

Qualifying Exam Information for Structural Engineering PhD Students

The Department requires students in the Doctor of Philosophy degree program to pass a Qualifying Examination administered by the student's specialty area. The exam is to be taken immediately after the student's first full semester of study in the program. All international students pursuing the PhD degree are required to take the ELPE and receive scores of 70 or above in all six sections regardless of the TOEFL and GRE-Verbal scores.

For students in the Structural Engineering specialty area, the exam includes both a written and an oral component. The written exam is offered twice a year, on the Friday before the start of the Spring and Summer semesters. It will be approximately 4 hours in length and consist of two parts: work-out problems and a demonstration of writing skills. All students required to take the exam will be contacted prior to the exam date.

The work-out problems will be taken from basic structures courses: Statics; Dynamics; Mechanics of Materials; and Structural Analysis. A sample syllabus from each course is attached. The students will be provided a list of standard formulas that will be useful in the solution of these problems. The demonstration of writing skills will involve the creation of a short sequence of coherent paragraphs over a non-technical topic.

Once the written exam is completed and graded, an oral examination will be scheduled for each student. The purpose of the oral exam is two-fold: (1) to explore any deficiencies that were uncovered during the written exam, and (2) to make sure that the student possesses reasonable oral communication skills. The committee will make an immediate pass/fail decision at the end of the oral exam.

CVEN 221-502
ENGINEERING MECHANICS: STATICS

Professor: Dr. W. Lynn Beason Office 701C CE/TTI BLD.

VERSION NO: FALL 2006

ASSUMPTIONS: 3 credits; 4 contact hours = 2-2 format 28 classes/semester Evening Exams

EXAM #1	10/10/06	Tuesday,	7 – 9 PM
EXAM #2	11/8/06	Tuesday,	7 -- 9 PM

**TEXT: Engineering Mechanics: STATICS,
 Second Edition, William F. Riley and Leroy D. Sturges,
 John Wiley & Sons: New York.**

<u>CLASS</u>	<u>TOPIC(S) TO BE ADDRESSED</u>	<u>REFERENCE (Riley/Sturges)</u>
1	Introduction to Course; Units; Newton's Laws; General Principles of Mechanics	1.1 – 1.7
2	General Principles Concurrent Force Systems	2.1-2.4
3	Concurrent Force Systems	2.4-2.7
4	Concurrent Force Systems; Statics of Particles	3.1-3.3
5	Statics of Particles	3.3
6	Equivalent Force/Moment Systems	4.1 – 4.2
7	Equivalent Force/Moment Systems	4.3-4.4
8	Equivalent Force/Moment Systems	4.5-4.6
9	Centroids and Center of Gravity	5.1-5.3
10	Centroids and Center of Gravity	5.4-5.5
11	Centroids and Center of Gravity	5.6-5.7
12	Equilibrium of Rigid Bodies	6.1-6.2
13	Equilibrium of Rigid Bodies	6.3
14	Equilibrium of Rigid Bodies	6.4
15	Trusses, Frames, and Machines	7.1-7.2
16	Trusses, Frames, and Machines	7.2
17	Trusses, Frames, and Machines	7.3

<u>CLASS TOPIC(S) TO BE ADDRESSED</u>	<u>REFERENCE (Riley/Sturges)</u>
18 Trusses, Frames, and Machines	7.4
19 Trusses, Frames, and Machines	7.4
20 Internal Forces in Structural Members	8.1 – 8.2
21 Internal Forces in Structural Members	8.3
22 Internal Forces in Structural Members	8.4
23 Internal Forces in Structural Members	8.5
24 Internal Forces in Structural Members	8.6
25 Friction	9.1-9.2
26 Friction	9.3-9.4
27 Second Moments of Areas	10.1-10.2
28 Second Moments of Areas	10.3

Your final grade will be based on the following criteria.

Item	Timing	Credit
Exam I	Tuesday, October 10, 2006, 7-9 pm	30%
Exam II	Wednesday, November 8, 2006 7-9 pm	30%
Final Exam	Wednesday, December 13, 2006 1:00-3:00	30%
Homework and Pop Quizzes	Daily	10%
	Final Grade	100%

A=90-100, B=80-89, C=70-79, D=60-69, F=0-59

Beason's Grading Rubric will be used to score all work.

THERE IS NO POSSIBILITY FOR EXTRA CREDIT IN ANY FORM -- EVERYONE IS TREATED THE SAME

CVEN 363
Engineering Mechanics: Dynamics (2-2)

Description: Application of first principles (Newtonian and conservation of energy methods) to model dynamic systems (particles and rigid bodies) with ordinary differential equations; solutions of models using analytical and numerical approaches; interpreting solutions/performance measures; linear vibrations, modeling of civil engineering systems and evaluating dynamic response to natural hazards.

Prerequisites: CVEN 305, CVEN 302, and MATH 308

Text: *Dynamics*. Authors: Goodman and Warner. Dover Publishing.
Structural Dynamics: Theory and Applications, Authors: Tedesco, McDougal, and Ross. Prentice-Hall

Course Objectives: To learn to use dynamics as a tool to evaluate a changing world. To introduce fundamentals for modeling civil systems for dynamic analysis, to derive differential equations of motion (kinetics and kinematics), determine systems dynamic response using mathematical analysis, to utilize computational tools and methods used in solving dynamics problems for which a closed form solution does not exist, to provide knowledge for practice in understanding dynamic structural systems behavior, and to evaluate and develop critical thinking and communication skills through projects that are based on realistic civil engineering problems.

Topics Covered:

1. Creating Simplified Models of Structures for Dynamic Analysis
2. Particle Dynamics: kinematics
 - Rectilinear motion in Cartesian Coordinates
 - Curvilinear motion in Cartesian Coordinates
 - Curvilinear Motion: Polar Coordinates
 - Curvilinear Motion: Normal/Tangential Coordinates
 - Coordinate Transformations: describing motion in different coordinate systems
3. Particle Energy Methods and Momentum
 - Principle of Work and Energy
 - Conservative Forces/Potential Energy
 - Principle of Impulse and Momentum
 - Impacts: elastic, plastic, coefficient of restitution
4. Particle Dynamics: kinetics
 - Newton's laws
 - Equilibrium and Energy principles for vibrating and non-vibrating systems
 - Pulleys and kinematic constraints
 - Motion of non-vibrating systems: constant and non-constant acceleration

- Motion of single-degree of freedom vibrating systems: developing equation of motion, basic dynamic properties, viscous damping, response due to initial conditions and harmonic forces, support motion, rotating unbalanced loads.
 - Motion of multi-degree of freedom vibrating systems: developing equation of motion, modal analysis, using modal superposition to find response due to initial conditions and harmonic forces
5. Numerical Methods
 - Review of basic principles: numerical integration
 - Review methods for first-order odes: converting a second order equations into a system of first-order equations and using Euler's or Runge-Kutta methods to solve
 - Newmark's Beta methods for vibrating systems
 6. Rigid Body Dynamics: kinematics
 - General Plane Motion: Velocities and Accelerations
 - Application to rolling without slip and linkage problems
 7. Rigid Body Energy Methods: Rotational Kinetic Energy and Conservation Principles
 8. Rigid Body Dynamics: kinetics
 - Inertia properties
 - Motion of non-vibrating systems: constant and non-constant acceleration
 - Motion on single-degree of freedom vibrating systems: basic dynamic properties, viscous damping, response due to initial conditions and harmonic forces, support motion, rotating unbalanced loads.

Professional Content: Preparation for engineering practice

ABET Outcomes Addressed:

- a. Ability to apply knowledge of basic mathematics, science, and engineering to solving civil engineering problems
- d. Ability to function on multi-disciplinary teams
- e. Ability to formulate and solve civil engineering problems
- g. Ability to communicate effectively in oral and written forms
- k. Ability to use modern tools, techniques, and computation methods necessary for civil engineering practice

CVEN 305-502
Mechanics of Materials
Fall 2006

Objectives: To introduce students to applications of stress and deformation relationships for structural members subjected to axial, torsional, and bending loads, and thin-walled pressure vessels. Students will study stress and deformation of structural members under combined loadings, stability of columns, nonsymmetrical bending, including indeterminate members.

Prerequisites: To take CVEN 305, you must have received a passing grade in one of the following courses: ENGR 211, ENGR 221, or ENGR 289. Concurrent registration is not permitted in any of the prerequisite ENGR courses and any section of CVEN 305.

Lecture: TR 8:00 a.m. – 9:15 a.m., CVLB room 419

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Office Hours: Announced in Class and Displayed on Website:
<http://ceprofs.tamu.edu/pgardoni/>

Textbook: Beer, Ferdinand P., E. Russell Johnston, Jr., and John T. DeWolf. 2006. *Mechanics of Materials*. Fourth Edition. McGraw-Hill.

Grading: Your letter grade for this course will be determined based upon grades from Homework assignments, Weekly Quizzes, and a Final exam. To receive a grade for a given Homework assignment, you will be required to submit a formal solution report within ten minutes of the beginning of class one week after the assignment date: see the “Reports” section below for requirements. Subject to Texas A&M University regulations, early submissions will not be especially rewarded, and late submissions will not be accepted. Specifically, your course letter grade will be determined by the quantity P shown below:

$$P = 20 \left(\frac{\text{Total_Homework_scores_earned}}{\text{Total_Homework_scores_possible}} \right) + 50 \left(\frac{\text{Total_Quiz_scores_earned}}{\text{Total_Quiz_scores_possible}} \right) + 30 \left(\frac{\text{Final_Exam_score_earned}}{\text{Final_Exam_score_possible}} \right)$$

A: $P \geq 90$; B: $90 > P \geq 80$; C: $80 > P \geq 70$; D: $70 > P \geq 60$; F: $60 > P$

List of Topics:

Introduction – Concept of Stress

Stresses in the Members of a Structure
Analysis and Design
Axial Loading; Normal Stress
Shearing Stress
Bearing Stress in Connections
Application to the Analysis and Design of Simple Structures
Method of Problem Solution
Numerical Accuracy
Stress on an Oblique Plane under Axial Loading
Stress under General Loading Conditions; Component of Stress
Design Considerations

Stress and Strain – Axial Loading

Normal Strain under Axial Loading
Stress-Strain Diagram
True Stress and True Strain
Hooke's Law; Modulus of Elasticity
Elastic versus Plastic Behavior of a Material
Repeated Loading; Fatigue
Deformations of Members under Axial Loading
Statically Indeterminate Problems
Problems Involving Temperature Changes
Poisson's Ratio
Multiaxial Loading; Generalized Hooke's Law
Shearing Strain
Relation among E , ν , and G
Stress and Strain Distribution under Axial Loading; Saint-Venant's Principle
Stress Concentrations

Torsion

Discussion of the Stresses in a Shaft
Deformation in a Circular Shaft
Stresses in the Elastic Range
Angle of Twist in the Elastic Range
Statically Indeterminate Shafts
Design of Transmission Shafts
Stress Concentrations in Circular Shafts

Pure Bending

Symmetric Member in Pure Bending
Deformations in a Symmetric Member in Pure Bending
Stresses and Deformations in the Elastic Range

Deformations in a Transverse Cross Section
Bending of Members Made of Several Materials
Stress Concentrations
Eccentric Axial Loading in a Plane of Symmetry
Unsymmetric Bending
General Case of Eccentric Axial Loading

Analysis and Design of Beams for Bending

Shear and Bending-Moment Diagrams
Relations among Load, Shear, and Bending Moment
Design of Prismatic Beams for Bending

Shearing Stresses in Beams and Thin-Walled Members

Shear on the Horizontal Face of a Beam Element
Determination of the Shearing Stresses in a Beam
Shearing Stresses τ_{xy} in Common Types of Beams
Longitudinal Shear on a Beam Element of Arbitrary Shape

Transformations of Stress and Strain

Transformation of Plane Stress
Principal Stresses: Maximum Shearing Stress
Mohr's Circle for Plane Stress
General State of Stress
Application of Mohr's Circle to the Three-Dimensional Analysis of Stress
Stresses in Thin-Walled Pressure Vessels

Deflection of Beams

Deformation of a Beam under Transverse Loading
Equation of the Elastic Curve
Direct Determination of the Elastic Curve from the Load Distribution
Statically Indeterminate Beams
Using Singularity Functions to Determine the Slope and Deflection of a Beam
Method of Superposition
Application of Superposition to Statically Indeterminate Beams

Columns

Stability of Structures
Euler's Formula for Pin-Ended Columns
Extension of Euler's Formula to Columns with Other End Conditions

CVEN 345
Theory of Structures (3-0)

Description: Structural engineering – functions of structure, design loads, reactions and force systems; analysis of statically determinate structures including beams, trusses and arches; energy methods of determining deflections of structures; influence lines and criteria for moving loads; analysis of statically indeterminate structures including continuous beams and frames.

Prerequisites: CVEN 302 or registration therein; CVEN 305

Text: *Structural Analysis*, by A. Kassimali, Thomson Publishing, 3rd Edition

Course Objectives: To develop an understanding of the basic principles of structural analysis
To become familiar with methods of analysis of beams, trusses, and rigid frames
To study the method of virtual work in determining deflections of structures, influence lines, and analysis of indeterminate structures.

Topics Covered:

1. Introduction and Mathematical Models of Structures
2. Design Loads
 - Code determination of: Dead Loads, Live Loads, Wind Loads, Snow Loads
 - Factored Load Combinations
 - Load Patterning
3. Static Determinacy and Stability
4. Interior Force Analysis of Statically Determinate Trusses:
 - Method of Joints
 - Method of Sections
5. Statically Determinate Beams and Frames:
 - Shear and Bending Moment Diagrams,
 - Superposition,
 - Sketching qualitative deflected shape from Moment Diagram
 - Sketching qualitative Moment Diagram from deflected shape
 - Deflection equation by Double Integration Method – beams only.
6. Virtual Work Method for calculation of deflections
 - Trusses: including support motion, applied external loads, temperature changes, and fabrication error effects
 - Beams and Frames: including support motion and applied external loads; both bending effects only and combined axial and bending effects
7. Analysis of Indeterminate Structures by Flexibility Method
 - Internal and external redundants
 - Trusses: including support motion, applied external loads, temperature changes, and fabrication error effects
 - Beams and Frames: including support motion and applied external loads

8. Influence Lines for Determinate and Indeterminate Structures
 - Quantitative: Equilibrium methods and Muller-Breslau's principle
 - Quantitative: Muller-Breslau's principle
 - Using influence lines: effects of moving loads, load patterning
9. Approximate Analysis of Indeterminate Structures
 - Estimation of inflection point locations
 - Portal Method,
 - Cantilever Method,
10. Analysis of Structures by Stiffness Method (Intro. To Computer Analysis of Structures)

Professional Content: Preparation for engineering practice

Outcomes Addressed:

- a. Ability to apply knowledge of basic mathematics, science, and engineering to solving civil engineering problems
- d. Ability to function on multi-disciplinary teams
- e. Ability to formulate and solve civil engineering problems
- g. Ability to communicate effectively in oral and written forms
- k. Ability to use modern tools, techniques, and computation methods necessary for civil engineering practice