**Las Positas College**
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**Course Outline for DSNT 69**

**STRUCTURAL DESIGN CONCEPTS**

**Effective: Fall 2002**

I. CATALOG DESCRIPTION:
DSNT 69 — STRUCTURAL DESIGN CONCEPTS — 4.00 units

Introduction to technical statics, including resolution of forces and basic coplanar force systems. Emphasis on graphical analysis.

3.00 Units Lecture 1.00 Units Lab

**Prerequisite**
-
or

MATH 38 - Trigonometry with Geometry
with a minimum grade of C

**Grading Methods:**
Letter Grade

**Discipline:**

| | MIN |
|---|---|
| **Lecture Hours:** | 54.00 |
| **Lab Hours:** | 54.00 |
| **Total Hours:** | 108.00 |

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:
**Before entering the course a student should be able to:**

A. MATH38

IV. MEASURABLE OBJECTIVES:
**Upon completion of this course, the student should be able to:**

A. identify and utilize the elements of a force in terms of magnitude, direction, and line of action;
B. determine resultant and equilibrants of simple force systems graphically and by mathematic computation;
C. incorporate Bow's notation on force space diagrams;
D. verify equilibrium conditions for beam and simple truss diagrams;
E. graphically determine line of action for a truss force system with a funicular polygon;
F. use stress/load tables to determine maximum allowable loading.

V. CONTENT:
A. Introduction to Force, Load, and Statics
  1. Force and Load classifications
  2. Conditions for static equilibrium
  3. Analysis of Internal Forces: Method of sections
  4. Components of Internal-force resultants
  5. Conventional diagrams for supports
B. Concepts of Stress
  1. Definition and components of Stress
  2. Internal Axial Forces
  3. Normal Stress
  4. Average Shearing stress
  5. Applications to simple structures
  6. Application to thin-walled pressure vessels
  7. Design of tensile and short compression members
C. Strain and Material relationships
  1. Deformations
  2. Definition and components of Strain
  3. Engineering Materials

4. Stress-Strain Diagram
5. Hooke's Law and Poisson's Ratio
6. Strain Energy
7. Fatigue from repeated loading

D. Analysis of Stress and Strain
1. Plane Stress
2. Principal Stresses: Maximum Shearing Stress
3. Mohr's Circle for Plane stress
4. Variation of stress throughout a member
5. Plane Strain
6. Measurement of Strain

E. Axially Loaded Members
1. Deflection of axially loaded members
2. Application of method of Superposition
3. Thermal Deformation and Stress
4. Stresses on Inclined Planes
5. Stress Concentrations
6. Saint-Venant's Principle

F. Torsion
1. Behavior of a twisted circular shaft
2. Torsion Formula
3. Stresses on Inclined Planes
4. Angle of Twist
5. Statically Indeterminate Shafts
6. Stress Concentrations
7. Design of circular Shafts in Torsion

G. Stresses in Beams
1. Classification of Beams
2. Shear and Moment in Beams
3. Load, Shear, and Moment relationships
4. Shear and Moment Diagrams
5. Beam Behavior in pure Bending
6. Assumptions in Beam Theory
7. Normal Strain-Curvature Relation
8. Normal Stress: Flexure Formula
9. Stress Concentrations
10. Shear Formula: Shear Flow
11. Shear-Stress Distribution in Rectangular and Flanged Beams
12. Design of Prismatic Beams
13. Design of Beams of Constant Strength

H. Combined Stresses
1. Axial and Torsional Loads
2. Direct Shear and Torsional Loads: Helical Springs
3. Axial, Traverse, and Torsional Loads
4. Direct Shear and Beading Loads
5. Asymmetric Bending
6. Eccentric Axial Loads
7. Shear Center
8. Yield and Fracture Criteria
9. Design of Transmission Shafts

I. Energy Methods
1. Strain Energy for a General State of Stress
2. Strain Energy under Axial Loading
3. Strain Energy in Circular Shafts
4. Strain Energy in Beams
5. Displacements by Work-Energy Method
6. Displacements by Castigliano's Theorum
7. Unit-Load Method
8. Statically Indeterminate Structures
9. Impact Loads

J. Inelastic Behavior
1. Stress-Strain Diagram for Elastoplastic Materials
2. Ductility and Design
3. Plastic Deformations and Residual Stresses
4. Plastic Torsion of Circular Shafts
5. Plastic Bending
6. Moment-Curvature relationship
7. Limit Analysis of Beams

K. Buckling of Columns
1. Stability of Structures: Critical Load
2. Buckling of Pin-Ended Columns
3. Columns with Other End Conditions
4. Critical Stress: Classification of Columns
5. Eccentrically Loaded Columns
6. Formulas for Centric and Eccentric Loading

## VI. METHODS OF INSTRUCTION:

A. Technical graphical and computational examples
B. Technical analytical problem-solving
C. **Demonstration** -
D. **Lecture** -

## VII. TYPICAL ASSIGNMENTS:

A. Problem-solving: 1. Calculate the required pin diameter at support D of the frame shown in Fig. P2.27. Assume that a steel having an allowable strength of 80 Mpa is used in the pin, which acts in double shear. 2. Calculate the modulus of resilence for two grades of steel (see Table B.1):(a) ASTM-A242 and (b) cold-roll, stainless steel (302). B. Reading: 1. Read Chapter 8 on Combined Stresses such as axially centric, torsional, and flexural loads. Be prepared to discuss problems 8.2, 8.10, 8.17, and 8.29. 2. Read Chapter 3 on an analysis of deformation.

VIII. EVALUATION:

A. **Methods**

B. **Frequency**

1. Frequency:
    a. Weekly assignments
    b. One Midterm and one Final examination
    c. Quizzes as frequently as required

IX. TYPICAL TEXTS:

1. Ugural, A.C *Mechanics of Materials.*, McGraw-Hill, Inc., 1991.
2. Parker, Harry *Simplified Mechanics and Strength of Materials.* 5th ed., John Wiley & Sons, Inc., 1992.
3. Cheng, Fa-Hwa *Statics and Strength of Materials.* 2nd ed., Glencoe/McGraw-Hill, 1997.

X. OTHER MATERIALS REQUIRED OF STUDENTS:

A. Calculator
B. Drafting equipment
C. Engineering grid paper