Chapter 9 Mechanics of Materials
KEY TERMS AND DEFINITIONS

combined loads
Complex loading consisting of axial loads, shear force, bending moments, and torsional moments acting simultaneously on a system.

equilibrium equations for plane (2-D) systems
$\Sigma F = 0$ in two independent directions
$\Sigma M = 0$ about any arbitrarily selected point

flexural stress (σ)
The bending moment, M, divided by the section modulus, S, of the section.

homogeneous material
Material with the same composition throughout.

internal member forces
P = axial force perpendicular to section
V = shear force tangential to section
M = bending moment about rectangular axis
T = torsional moment (torque) about polar axis

isotropic material
Material with the same mechanical properties in all directions.

linearly elastic material
Material that obeys Hooke's law (linear) and for which the residual deformation is zero upon removal of a force (elastic).

modulus of elasticity (E)
The constant of proportionality between stress and strain. E equals stress divided by strain, which can be calculated as the slope of the initial linear portion of a stress-strain diagram.

Mohr's circle
A semi-graphical method of transforming states of stress or strain at a point in an element subject to combined loads.

normal stress (σ)
The axial force, P, divided by the area, A, of the section.

Poisson's ratio
The ratio of lateral strain to longitudinal strain resulting from a member subjected to an axial force.

positive face
In a body under stress, a plane area under load with a normal outward stress in tension.

section modulus
The ratio of the moment of inertia of a beam cross-section to the distance from the neutral axis to the farthest structural fiber.

section properties of an area
Section properties normally are calculated with respect to the centroid of an area, which is the point about which the first moment of an area is zero.

A = area of cross-section
I = rectangular moment of inertia, computed as the second moment of an area about an axis
S = section modulus—the moment of inertia, I, divided by the distance from the neutral (centroidal) axis to the farthest structural fiber.
J = polar moment of inertial, computed as the second moment of an area about a point
r = radius of gyration, computed as the square root of the moment of inertia divided by the cross-sectional area.

shear flow
In a hollow, thin-walled shaft under torsion, the product of wall thickness and shear stress.

shear stress (τ)
The tangential force, V, divided by the area, A, of the section.

strain
The ratio of the change in a dimension under a deforming force to the original dimension.

stress
Force per unit of area.

superposition principle
A complex loading system can be divided into a series of simple loads with each being analyzed separately. These can be combined to obtain the solution of the complex loading. Superposition applies only to linear systems—those whose behavior is governed by linear algebraic or differential equations.

torsion
The twisting deformation of a long member under a load.

yield
The point on a plot of stress versus strain where the relationship is no longer linear and strain increases rapidly.

