

BARD HIGH SCHOOL EARLY COLLEGE

A partnership between Bard College and the New York City Public Schools

Engineering: Introduction to Design and Analysis

Syllabus and Policies: Fall 2015 (Rev 9.8.15))

Instructor: Dr. Paul Schubert

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(Office: 308; Individual Consultation Periods: M,R: 2,3,5; W5,6)

(Class: 306 MWR 3rd period, 3 credits)

Science Department Phone Number: 212-995-8479 x3081

Course Objectives

Engineering requires the application of mathematics and science to develop innovative solutions to meet the needs of the world. This course is an introduction to actually using engineering principles and problem solving. The emphasis is to have the student develop the ability to analyze complex problems in a logical manner and formulate quantitative solutions. The solutions are used to design, build, and test their own equipment. Finally, the project results must be communicated effectively.

Topics:

Thinking as Doing*

Strategies of Problem Solving

Heuristics

Strategies for Technical Design

 Concept Maps

 Levels of Understanding

 Application to Problems

Laws of Nature and Theoretical Models

Data Analysis and Empirical Models

Risk Analysis

Strategy of Experimentation

Bayes Probability

Engineering Disciplines*

Analysis of Major Engineering Challenges/Failures*

 *written assignment

Text: Doing Engineering: Introduction to Analysis and Design (Schubert)

Web Resource: www.doinghighschoolengineering.com

Projects

Three projects will be completed in assigned teams of 3-4 people. Each project will extend for several weeks. The projects will require the teams to independently learn and understand principles and organize their approach to solving the problem using the principles discussed in class. Each project requires the group to design, construct and test their own equipment.

In class, groups will be given time to organize their approach to the problem, applying problem solving principles discussed in class, and make assignments to advance the project between class meetings.

These projects are built on foundation concepts in Gr 10 Chemistry (Calorimetry) and Grade 9 Physics (Newton's Laws). There will be a short review of these topics in class. Additional assistance is available during tutoring periods. It is the student's responsibility to demonstrate understanding of these concepts at grade level.

Project Evaluation will be based on:

- Relation of the design to technical principles
- Performance of the designed device
- Homework/Progress Reports
- Peer Evaluations
- Final report (Group and Individual)

Peer Evaluations: At the conclusion of each project, group members will confidentially evaluate the contributions of each member. These evaluations, together with the instructor's assessment, will be a factor in the overall individual grade.

Design of a Heating Unit

Using principles that were covered in the high school chemistry course, a heating unit will be constructed that will increase the temperature of a fluid by 10 °C in 10 minutes. This work will require calculations based on heats of reaction and calorimetry selection of a reaction and container system, specification of all equipment and testing the system

Bottle Rockets

Beginning with force concepts and a short introduction to aero engineering, students will conduct an independent study of the forces and relate the forces to design and performance. Based on this analysis, a water pressure rocket will be constructed, tested and evaluated. Each element of the design must be related to the underlying forces. Performance will be based on flight and accuracy.

Bridge Strength

After an introductory lecture by a civil engineer on the design principles of bridges, students will research forces from a static load perspective. Literature searches will be used to develop background and design principles. Based on this work, a bridge of specified dimensions will be constructed from wooden sticks. The bridges will be tested to failure using a testing instrument. Evaluation will be on strength to weight ratio and aesthetics.

Procedures and Policies

Evaluations: (This may be revised at mid-term)

Projects	36%
Homework	13%
Exams	36%
Quizzes/ Classwork/ Peer Eval.	15%

Note that numerical grades on assignments, tests, quizzes etc. do not directly correspond to letter grades.

Homework/Projects/Papers

All projects and papers must be completed and submitted on time. Initial penalty will be at least 10% of the credit. Project completion dates will be announced well before the due date. Equipment must be available for testing on the assigned date for credit.

Note that all assignments must be submitted directly to me. If you miss a class, assignments (homework and tests) are due on the next class day, if the assignment has been posted on the web site. All reports/papers must be typed. No e-mail submissions.

Attendance and Behavior

Attendance will be taken at the beginning of each class.

The school policy is that the only excused absences are for the observance of religious holidays. Refer to the BHSEC Student Planner.

BHSEC has developed an extensive academic integrity policy addressing cheating, plagiarism, and other issues. Please consult the Academic Integrity Handbook for school guidelines. ***Repeated disregard for the BHSEC academic integrity policy may result in the withholding of the A.A. degree.*** The Academic Integrity policies on plagiarism and cheating are strictly enforced.

If there are any behavior or attendance issues, guidance counselors, academic counselors, parents/guardians will be notified. The intent is to recognize, focus, and resolve these issues so that they do not interfere with your progress.

Missed tests or quizzes, due to documented illness, must be taken on the day you return to school.

If you cut a class, no work, including tests and quizzes, can be made up. Short quizzes do not have make-ups.

Class participation is based on being present, on time, and contributing in a positive way to the discussion. Homework is part of the participation grade. This component is a significant part of the grade.

Seating—Teams for each project will sit together.