

**WILBUR WRIGHT COLLEGE
PHYSICAL SCIENCE DEPARTMENT
SPRING 2008 SYLLABUS**

PHYSICS 217 – PHYSICS

Mechanics of Materials

Credit Hours:

Three

Contact Hours:

Three

Course Length:

One Semester - 16 Weeks

Prerequisites:

Math 207, Engineering 210, Physics 215, or consent of the department chairperson.

Catalog Description:

The study of the elastic and inelastic relationships of the external forces acting on deformable bodies. Includes the study of stresses and deformations produced by tension and compression, torsion, and bending, buckling, repeated loads, energy loads, impact, and the influence of properties of materials.

Contact Hours:

Three hours per week. Faculty are also available for consultation during office hours, advisement hours or by appointment.

Course Objectives:

The student shall be able to determine the nature and magnitude of the stresses and deflections of machine and structural elements, given their dimensions and loadings.

The student will be able to state the essential design requirements for machine and structural members given their function and uses.

The student will be able to take into account material properties as they relate to steady, dynamic, or repeated loading and other conditions of service.

The student shall be able to specify and perform elementary tests of material properties considered in the above.

Course Outline:

Stress

- 1.1 Introduction
- 1.2 Equilibrium of a deformable body
- 1.3 Stress
- 1.4 Average normal stress in an axially loaded bar
- 1.5 Average shear stress
- 1.6 Allowable stress

Strain

- 2.1 Deformation
- 2.2 Strain

Mechanical Properties of Materials

- 3.1 Tension and compression test
- 3.2 The stress-strain diagram
- 3.3 The stress-strain behavior of ductile and brittle materials
- 3.4 Hooke's Law
- 3.5 Strain energy
- 3.6 Poisson's ratio
- 3.7 The shear stress – strain diagram
- 3.8 *Failure of materials due to creep and fatigue

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Axial Load

- 4.1 Saint-Vincent's Principle
- 4.2 Elastic deformation of an axially loaded member
- 4.3 Principle of superposition
- 4.4 Statically indeterminate axially loaded member
- 4.5 The force method of analysis for axially loaded members
- 4.6 Thermal stress
- 4.7 Stress concentrations
- 4.8 *Inelastic axial deformations
- 4.9 *Residual stress

Torsion

- 5.1 Torsional deformation of a circular shaft
- 5.2 The torsion formula
- 5.3 Power transmission
- 5.4 Angle of twist
- 5.5 Statically indeterminate torque-loaded member
- 5.6 *Solid non-circular charts
- 5.7 *Thin walled tubes having closed cross sections
- 5.8 Stress concentrations
- 5.9 *Inelastic torsion
- 5.10 *Residual stress

Bending

- 6.1 Shear and moment diagrams
- 6.2 Graphical method for constructing shear and moment diagrams
- 6.3 Bending deformation of a straight member
- 6.4 The flexure formula
- 6.5 Relative-motion analysis: velocity
- 6.6 *Relative-motion analysis: acceleration
- 6.7 *Relative-motion analysis using rotating axes
- 6.8 *Curved beams
- 6.9 Stress concentrations
- 6.10 *Inelastic bending
- 6.11 *Residual stress

Transverse Shear

- 7.1 Shear in straight members
- 7.2 The shear formula
- 7.3 Shear stresses in beams
- 7.4 Shear flow in built-up members
- 7.5 Shear flow in thin-walled members
- 7.6 *Shear center

Combined Loading

- 8.1 Thin walled vessels
- 8.2 State of stress caused by combined loadings

Stress Transformation

- 9.1 Plane stress transformation
- 9.2 General equations of plane stress transformation
- 9.3 Principle stresses and maximum in-plane shear stress
- 9.4 Mohr's circle – Plane stress
- 9.5 Absolute maximum shear stress

Strain Transformation

- 10.1 Plane strain
- 10.2 General equations of plain-strain transformation
- 10.3 *Mohr's circle – plane strain
- 10.4 *Absolute maximum shear strain

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- 10.5 Strain Rosettes
- 10.6 Material-property relationships
- 10.7 *Theories of failure
- Design of beams and shafts
 - 11.1 Basis for beam design
 - 11.2 Prismatic beam design
 - 11.3 *Fully stressed beams
 - 11.4 *Shaft design
- Deflections of beams and shafts
 - 12.1 The elastic curve
 - 12.2 Slope and displacement by integration
 - 12.3 *Discontinuity functions
 - 12.4 *Slope displacement by moment-area method
 - 12.5 Method of superposition
 - 12.6 Statically indeterminate beams and shafts
 - 12.7 Statically indeterminate beams and shafts-Method of integration
 - 12.8 *Statically indeterminate beams and shafts-Moment -Area method
 - 12.9 Statically indeterminate beams and shafts-Method of superposition
- Buckling of Columns
 - 13.1 Critical load
 - 13.2 Ideal column with pin supports
 - 13.3 Column having various types of supports
 - 13.4 *The secant formula
 - 13.5 *Inelastic buckling
 - 13.6 *Design of columns for concentric loading
 - 13.7 *Design of columns for eccentric loading
- Energy Methods
 - 14.1 External work and strain energy
 - 14.2 Elastic work and strain energy for various types of loading
 - 14.3 Conservation of energy
 - 14.4 Impact loading
 - 14.5 *Principle of virtual work
 - 14.6 *Method of virtual forces applied to trusses
 - 14.7 *Method of virtual forces applied to beams
 - 14.8 *Castigliano's Theorem
 - 14.9 *Castigliano's Theorem applied to trusses
 - 14.10 *Castigliano's Theorem applied to beams

*Sections are considered optional

Assignments:

The student is required to complete a problem set consisting of 10-15 problems for each chapter. A complete set of solutions will be made available for copying in the library on the due date.

Clientele for Course:

This course is a first course in materials designed for engineering students who have completed Engineering 210 or Physics 215 (Engineering Statics or its equivalent), Differential Calculus, and have completed or are currently enrolled in integral calculus.

Methods of Evaluating Student Performance:

Eight exams each carrying a weight of 12.5% will serve as the basis for final grade.

Textbooks:

MECHANICS OF MATERIALS
R. C. Hibbeler , 7th ed. Pearson/Prentice Hall