course Outcome:

After learning the course the students should be able to:

1. Determine stability of columns and frames
2. Determine stability of beams and plates
3. Use stability criteria and concepts for analyzing discrete and continuous systems

List of Experiments:

1. Study of effective length of columns with different end condition & determine buckling load
2. Study of Axial, Flexural & Torsional buckling in columns
3. Study of lateral torsional buckling of beams
4. Study of Structural stability of Beams, trusses & Frames

Major Equipment:

1. Model of column with different end condition
2. Model of beams for lateral torsional buckling
3. Model of columns for Axial, Flexural & Torsional buckling
4. Model of beams, frames & truss with different support condition

List of Open Source Software/learning website: NPTEL, Structural engineering software like ETABS, SAP, ANSYS etc