https://exploreintrosems.stanford.edu/frosh/great-principle-similitude

Stanford University, Stanford, California 94305

INTRODUCTORY SEMINARS FOR FIRST-YEAR STUDENTS

The Great Principle of Similitude

ME 13N

Prerequisites:
strong interest in engineering, physics, chemistry, and/or biology.

The basic rules of dimensional analysis were formulated by Isaac Newton, who called it "The Great Principle of Similitude." On its surface, it is a look at the relationships between physical quantities by exploring their basic "units." In fact, it is a powerful and formalized method to analyze complex physical phenomena, including those for which we cannot pose, much less solve, governing equations. The method is also valuable to engineers and scientists as it helps perform back-of-the-envelope estimates and derive scaling laws for the design of machines and processes. The principle has been applied successfully to the study of complex phenomena in biology, aerodynamics, chemistry, social science, astrophysics, and economics, among other areas. In this course, the students will be provided with the basic tools to perform such flexible and powerful analyses. We will then review particular example analyses. These will include estimating the running speed of a hungry velociraptor, the shapes of blood splatters in forensics, the cost of submarines, and the energy released by an atomic weapon. We will then work together as a class to identify problems in everyday life and/or current world events to analyze with this powerful tool.

Year: 2016-2017

Quarter(s): Spring

Units: 3

Grading: Letter or Credit/No Credit

Preference: First-Year

Department(s): Mechanical Engineering

ME 13N: The Great Principle of Similitude

Basic rules of dimensional analysis were proposed by Sir Isaac Newton. Lord Rayleigh called the method ¿The Great Principle of Similitude.¿ On its surface, it is a look at the relationships between physical quantities which uses their basic ¿units¿. In fact, it is a powerful and formalized method to analyze complex physical phenomena, including those for which we cannot pose, much less solve, governing equations. The method is also valuable to engineers and scientist as it helps perform back-of-the-envelope estimates and derive scaling laws for the design of machines and processes. The principle has been applied successfully to the study of complex phenomena in biology, aerodynamics, chemistry, sports, astrophysics, and forensics, among other areas. In this course, the students will be provided with the basic tools to perform such flexible and powerful analyses. We will then review particular example analyses. These will include estimating the running speed of a hungry tyrannosaurus rex, a comparison of the flights of mosquitos and jet airliners, the cost of submarines, and the energy released by an atomic weapon. We will then work together as a class to identify problems in everyday life and/or current world events to analyze with this powerful tool.

Terms: Spr | Units: 3 | Grading: Letter or Credit/No Credit
Instructors: Santiago, J. (PI)
Schedule for ME 13N

2016-2017 Spring

- ME 13N | 3 units | Class # 33185 | Section 01 | Grading: Letter or Credit/No Credit | ISF | Students enrolled: 7

  04/03/2017 - 06/07/2017 Tue, Thu 1:30 PM - 2:50 PM at Thornt211 with Santiago, J. (PI)

  Instructors: Santiago, J. (PI)

  Notes: Preference to first-year students; sophomores admitted if space available. Application required, due 12:00pm Monday, January 30, 2017; apply at http://vcais.stanford.edu.