

COURSE OUTLINE

**ENGINEERING 152**  
**Engineering Mechanics - Statics**

**I. Catalog Statement**

Engineering 152 covers the composition and resolution of co-planar and non-planar force systems, equilibrium of rigid bodies, distributed forces, forces in trusses, frames and cables, shear and bending moments in beams, and moments of inertia of areas and bodies.

Total Lecture Units: 3.0

**Total Course Units: 3.0**

Total Lecture Hours: 48.0

**Total Faculty Contact Hours: 48.0**

Prerequisite: Physics 101 or equivalent and Math 104 or equivalent.

**II. Course Entry Expectations**

Skills Level Ranges: Reading 5; Writing 5; Listening/Speaking 5; Math 7.

Prior to enrolling in the course, the student should be able to:

1. quantitatively analyze and solve mechanics problems;
2. evaluate and perform experiments involving basic mechanics measurements;
3. use a microcomputer and spreadsheet to solve complex equations;
4. graph logarithmic and exponential functions;
5. graph equations in polar parametric form;
6. graph conic sections;
7. integrate functions using variety of techniques;
8. differentiate inverse trigonometric functions;
9. apply l'Hospital's rule to find limits of indeterminate forms;
10. evaluate improper integrals;
11. model differential equations;
12. solve separable differential equations;
13. solve differential equations using slope fields and Euler's Method;
14. work with exponential and logistic models of growth and decay;
15. determine divergence or convergence of infinite series;
16. differentiate and integrate power series;
17. find Taylor and Maclaurin series for a function.

**III. Course Exit Standards**

Upon successful completion of required coursework the student will be able to:

1. apply the principles of mechanics - statics to practical engineering problems in the following areas: composition and resolution of co-planar and non-planar force systems, equilibrium of rigid bodies, distributed forces, forces in trusses, frames and cables, shear and bending moments in beams, moments of inertia of areas and bodies;
2. analyze and determine mechanics - statics situations or problems in order to develop the most efficient solutions;
3. convert practical or hypothetical mechanics - statics situations or problems into mathematical or graphic terms.

**IV. Course Content****Total Faculty Contact Hours: 48**

- |  |         |
|--|---------|
| A. Vector Mathematical Operations  | 3 hours |
| 1. Addition, subtraction, and negation                                     |         |
| 2. Dot-product and cross-product   |         |
| 3. Mixed triple product  |         |
| B. The Principle of Static Equilibrium: $\Sigma \underline{F} = 0$         | 3 hours |
| 1. Newton's First Law of Motion  |         |
| 2. Decomposition of force vectors into Cartesian components                |         |
| 3. Unit vectors  |         |
| C. Statics of Particles in Two or Three Dimensions                         | 2 hours |
| 1. Space (dimensional) diagram   |         |
| 2. Free body diagrams  |         |
| a) Internal vs. external forces  |         |
| D. Equivalent System of Forces   | 4 hours |
| 1. Moment of a force about a point or axis                                 |         |
| 2. Moment of a force-couple  |         |
| 3. Equivalent force systems: forces only, moments, and forces              |         |
| 4. Varignon's Theorem  |         |
| E. Statics of Rigid Bodies   | 6 hours |
| 1. Constructing free-body diagrams   |         |
| 2. Line-of-action and the principle of transmissibility                    |         |
| 3. Equilibrium of two-force and three-force bodies                         |         |
| 4. Force reactions at supports and connections in two and three dimensions |         |
| 5. Determinate and indeterminate reaction systems                          |         |
| 6. Support-reaction types  |         |
| a) Ball  |         |
| b) Rough surface roller  |         |
| c) Ball-and-socket   |         |
| d) Universal joint   |         |

- e) Fixed support
- f) Hinge and bearing
- g) Pin and bracket

F. Distributed Forces: Centroids and Centers of Gravity	4 hours
1. First moment of areas and lines	
2. Theorem of Pappus-Guldinus	
G. Forces on Submerged Surfaces	2 hours
1. Hydrostatic-pressure versus fluid-depth	
2. Free body diagrams for submerged bodies	
3. Center of pressure location using the first moment of areas	
4. Resultant of hydrostatic forces	
H. Analysis of Structures	6 hours
1. Trusses: forces in members	
a) Method of joints	
b) Method of sections	
2. Frames and machines: transmission and transformation of forces	
I. Forces in Beams and Cables	5 hours
1. Shear and bending-moment diagrams for point-loaded and distributed-loaded beams	
2. Cables with concentrated and distributed force-loads	
J. Friction	6 hours
1. Laws of dry friction	
2. Coefficient of sliding and static friction	
3. Angle of friction	
4. Friction forces: $\underline{F} = \mu \underline{N}$	
5. Free-body diagrams that include friction forces	
6. Belt friction forces and the angle of wrap	
K. Moments of Inertia	7 hours
1. Second moment	
2. Radius of gyration	
3. Product of inertia	
4. Parallel-axis theorem	
5. Moments of inertia for composite areas/masses	

V. **Methods of Instruction**

The following instructional methodologies may be used in the course:

- 1. lecture/discussion;
- 2. demonstrations;
- 3. films;
- 4. peer learning;

5. guest speakers.

## **VI. Out of Class Assignments**

The following out of class assignments may be used in the course:

1. convert practical or hypothetical mechanics - statics situations or problems into mathematical or graphic terms;
2. individual projects (i.e. written assignments, reading reports).

## **VII. Methods of Evaluation**

The following methods of evaluation may be used in the course:

1. quizzes;
2. midterm examination;
3. final examination.

## **VIII. Textbooks**

Hibbeler, R., Engineering Mechanics: Statics, [13<sup>th</sup> Edition]. Upper Saddle River, NJ: Prentice Hall, 2012.

10<sup>th</sup> Grade Textbook Reading Level

ISBN: 978-0132915540

## **IX. Student Learning Outcomes:**

1. Student will be able to utilize position and unit vectors to solve force equations.
2. Student will be able to analyze the external and internal force systems acting on rigid bodies in equilibrium.
3. Student will be able to convert practical statics problems into mathematical or graphic terms.