ENS 101
Engineering Mechanics I — Statics

LEARNING OBJECTIVES

Revised September 3, 1998
Professor Mike Qaissane
ENS 101 LEARNING OBJECTIVES

COURSE DESCRIPTION
Statics is the branch of mechanics that studies the effects of forces and moments acting on rigid bodies that are either at rest or moving with constant velocity along a straight path.

PREREQUISITES
MTH 171, PHY 121

REQUIRED TEXT AND MATERIALS

PARTICIPATION
Active participation in this course by all students is required and expected. Attendance for all lectures is strongly advised. Any student whose performance/attendance is unsatisfactory or not up to date will be notified by the College and may be dropped from the course for insufficient progress or participation.

STUDENT PERFORMANCE EVALUATION / GRADING
The course consists of a three-hour lecture per week. Homework will be assigned at the end of each class and the explanations or solutions will be given at the beginning of the next class. Students are expected to do the homework after class.

Class participation, quizzes and the final examination will evaluate student progress.

There are a total of 6 units that comprise this course. For units 1-5, a quiz will be administered after the unit is completed. Each quiz grade is valued at 10% of the grade for this course. In addition to the 5 quizzes, there will be a final exam, which will constitute the remaining 50% of the course grade.

Upon successful completion of this course, the student will earn 3 credits.

FINAL GRADE
The final grade will be determined by averaging each section and assigning them the following weights:

\[
\begin{align*}
50\% & \quad \text{for the Quiz Average} \\
50\% & \quad \text{for Final Exam} \\
100\% & \quad \text{Grade for the Course}
\end{align*}
\]

The following scale will be used to determine the letter grade for this course.

CRHH: If your course grade average is 90 to 10
CRH: If your course grade average is 80 to 89
CR: If your course grade average is 70 to 79
ENS 101 LEARNING OBJECTIVES

DEFERRED CREDIT

It is the student's responsibility to submit all classwork on a timely basis, and it is expected that all course requirements be completed by the last class meeting. However, in cases of hardship or emergency, a grade of DCR (deferred credit) may be granted by your instructor. In order to be considered for the grade DCR, the student must have satisfactorily completed the first four units of the course, have a passing test average for the first 3 quizzes, and must meet with the instructor prior to the last class meeting to discuss this option. Your instructor is under no obligation to grant a DCR. In the event that you are granted a DCR, it must be completed by the second week of the following semester.

COURSE SCHEDULE

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<th>SUBJECT</th>
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<td>Forces and Force Systems</td>
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EN 101 UNIT 1 LEARNING OBJECTIVES

UNIT 1 OF 6

Name Of Unit Introduction to Statics / Vectors

Unit Objective

Method Of Evaluation Class participation and the grading of a unit quiz.

Estimated Time To Achieve ~2.5 Weeks.

Learning Objectives

At the conclusion of this unit:

1. The students should be able to define and describe the following basic concepts in mechanics:
   - Space
   - Time
   - Mass
   - Force
   - Particle
   - Rigid body
   - Scalar
   - Vector
     1. Free vector
     2. Sliding vector
     3. Fixed vector

2. The students will be able to perform the following basic vector calculations:
   - Summation
   - Subtraction
   - Direction cosine
   - Magnitude
   - Component
   - Unit vector
   - Vector decomposition

3. The students will be able describe and define the following components of Newton’s Laws:
   - First law
   - Second law
   - Third law
   - Gravitation law

4. The student will be able to work with any of the following system of units:
   - SI units
   - US units
   - Base units
   - Derived units

5. The student will be able to describe the significance of the following mathematical concepts:
   - Accuracy
   - Limits
   - Approximations

Recommended Learning Experiences

Attend Class and participate in the lecture.

Read Chapters 1 and 2 of the textbook

Perform Assigned exercises
1. The students should demonstrate an understanding of the following concepts relating to forces:
   - Contact force
   - Body force
   - Concurrent force system
   - Resultant (Combination of a force system)
   - Decomposition of a force (rectangular and non-rectangular)
   - Using triangle law to obtain the resultant will create a couple because forces in rigid body mechanics are sliding vectors, not free vectors.

2. The student will be able to apply the following concepts to determine moments:
   - Cross product
   - Varignon’s theorem

3. The student will be able to show the following:
   - Couple is a special moment.
   - Prove that couple is a free vector
   - Prove that moving a force to a parallel location creates a couple

4. The student will be able to calculate the resultants of forces and couples.

5. The students will learn the differences and similarities between 2D and 3D systems. Additionally, the students should understand what complications are arise in studying 3D systems, and what is done to deal with these complications.

**Recommended Learning Experiences**

**Attend**  Class and participate in the lecture.

**Read**  Chapters 3 and 4 of the textbook

**Perform**  Assigned exercises
ENS 101 UNIT 3 LEARNING OBJECTIVES

UNIT 3 OF 6

Name Of Unit  
Equilibrium: Particles/Structures

Unit Objective

Method Of Evaluation  
Class participation and the grading of a unit quiz.

Estimated Time To Achieve  
~3.5 Weeks.

Learning Objectives

1. The student will be able to write and describe the governing equations of equilibrium.

2. The student will be able to isolate a mechanical system using:
   - Free body diagrams
   - Constraints

3. The student will be able to write and describe the following scalar forms of the equilibrium equations:
   - Standard formulation ($FFM$)
   - Alternative 1 ($FMM$)
   - Alternative 2 ($MMM$)

4. The student will be able to answer the following questions regarding statical in/determinacy:
   - What is statically indeterminate?
   - What is statically determinate?
   - What is redundant?

5. Students will be able to use the 3-D equilibrium equations to solve 3-D engineering problems.

Recommended Learning Experiences

Attend  
Class and participate in the lecture.

Read  
Chapters 5 and 6 of the textbook

Perform  
Assigned exercises
Unit 4 of 6

Name of Unit: Distributed Forces

Method of Evaluation: Class participation and the grading of a unit quiz.

Estimated Time to Achieve: ~2 Weeks.

Learning Objectives

1. The student will be able to define and describe the following concepts:
   - Line distributed forces
   - Area distributed forces
   - Volume distributed forces

2. The student will be able to calculate the center of mass of a body, and apply the equations of equilibrium to solve relevant application problems.

3. The student will be able to calculate centroids for:
   - lines
   - areas
   - volumes

4. The student will be able to find centroid of composite bodies.

5. The student will be able to apply the Theorems of Pappus to find centroids of complex geometries.

6. The student will be able to apply the concepts learned in this unit to solve problems involving flexible cables.

Recommended Learning Experiences

Attend: Class and participate in the lecture.

Read: Chapters 7 and 8 of the textbook

Perform: Assigned exercises
Name Of Unit: Friction

Unit Objective

Method Of Evaluation: Class participation and the grading of a unit quiz.

Estimated Time To Achieve: ~1.5 Weeks.

## Learning Objectives

1. The student will be able to define and describe the following types of friction:
   - Dry friction
   - Fluid friction
   - Internal friction

2. The student will be able to write and discuss the governing equation of dry friction.

3. The student will be able to define and discuss the concept of the friction angle.

4. The student will be able to use the concepts in this unit to solve the following type of application problems.
   - Wedges
   - Screws
   - Journal Bearings
   - Disk friction
   - Belts

## Recommended Learning Experiences

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<tr>
<th>Attend</th>
<th>Read</th>
<th>Perform</th>
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<tbody>
<tr>
<td>Class and participate in the lecture.</td>
<td>Chapter 9 of the textbook</td>
<td>Assigned exercises</td>
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# UNIT 6 OF 6

## Name Of Unit
Virtual Work

## Unit Objective

## Method Of Evaluation
Class participation and the grading of a unit quiz.

## Estimated Time To Achieve
~.75 Weeks.

### Learning Objectives

1. The student will be able to define and describe work.

2. The student will be able to define and describe work of a couple.

3. The student will be able to define and describe the concept virtual work.

4. The student will be able to write the equilibrium conditions in terms of virtual work, for:
   - a particle
   - a rigid body
   - a system of rigid bodies

5. The student will be able to define and discuss the following concepts:
   - degree(s) of freedom
   - mechanical efficiency

6. The student will be able to define and discuss potential energy and relate to stability
   - Elastic potential
   - Gravitational potential
   - Energy equation
   - Stability of equilibrium

### Recommended Learning Experiences

**Attend**  
Class and participate in the lecture.

**Read**  
Chapter 11 of the textbook

**Perform**  
Assigned exercises