ENDS 231. Study Guide for Final Examination

This guide is not providing "answers" for the conceptual questions. It is a list of topical concepts and their application you should be familiar with. It is an *aid* to help prepare for the final exam.

Statics

- ☐ Sin, Cos, Tan, opposite, adjacent & hypotenuse
- ☐ Perpendicular
- ☐ Result of acceleration on a mass and Weight
- ☐ Law of transmissibility
- ☐ Internal vs. external forces
- ☐ Tension and compression
- ☐ Collinear, Coplanar, Space, Concurrent & Parallel force systems
- ☐ Vectors and scalars
- ☐ Scale
- ☐ Parallelogram law
- ☐ Tip-to-tail method
- ☐ Resultant of a force
- ☐ Component of a force
- ☐ Moment of a force
- ☐ Varignon's Theorem of moments
- ☐ Moment Couple
- ☐ Equivalent Force Systems
- ☐ Equilibrium
- ☐ Newton's First Law
- ☐ Direction and type of force in a cable with relation to geometry
- ☐ Free Body Diagram
- ☐ Reactions at a support and relationship to motion prevented
- ☐ Short link or cable, roller, rocker, pin or hinge, smooth surface, rough surface, fixed
- ☐ Negative result for a variable from equilibrium equations from free body diagram
- ☐ "Best" location for summation of moment
- ☐ Statically Determinate vs. Indeterminate
- ☐ Two-force bodies and relationship to loads
- ☐ Three-force bodies
- ☐ Pin connections
- ☐ Method of Joints
- ☐ Method of Sections
- ☐ Actions vs. reactions

General: Systems

- ☐ What happened to the Wonderful "one-Hoss Shay"
- ☐ Truss configurations and assumptions for analysis
- ☐ Zero-force member
- ☐ Special truss member configurations at joints and conditions
- ☐ Basis of graphical truss analysis (aka Maxwell's diagram)
- ☐ Compound truss
- ☐ Diagonal tension counters and solution method
- ☐ Pinned arches and frames
- ☐ Rigid vs. non-rigid pinned frames
- ☐ Rigid frame behavior
- ☐ Free Body Diagram rule for force at a pin of a frame
- ☐ Connection types and load/moment transfer
- ☐ Types and purpose of bracing
- ☐ One-way vs. two-way slab behavior
- ☐ Bearing, shear, curtain walls ...
- ☐ Shallow foundations: spread, wall, mat
- ☐ Deep foundations: piles, pile caps, grade beams
- ☐ Framing system *choices* exist
- ☐ System selection and design should NOT be the last phase of design

Mechanics of Materials

- ☐ Normal stress (compression & tension)
- ☐ Shear stress (non beams)
- ☐ Bearing stress
- ☐ Bending & shear stress (beams)
- ☐ Torsional (shear) stress (with respect to shape and where maximum occurs)
- ☐ Relation of strain to stress & Modulus of Elasticity
- ☐ Brittle, Ductile & Semi-brittle material behavior
- ☐ Yield strength (or point & proportional limit)
- ☐ Elastic vs. plastic range
- ☐ Ultimate strength
- ☐ Strength vs. stress
- ☐ Rupture / Fatigue behavior
- ☐ Orthotropic vs. Isotropic vs. Anisotropic materials
- ☐ Stress concentration
- ☐ Thermal vs. elastic strains
- ☐ Geometric constraints
- ☐ Serviceability
- ☐ Deflections & elongation
- ☐ Stiffness (relative to EI/L through Δ, or AE/L through δ)
- ☐ *Superpositioning*
- ☐ Single vs. double shear

General: Beams

- ☐ Load tracing & tributary width (vs. area)
- ☐ Concentrated loads
- ☐ Distributed loads – uniform / non-uniform
- ☐ Simply supported
- ☐ Overhang
- ☐ Cantilever
- ☐ Continuous
- ☐ w vs. W
- ☐ Rafter, joist, girder, decking, pilasters, bearing walls
- ☐ Equivalent center of load area
- ☐ Internal shear, axial force & bending moment
- ☐ Inflection point
- ☐ The Equilibrium Method
- ☐ The Semigraphical Method
- ☐ Areas under a curve and *change*
- ☐ Effect of forces on shear diagram
- ☐ Effect of moments on moment diagram
- ☐ Location of zero shear (x) and relation to maximum moment
- ☐ Slope relationships with integration
- ☐ Composite shape
- ☐ Centroid, moment of inertia, Q, radius of gyration
- ☐ Neutral axis, section modulus, Q, extreme fiber
- ☐ Negative area method
- ☐ Parallel axis theorem
- ☐ Maximum bending stress (& location along length and in cross section)
- ☐ Maximum shear stress (& location along length and in cross section)
- ☐ Maximum shear stress by beam shape (proper equations)
- ☐ Shear flow and shear center
- ☐ Connected area
- ☐ Nail capacity and pitch for resisting longitudinal shear
- ☐ Lateral buckling (and bracing)
- ☐ Stress types in beams
- ☐ Self-weight
- ☐ Deflections & superpositioning (+ *units)*
- ☐ Use of Beam Diagrams and Formulas

General: Columns

- ☐ Stability
- ☐ Buckling
- ☐ Slenderness
- ☐ Critical Buckling and Euler's Formula
- ☐ Effective length, K & bracing
- ☐ Beam-Columns
- ☐ Combined bending and compression - *interaction*
- ☐ P-Δ effect
- ☐ Eccentricity
- ☐ Kern

General: Design

- ☐ Allowable Stress Design
- ☐ Load and Resistance Factor Design
- ☐ Factored loads
- ☐ Resistance Factors
- ☐ "Design" values vs. "Capacity"
- ☐ Factor of Safety
- ☐ Density of materials and relation to weight
- ☐ Load types (and directions) (*like D, L, S ...)*
- ☐ Load combinations
- ☐ Serviceability and limits
- ☐ Design vs. analysis

Timber Design

- ☐ Lumber vs. engineered timber characteristics
- ☐ Various strengths (directionality, wood type, etc.)
- ☐ Design methodology and obtaining allowed stress (like with duration factor....)
- ☐ Creep
- ☐ Column stability factor, F_{CE} & l/d
- ☐ Connection stresses
- ☐ Nominal dimensions
- ☐ Design vs. analysis

Steel Design

- ☐ Design methodologies
- ☐ Steel grades (standard properties)
- ☐ Yield strength vs. ultimate strength
- ☐ Local buckling in web & flange
- ☐ Bearing on flange
- ☐ Plastic section modulus
- ☐ Plastic moment & plastic hinges
- ☐ Braced vs. unbraced length
- ☐ Slenderness criteria & l/r
- ☐ *with respect to least radius of gyration*
- ☐ Compact section criteria
- ☐ W (first number meaning) x (second number meaning)
- ☐ Bolt designations
- ☐ Effective net area
- ☐ Area of web
- ☐ Connection types
- ☐ Weld strengths
- ☐ Throat thickness
- ☐ Fillet, butt, plug, slot
- ☐ Coping
- ☐ Tension member
- ☐ Simple shear connector
- ☐ Capacity of a connection
- ☐ Design vs. analysis