QUALIFYING EXAM INFORMATION FOR STRUCTURAL ENGINEERING

The Department requires students in the Doctor of Philosophy degree program to pass a Qualifying Examination administered by the student’s specialty area. The Ph.D. Qualifying Exam is only for students already enrolled in the Ph.D. graduate program Texas A&M University; it is not an examination involved with determining if an applicant is qualified for admission.

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, immediately prior to the start of the Spring and Summer semesters (typically the Friday or Saturday right before the start of classes). 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. If equations are needed and expected to be used to solve problems in the closed-book exam session, students will be provided a list of standard formulas. However, students should be able to derive basic equations and exam questions can require that they be derived from fundamental principles. 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,  

<table>
<thead>
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<th>CLASS</th>
<th>TOPIC(S) TO BE ADDRESSED</th>
<th>REFERENCE (Riley/Sturges)</th>
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<tr>
<td>1</td>
<td>Introduction to Course; Units; Newton's Laws; General Principles of Mechanics</td>
<td>1.1 – 1.7</td>
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<td>2</td>
<td>General Principles</td>
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<td>Concurrent Force Systems</td>
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<td>Concurrent Force Systems; Statics of Particles</td>
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<td>Statics of Particles</td>
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<td>6</td>
<td>Equivalent Force/Moment Systems</td>
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<td>7</td>
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<td>9</td>
<td>Centroids and Center of Gravity</td>
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<td>Centroids and Center of Gravity</td>
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<td>Centroids and Center of Gravity</td>
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<td>Equilibrium of Rigid Bodies</td>
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<td>Equilibrium of Rigid Bodies</td>
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<td>Equilibrium of Rigid Bodies</td>
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<td>15</td>
<td>Trusses, Frames, and Machines</td>
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<td>16</td>
<td>Trusses, Frames, and Machines</td>
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<td>17</td>
<td>Trusses, Frames, and Machines</td>
<td>7.3</td>
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**CLASS TOPIC(S) TO BE ADDRESSED** | **REFERENCE (Riley/Sturges)**
---|---
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.

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<thead>
<tr>
<th>Item</th>
<th>Timing</th>
<th>Credit</th>
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<tbody>
<tr>
<td>Exam I</td>
<td>Tuesday, October 10, 2006, 7-9 pm</td>
<td>30%</td>
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<td>Exam II</td>
<td>Wednesday, November 8, 2006 7-9 pm</td>
<td>30%</td>
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<tr>
<td>Final Exam</td>
<td>Wednesday, December 13, 2006 1:00-3:00</td>
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<tr>
<td>Homework and Pop Quizzes</td>
<td>Daily</td>
<td>10%</td>
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<tr>
<td>Final Grade</td>
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<td>100%</td>
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</table>

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

*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


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

Instructor: Paolo Gardoni, Ph.D.
Office: 705F CE/TTI
e-mail: gardoni@tamu.edu

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


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 Ration
- Multiaxial Loading; Generalized Hooke’s Law
- Shearing Strain
- Relation among $E$, $v$, 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 $\tau_{xy}$ 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


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
   - 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