April 5, 2005

TO: The Faculty of the College of Engineering

FROM: The Faculty of the Department of Engineering Education and The First-Year Engineering Curriculum Committee

SUBJECT: New Undergraduate Course – ENGR 126

The Faculty of the Department of Engineering Education and the First-Year Engineering Curriculum Committee has approved the creation of ENGR 126, a modification of and replacement for ENGR 106, a required first-year engineering course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

Current:

ENGR 106 Engineering Problem Solving and Computer Tools

Sem. 1 and 2. Class 2, lab. 2, cr. 2.
Corequisite: MA 165 or equivalent, or consent of instructor
Introduction to engineering problem solving and the use of computer software, UNIX™, computer communications, spreadsheets and MATLAB®. Applications in engineering.

Proposed:

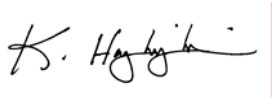
ENGR 126 Engineering Problem Solving and Computer Tools

Sem. 1 and 2. Class 2, lab. 2, cr. 3.
Corequisite: MA 165 or equivalent, or consent of instructor
Introduction to the solving of open-ended engineering problems and the use of computer software, including UNIX™, computer communications, spreadsheets and MATLAB®. Explicit model-development activities are utilized, and students are expected to develop skill at working in teams. This is emphasized both in laboratories and on projects.

Reason:

The proposed new course's description and allocation of course credit more closely resembles ENGR 106 as it is presently offered than does the current description. Materials on the following pages describe and give specific examples of differences between 1999 and 2004 offerings of ENGR 106 in order to illustrate its evolution over a five-year period.

With regard to course credit, the class meeting hours do not adequately describe the course operation. In 1999, the two hours of class meeting time in ENGR 106 were divided more or less equally between lecture and "pre-lab" or "post-lab" discussion. By 2004 the course had evolved, by the addition of engineering content and context, to the point where the second class hour was needed for lecture time. The course is now clearly 2 hours of lecture time and 2 hours of laboratory time, with virtually all laboratory preparation and "post-mortem" work being done in the laboratory period. According to Office of the Registrar guidelines, this clearly constitutes a 3-credit course. Repackaging the course as ENGR 126 eliminates the possibility of confusion arising from existence of student records showing ENGR 106 for 3 credits while others have the same course on their record for 2 credits. This renumbering will also help eliminate confusion for students' counselors and the Registrar's Office during the transition to the updated first-year curriculum.



Kamyar Haghighi, Head
Department of Engineering Education

Supporting Documentation

Changes to ENGR 106 – A comparison of Fall 2004 to Fall 1999

ENGR 106 has changed dramatically over the last 5 years in terms of course content, instructor delivery, and student expectations. The remainder of this document compares features of the course in 2004 to 1999, highlighting the following changes:

- A move away from a strong emphasis on student learning of the features of a computer tool to a strong emphasis on developing problem solving skills and learning to use computer tools to solve fundamental and open-ended engineering problems.
- Greater presentation of problems within engineering contexts.
- Greater student independence of learning computer tools syntax and features.
- Increased emphasis on teaming skills development.

The pages to follow compare, from fall 1999 to fall 2004, the following course elements:

- Course objectives as communicated to the students,
- Course grading components, and
- Course syllabi.

In addition, a listing of the course expectations distributed to and discussed with ENGR 106 students since 2002 is included. A sample of a weekly laboratory/homework combination is available as a supplement to this document upon request.

Course Objectives

Fall 1999

Through this course you should:

- Learn to effectively use computer tools (Excel, MATLAB, Operating Systems) to solve fundamental engineering problems
- Be able to identify the proper computer tool to solve engineering problems
- Learn to work effectively in teams

Fall 2004

Successful completion of this course will enable students to:

- Develop a logical problem solving process which includes sequential structures, conditional structures, and repetition structures for fundamental engineering problems,
- Translate a written problem statement into a mathematical model,
- Solve fundamental engineering problems using computer tools,
- Perform basic file management tasks using an appropriate computer tool,
- Work effectively and ethically as a member of a technical team, and
- Develop a work ethic appropriate for the engineering profession.

Graded Components to the Course

Fall 1999

- In-class (lecture) team and individual exercises and/or quizzes (10%)
- Weekly Laboratory Quizzes - focusing on computer tools and simple engineering fundamental problems (10%, 13 labs)

- Weekly Homework Assignments - focusing on the use of computer tools to solve engineering context problems (10%, 10 assignments)
- Team Projects (15% each)
  - Open-ended engineering problem involving the application of algebra and trigonometry, statistics, and/or economics and the use of Excel (4-5 weeks)
  - Open-ended engineering problem involving the application of MATLAB programming concepts with emphasis on (1) the development of an executive program that calls functions and (2) the use of repetition and branching structures (5-6 weeks)
- Written Exams (2) (10% each)
- Laboratory Practical (2) (10% each)

Fall 2004

- In-class (lecture) team and individual exercises and/or quizzes (5%)
- Weekly Laboratory Assignments (10%)
  - Quizzes – Use focusing on computer tools and simple engineering fundamental problems (9 labs)
  - Model-Eliciting Activities – open-ended, client-driven mathematical modeling problems set in engineering contexts and solved by student teams (4 labs)
- Weekly Homework Assignments (15%, 12 assignments)
  - Use of computer tools to solve engineering context problems
  - Model eliciting, exploration, or adaptation activities - open-ended, client-driven mathematical modeling problems set in engineering contexts and solved by student teams. These require review of lab work and continued development and implementation of model solutions to solve problems with increased complexity. (4 activities)
  - Teaming skills development (4+ activities- development and revision of Code of Cooperations)
- Team Projects (15% each)
  - Open-ended engineering problem involving the application of algebra and trigonometry, statistics, and/or economics and the use of Excel (4-5 weeks)
  - Open-ended engineering problem involving the application of MATLAB programming concepts with emphasis on (1) the development of an executive program that calls functions and (2) the use of repetition and branching structures (5-6 weeks)
  - Peer and team evaluations (4 times)
  - Individual Time logs (4 times)
- Written Exams (3, 10% each)
- Laboratory Practical (10%)

Course Expectations

Due to increased course expectations and increased problems with first-year transition from high school to college, the following list of expectations is discussed with all students as of Fall 2002.

What You Can Do To Be Successful In ENGR 106

- *Take ownership of your education and learning process.* Successful problem solvers have to practice and learn material on their own.
- *Remember that you are beginning to learn a new language - the language of engineering.* Most freshmen engineering students do not have a background in engineering. So when problems are

placed in an engineering context that uses the language of engineering, as will occur in ENGR 106, you may find some problems difficult to understand at first glance.

- *Be an active participant in classroom activities.* The more engaged you are in the classroom, the more you will get out of the class.
- *Come prepared for class.* By doing the reading assignments before class, you will understand more of the content covered in class.
- *Learn to be accountable to your team* and have your team be accountable to you to complete assignments and learn the course material. You will be working in a team of four in lab, in lecture, and on projects. You will need to be an active participant on the team.
- *Meet your team outside of class to complete assignments.* Projects and some homework assignments will require that your team meet outside of class.
- *Rely on your peers as well as the faculty and staff to learn the course material.* Your peers are a great resource! On the flip side, your peers may come to you for help. By helping your peers learn the material, you will gain greater understanding of the course material. Do not be reluctant to contact any member of the ENGR 106 Instructional Team when you need help. All faculty have regularly scheduled office hours, and there are evening office hours manned by the teaching assistants.
- *Be aware that you will solve problems for which there are no unique solutions.* Due to this fact, you may get many different responses when you seek help on a problem because there are many different ways to solve the problem.
- *Expect to spend more time per credit hour on this class compared to your other classes* depending on your prior knowledge, experiences, and study habits. The content of this course and the skills we wish you to develop are very different from high school courses. Therefore, some ENGR 106 assignments may take longer than your math and chemistry assignments.

Topics

The following pages contain a detailed comparison of the syllabi for Fall 1999 and Fall 2004.
A sample Fall 1999 and Fall 2004 lab and homework combination is available upon request as a supplemental illustration of the difference in the nature of the assignments. This particular example demonstrates lab and homework coverage during the weeks that plotting was covered.

	Fall 1999		Fall 2004	
Week	Lecture Topics & Lab Activities	Assignments: typically 1-2 problems in an engineering context	Lecture Topics & Lab Activities	Assignments: typically 3-5 problems in an engineering context plus computer tool and teaming skills development
1	*Lecture:* Netscape, E-mail, Newsgroup *Lab:* • Open Netscape and navigate through the Internet • Get to the ENGR 106 web site • Read and Post messages to the bulletin board • Communicate through E-mail	Homework 1 • Post a paragraph describing a Professional Engineering Association to the course bulletin board	*Lecture:* Introduction – Syllabus, Problem Solving, Ethics *Lab:* Network Issues, Communications • Open and use an internet browser • Log on to and navigate the ENGR 106 site on WebCT • Understand the ENGR 106 course syllabus, rules, and expectations • Launch and use MATLAB • Locate contact information for people at Purdue University • Save files to your career account • Effectively use e-mail to send and receive messages	Homework 1(4) • MATLAB Glossary 1 • MATLAB assigning variable names • MATLAB mathematical operators • Learning Styles Inventory
2	*Lecture:* Plotting *Lab:* • Generate xy plots • Perform basic computations	Homework 2 • Mathematical operators in Excel and MATLAB • Log plotting in Excel and MATLAB	*Lecture:* Problem Solving, Teaming Concepts *Lab:* • Write and run a MATLAB script • Review the use of MATLAB algebraic and trigonometric functions in computations • Review how to appropriately assign variables (scalars) in MATLAB • Appropriately assign variables (vectors) • Plot a mathematical function using appropriate labeling • Create x-y graphs in MATLAB with linear scales, which are suitable for a technical presentation	Homework 2 (4) • MATLAB Glossary 2 • MATLAB Problem Solving Method o Flowchart o Plotting • Excel Problem Solving Template • Excel Cell Addressing

	Fall 1999		Fall 2004	
Week	Lecture Topics & Lab Activities	Assignments: typically 1-2 problems in an engineering context	Lecture Topics & Lab Activities	Assignments: typically 3-5 problems in an engineering context plus computer tool and teaming skills development
3	*Lecture:* Engineering Economics *Lab:* • Solve compound interest problems • Compare simple economic alternatives using present value • Solve uniform, multipayment cash flow problems • Find the net present value of an irregular cash flow	Homework 3 • Irregular cash flow problem	*Lecture:* MEA Example, Excel Cell Addressing *Lab:* • Solve an open-ended problem focused on the application of algebra, trigonometry, and geometry skills (MEA 1) • Use relative, absolute, and semi-absolute addressing in Excel appropriate	Homework 3 (4) • MATLAB Glossary 3 • Excel Cell Addressing & Plotting • Team 1 Code of Cooperation • MEA 1 model development continued
4	*Lecture:* Statistics, Histograms, Importing Data (Excel) *Lab:* Excel • Find the mean, median, standard deviation, minimum, and maximum for any set of data • Create a histogram and cumulative distribution plot for any set of data • Draw inferences from these basic statistical analysis	Homework 4 (Excel) • Descriptive statistics • Histogram • Cumulative distribution	*Lecture:* Plotting: Linear, Log-log, and Semi-log. UNIX – Navigation *Lab:* • Launch a telnet session • Locate and use UNIX commands • Create and interpret x-y graphs in MATLAB with linear and/or log axis scales, which are suitable for a technical presentation • Create and interpret x-y graphs in Excel with linear and/or log axis scales, which are suitable for a technical presentation	Homework 4 (3) • UNIX – navigation • Log plotting with Excel • Log plotting with MATLAB

	Fall 1999		Fall 2004	
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5	*Lecture:* Statistics, Histograms, Loading Data (MATLAB) *Lab:* (MATLAB) • Write a MATLAB script • Find the mean, median, standard deviation, minimum, and maximum for any single set of data • Create a histogram and cumulative distribution plot for any set of data • Draw inferences from these basic statistical analysis	Homework 5 (MATLABl) • Descriptive statistics • Histogram • Cumulative distribution	*Lecture:* Economics: Law of Compound Interest, Uniform, Multipayment Cash Flows *Lab:* • Solve an open-ended problem focused on mathematical modeling (MEA 2) • Solve compound interest problems • Solve uniform, multi-payment cash flow problems	Homework 5 (3) • UNIX – file management • Compound Interest • Uniform-Multipayment Cash Flow Project 1 - A • Employ the problem solving method to an open-ended engineering problem • Understand and use a number of engineering fundamental concepts: o Measuring values and calculating thrust using international units o Design of experiments, data collection, and design testing o Simple economics • Understand the development and use of written reports as part of the design process • Appreciate the interconnectivity of hands-on design and computer tool use • Begin to employ effective teaming skills o Team Peer-Evaluation o Individual Time Log

	Fall 1999		Fall 2004	
Week	Lecture Topics & Lab Activities	Assignments: typically 1-2 problems in an engineering context	Lecture Topics & Lab Activities	Assignments: typically 3-5 problems in an engineering context plus computer tool and teaming skills development
6	*Lecture:* Statistics, Logic (MATLAB) *Lab:* • Find the mean, median, standard deviation, minimum, and maximum for any number of data sets • Create a histogram and cumulative distribution plot for any number of data sets • Draw inferences from these basic statistical analysis • Perform tasks using logic statements	Practice Exam 1	*Lecture:* Economics: compound interest, uniform multipayment, present value, Economic Comparisons, Economic Alternatives *Lab:* • Diagram an irregular cash flow • Compute the net present value of an irregular cash flow • Compare economic alternatives with irregular cash flows	Homework 6 (4) • Uniform, Multipayment Cash Flow • Non-Uniform Cash Flow • Economic Alternatives • MEA 2 - model development continued • Team 1 Code of Cooperation Revisited Exam I - Written (Evening)
7	*Lecture:* EXAM 1 • Written 1 in class *Lab:* • Lab Practical 1		*Lecture:* For Loops, Statistics, Review For Exam *Lab:* • Create and manipulate vectors • Draw and interpret flowcharts containing one or more loops • Construct and track for loops • Use for loops to create and manipulate vectors	Homework 7(2) • MATLAB Glossary 4 • for loop problem

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Week	Lecture Topics & Lab Activities	Assignments: typically 1-2 problems in an engineering context	Lecture Topics & Lab Activities	Assignments: typically 3-5 problems in an engineering context plus computer tool and teaming skills development
8	*Lecture:* Conservation Principles *Lab:* Excel • Perform matrix operations • Solve systems of simultaneous linear equations • Solve conservation principles based problems	Project 1	*Lecture:* Descriptive Statistics, Load a File, Histograms *Lab:* • Find the mean, median, standard deviation, minimum, and maximum for any set of data • Create a histogram • Take measurements using calipers • Create subplots • Call scripts from scripts	Homework 8 (4) • for loop problem • Statistics with Excel • Statistics with MATLAB Project 1 - B • Employ the problem solving method to an open-ended engineering problem • Understand and use a number of engineering fundamental concepts: • Measuring values and calculating thrust using international units o Design of experiments, data collection, and design testing o Simple economics • Understand the development and use of written reports as part of the design process • Appreciate the interconnectivity of hands-on design and computer tool use • Begin to employ effective teaming skills o Team Peer-Evaluation o Individual Time Log

	Fall 1999		Fall 2004	
Week	Lecture Topics & Lab Activities	Assignments: typically 1-2 problems in an engineering context	Lecture Topics & Lab Activities	Assignments: typically 3-5 problems in an engineering context plus computer tool and teaming skills development
9	*Lecture:* Conservation Principles *Lab:* (MATLAB) • Perform matrix operations • Solve systems of simultaneous linear equations • Solve conservation principles based problems	Homework 6 • Linear Algebra Problem	*Lecture:* Logical and Conditional Statements & IF Structures, Matrix Manipulations, More on Statistics and For Loops *Lab:* • Interpret logic statements • Load data from a text file into a computer tool • Dissect, build, and manipulate matrices • Construct and label histograms using multiple data sets	Homework 9 • For Loops, If Structures, Relational and Logical Operators • Statistics • for loop
10	*Lecture:* UNIX, Common Desktop Environment, Control Structures *Lab:* • Start and use the Common Desktop Environment, • Use UNIX commands to perform file management tasks, and • Construct while loops using MATLAB	Homework 7 • Linear Algebra Problem	*Lecture:* Linear Regression, UNIX – FTP *Lab:* • Solve an open-ended problem focused on the application of statistics (MEA 3) • Perform linear regression using the method of least squares • Fit a first-order polynomial to a set of data	Homework 10 (5) • Linear Regression • Teaming Experience Reflection • Team 2 Code of Cooperation • MEA 1 model development continued • Per-reading for MEA 4 Exam II - Written (Evening) (NOTE: Canceled due to scheduling problem)
11	*Lecture:* UNIX, Control Structures *Lab:* • Use UNIX commands to perform internet tasks • Construct for loops using MATLAB, and • Construct and solve problems that require flow control structures using MATLAB	Homework 8 • Flow control structures problem	*Lecture:* User Defined Functions *Lab:* • Construct an appropriate function definition • Create a user-defined function • Review knowledge of logic and histogram use • Use MATLAB to deal with very large arrays • Solve a problem focused on the application of algebra and trigonometry skills (MEA 4)	Homework 11 (3) • MATLAB Glossary 5 • Linear Regression • MEA 4 model development continued

	Fall 1999		Fall 2004	
Week	Lecture Topics & Lab Activities	Assignments: typically 1-2 problems in an engineering context	Lecture Topics & Lab Activities	Assignments: typically 3-5 problems in an engineering context plus computer tool and teaming skills development
12	*Lecture:* Data Analysis, Curve Fitting *Lab:* • Find a best polynomial fit for a given set of data, • Use a polynomial to generate dependent variable values for given independent variable values, and • Write a function with input and output arguments.	Homework 9 • Flow control structures problems (2)	*Lecture:* More User Defined Functions, While Loops, UNIX Access Privileges *Lab:* • Change access privileges on directories and files • Review how to create a user-defined function • Break the solution to a large problem into user-defined functions that are called from an executive user-defined function • Construct and track **while** loops • Construct and track imbedded loops and **if** statements	Project II - A • Employ the problem solving method to an open-ended engineering problem • Use flowcharting to aide in the development of a large computer program • Effectively use a number of computer programming concepts: o Large array and vector manipulations and computations o Logic and conditional statements o Repetition structures (loops) • Break a large programming task into a series of interconnected user-defined functions • Develop written reports as part of the design process • Employ effective teaming skills and complete work within deadlines o Team Peer-Evaluation o Individual Time Log

	Fall 1999		Fall 2004	
Week	Lecture Topics & Lab Activities	Assignments: typically 1-2 problems in an engineering context	Lecture Topics & Lab Activities	Assignments: typically 3-5 problems in an engineering context plus computer tool and teaming skills development
13	*Lecture:* Functional Analysis *Lab:* • Plot functions, • Perform functional analysis (i.e. find function minimums, maximums, and zeros), and • Use functional analysis to solve engineering problems.	Homework 10 • Linear and polynomial curve fitting	*Lecture:* Functional Analysis *Lab:* • Find the minimums and maximums of a mathematical function • Find the zeros of a mathematical function • Review how to construct user-defined functions • Review how to construct and track while loops	Homework 12 (2) • Team 2 Code of Cooperation Revisited • Functional analysis problem
14	Thanksgiving	---		
15	*Lecture:* EXAM 2 • Written 2 in class *Lab:* • Lab Practical 2	Practice Exam 2	*Lecture:* Review for Exam II & Practical *Lab:* • Lab Practical	Exam III - Written (Evening)

	Fall 1999		Fall 2004	
Week	Lecture Topics & Lab Activities	Assignments: typically 1-2 problems in an engineering context	Lecture Topics & Lab Activities	Assignments: typically 3-5 problems in an engineering context plus computer tool and teaming skills development
16	*Lecture:* Goal Seek *Lab:* • Solve single equations • Project 2 Demonstrations	Project 2	*Lecture:* Instructor's Choice *Lab:* • Project 2 Demonstrations	Project 2 - B • Employ the problem solving method to an open-ended engineering problem • Use flowcharting to aide in the development of a large computer program • Effectively use a number of computer programming concepts: o Large array and vector manipulations and computations o Logic and conditional statements o Repetition structures (loops) • Break a large programming task into a series of interconnected user-defined functions • Develop written reports as part of the design process • Employ effective teaming skills and complete work within deadlines o Team Peer-Evaluation o Individual Time Log