Instructor: Dr. Uğurhan Akyüz


Catalog Description:

Concepts of stability; types of buckling; mechanical stability models; elastic and inelastic buckling of columns; elastic buckling of frames; plasticity on frame behavior; design of beam columns; P-Delta effects; energy criterion and energy-based methods; torsional and torsional-flexural buckling of columns; lateral buckling of beams; bracing.

Course in relation to the programs:

i) M.S. and Ph.D. programs in Civil Engineering and Mechanical Engineering
ii) This course is one of the basic course in structural mechanics.

The basic purpose is to give fundamental theories of structural stability of member and frames to students of structural engineering.

Course Objectives:

To provide a detailed treatment of buckling characteristics of various structural elements, and to present different methods to solve stability problems.

Course Outline:

I. Introduction
   I-1. Background
   I-2. Concepts of stability
      I-2.a. Static criterion of stability
      I-2.b. Dynamic criterion of stability
      I-2.c. Energy criterion of stability
   I-3. Types of Buckling

II. Mechanical Stability Models
   II-1. One degree of freedom models
   II-2. Two degree of freedom models
   II-3. Snap through models
   II-4. Imperfect models

III. Buckling of Columns
   III-1. Elastic buckling of columns
      III-1.a. Critical loads of perfect columns
      III-1.b. Imperfect columns
      III-1.c. Large deformation theory for columns
      III-1.d. Restrained columns
III-2.  Inelastic buckling of columns

IV.  **Buckling of frames**
- IV-1.  Elastic buckling of frames
  - IV-1.a.  Beam-column theory
  - IV-1.b.  Stability of a frame by matrix analysis
  - IV-1.c.  Design of framed columns
- IV-2.  Plasticity on frame behavior

V.  **Design of Beam Columns**
- V-1.  P-Delta effects
- V-2.  Use of $C_m$ factor in beam-column design
- V-3.  Effect of end restraint on buckling strength of columns – the $K$ factor
- V-4.  Modifications to the monographs for different beam end conditions
- V-5.  Modifications to the monographs for different column end conditions
- V-6.  Correction factor for monograph for unidentical columns

VI.  **The Energy Criterion and Energy-based methods**
- VI-1.  Timoshenko’s method
- VI-2.  The Rayleigh-Ritz method

VII.  **Torsional Buckling**
- VII-1.  Torsional behavior
- VII-2.  Strain energy of torsion
- VII-3.  Torsional and torsional-flexural buckling of columns
- VII-4.  Effect of moment gradient on lateral torsional instability of beams – the $Cb$ factor
- VII-5.  Lateral Buckling of Beams
- VII-6.  Design simplifications for lateral buckling

VIII.  **Bracing**
- VIII-1.  Bracing for stability

**Course Evaluation:**

- Two take home exams: 45% (22.5% each test)
- One final exam: 35%
- Homeworks: 20%