# College of Engineering Curriculum Committee (2004-05)

## Final Report

| Members | Term Expiring |
|---|---|
| Prof. Ray Han, ME, Chair | May 2005 |
| Prof. Madhavan Raghavan, BME | May 2005 |
| Prof. Bill Eichinger, CEE | May 2006 |
| Prof. Tom Schnell, IE | May 2006 |
| Prof. Dave Rethwisch, CBE | May 2007 |
| Prof. Er-Wei Bai, ECE | May 2007 |
| Michelle Sukup | May 2005 |
| Dean Alec Scranton, *ex officio* and nonvoting | |

**General**

The Curriculum Committee (CC) met a total of 11 times, twice with EFC and once with the CoE Advisory Board SubCommittee on Curriculum to discuss Charge 1. The Charges provided by EFC were divided among CC members to investigate and develop responses. The description that follows summarizes the Charges, actions taken, and, where appropriate, recommendations to EFC.

**Charges & Actions**

1. **Charge 1**: *Develop the guiding principles that describe the role of the GEC courses in the CoE curriculum. Review the existing GEC policy, in particular with respect to ABET requirements. Determine to what extent it is possible to allow individual academic programs within the CoE to tailor the GEC requirements to their own needs. As appropriate, develop a motion to change the current GEC policy for consideration at the December CoE faculty meeting.*

   Subcommittee Assignment: Bill Eichinger and Dave Rethwisch

   After several months of deliberation and working with EFC and the CoE Advisory Board SubCommittee on Curriculum, CC voted to approve the proposal developed by the subcommittee. The proposal was forwarded to EFC in early March. In response to this proposal, EFC modified the charge to one of essentially enlarging the current GEC list of approved courses. With the revised charge, CC after further deliberation added the following courses to the GEC list:

   a) 22M:107:GW1 History of Math
   b) 8N courses from Department of English
   c) 8C courses from Department of English
   d) 6J:047 Introduction to Law
   e) 6J:048 Introduction to Management
   f) 6M:100 Introduction to Marketing

2. **Charge 2**: *Develop and work with the Dean's office to implement an assessment process for the math sequence that can be used for continual improvement of the courses in the sequence and to better understand the effectiveness of the preparation of the students for courses that depend on the skills learned in the math sequence.*

   Subcommittee Assignment: Madhavan Raghavan and Alec Scranton

   After several months of deliberation, CC voted to approve the revised proposal developed by the subcommittee. The revised proposal is listed in Appendix A.

3. **Charge 3**: *Establish appropriate learning goals and develop a plan that will enhance the global awareness of CoE students. As appropriate, develop a motion for consideration by the faculty to implement the plan.*

   Subcommittee Assignment: Er-Wei Bai, Tom Schnell, Michelle Sukup and Ray Han

   After several weeks of deliberation and getting feedback from EFC, CC voted to approve the revised proposal developed by the subcommittee. The revised proposal is listed in Appendix B.

4. **Provide an interim report to the EFC by January 17, 2005 and the final report by April 15, 2005.**

   The interim and final reports were provided to EFC.

5. **Recommend specific charges for the 2005-2006 Curriculum Committee.**

   The Charges for the 2005-2006 CC should be a continuation of the Charges 2 & 3 of the current committee. Therefore, the following list of Charges is suggested:

   a. Finalize an assessment process for the math sequence that can be used for continual improvement of the courses in the sequence and to better understand the effectiveness of the preparation of our students for courses that depend on the skills learned in the math sequence.

   b. Develop a motion for consideration by the faculty to implement the plan that will enhance the global awareness of our engineering students.

CoE Curriculum Committee
April 25, 2005

# APPENDIX A - Charge 2: Final Report on Math Assessment

## April 21, 2005

**Math assessment charge**

*Develop and work with the Dean's Office to implement an assessment process for the math sequence that can be used for continual improvement of the courses in the sequence and to better understand the effectiveness of the preparation of the students for courses that depend on the skills learned in the math sequence.*

**Sub-committee members**

Alec Scranton, Ph.D.

Madhavan L. Raghavan, Ph.D.

**Description of actions by 2004/2005 sub-committee**

The sub-committee members met 7 times and discussed options for development of an assessment process.

1. In fall 2004, a proposal was submitted to EFC. Specifically, we proposed to insert a question in the online ACE evaluation of instructors teaching selected college and department core courses that would poll students' opinions on their math preparedness (metric #2 from 2003-2004 report). The proposal was not considered feasible due to lack of an approved mechanism for inserting questions into instructors' ACE forms.
2. Since the value of student self-assessment is considered by many to be unreliable, the committee chose to pursue faculty assessment of students' math preparedness. Therefore, the following course of action is recommended.
    a. Each of the core math courses will be assessed based upon the course topic list (each list was adopted by the engineering faculty during the last curriculum change). For each course topic the faculty of the selected engineering courses will be polled regarding: 1) the relevance of math topic to the instructor's course; and 2) the students' knowledge and understanding of the math topic as demonstrated in the instructor's course. The questionnaire containing the topic list for each math course is provided as Attachment I.
    b. The following principles were developed for selection of the engineering courses whose instructors will be polled in this assessment process: 1) ~3 courses included from each of the six undergraduate programs; 2) the courses should be required for all students in the program; 3) must be a junior/senior level course in recommended 4-year curriculum. Based upon these principles, the list of selected courses for the first implementation of the process is provided as Attachment II (restricted to Fall 2004 courses).
    c. The sub-committee proposes a web interface be developed to perform the instructor polling, and that the polling be completed during the spring and summer 2005.

Prepared on April 21, 2005 by Alec Scranton and Madhavan Raghavan

## **APPENDIX A -** Attachment I

| *Core Math Course: 22M:031 Single Variable Calculus* | Topics covered during class | Relevance to course (0 to 10) | Student preparedness (0 to 10) |
|---|---|---|---|
| 1) | Pre-calculus: absolute value, intervals, lines, functions and their graphs including trig and inverse trig functions, exponential and log, base e and natural log. | | |
| 2) | Limits: Definition (intuitive, geometric and epsilon-delta). Limit theorems and their use. One sided limits and limits at infinity. | | |
| 3) | Continuity and introduction to the derivative; define point-wise continuity and continuity on an interval; state and explain intermediate value theorem and extreme value theorem; define derivative of a function at a point and connect to slopes of tangent lines and instantaneous rates of change. | | |
| 4) | Differentiation techniques, products, quotients, chain-rule | | |
| 5) | Derivatives of trig functions, inverse trig functions, exponential and log functions | | |
| 6) | Applications of derivative, implicit differentiation, related rates, differentials and tangent line approximation. | | |
| 7) | Max-Min and the Mean-Value Theorems, absolute max-min of continuous function on a closed bounded interval, critical points, endpoints, increasing and decreasing functions, the mean value theorem, relative max/min, first derivative test and some applied max-min problems | | |
| 8) | Taylor polynomials and the remainder; extend the Mean-Value Theorem to approximate and estimate error. | | |
| 9) | Graphing concavity, second derivative test, curve-sketching | | |
| 10) | Exponential growth and decay; L'Hospital's rule; graphs involving log and exponential functions. | | |
| 11) | Definite Integral and Fundamental Theorem of Calculus; definition of definite integral via Riemann sums, properties, relate to anti-derivative via the Fundamental Theorem. | | |

| | | | |
|---|---|---|---|
| 12) | Techniques of integration; standard rules for anti-differentiation and use of substitution | | |
| 13) | More techniques of integration include integration by parts and partial fractions | | |
| 14) | Improper integrals and numerical integration | | |
| 15) | Area and volumes of revolution | | |

| *Core Math Course: 22M:032 Multivariable Calculus* | Topics covered during class | Relevance to course (0 to 10) | Student preparedness (0 to 10) |
|---|---|---|---|
| 1) | Explicit, implicit, parametric equations for curves, including lines, circles, ellipses, and parabolas. | | |
| 2) | Vector geometry addition, scalar multiple, dot product, projections and angles, cross product. (postpone determinants and oriented areas and volumes until later in the course) | | |
| 3) | Functions of several variables (include polar/cylindrical coordinates) | | |
| 4) | Partial derivatives, directional derivatives, differential | | |
| 5) | Tangents lines and planes, relation to gradient vector | | |
| 6) | Maxima and minima | | |
| 7) | Applications of MAX-MIN | | |
| 8) | Multiple integrals in 2-dimensions | | |
| 9) | Multiple integrals in 3-dimensions (somewhere in 2- and 3- dim integrals, do polar/cylindrical coordinates; this means confronting “change of variable” “stretching factor” in some form) | | |
| 10) | Parametric curves, velocity, curvature | | |
| 11) | Vector fields and flows | | |
| 12) | Integration on curves (work integrals) | | |

| *Core Math Course: 22M:033 Matrix Algebra* | Topics covered during class | Relevance to course (0 to 10) | Student preparedness (0 to 10) |
|---|---|---|---|
| 1) | Matrix arithmetic: addition, multiplication, properties | | |
| 2) | Vectors: addition, scalar multiplication - algebraic and geometric | | |
| 3) | Linear combinations, linear independence, basis subspace - examples from R2 and R3 | | |
| 4) | Reduced row echelon form of a matrix; calculation by hand and with computer | | |
| 5) | Solving linear systems and finding bases for row space and column space of matrix | | |
| 6) | Inverse of an nxn matrix: existence; calculate by hand and with computer | | |
| 7) | Use of inverse in solving systems of equations. Rank and dimension | | |
| 8) | Null Space; solution of Ax=0; General solution of Ax=b | | |
| 9) | Determinants; definition and properties; calculate by hand (row reduction) and computer; Expansion by minors (Laplace expansion of determinant) | | |
| 10) | Applications of determinants: Cramer's rule; cross- product. | | |
| 11) | Eigenvalues and eigenvectors: linear transformation; eigen-value, -vector, - space and examples | | |
| 12) | Diagonalization: P-1AP=D, where columns of P are basis for Rn consisting of eigenvectors of A, and D is a diagonal matrix of eigenvalues of A. Examples of diagonalization | | |
| 13) | Orthogonal bases: calculation by hand and by computer; Orthogonal diagonalization of symmetric matrix: principal axis theorem; calculation by hand and by computer. | | |
| 14) | Fitting a line or curve to data: Vandermonde matrices; least squares fittings. | | |
| 15) | Projection in R2 and R3: projecting a vector on a line and into a plane | | |
| 16) | Orthogonal matrices in R2 and R3: Applications of principal axis theorem | | |
| 17) | Rotations and reflections in R2 and R3 | | |
| 18) | Exams, review/practice | | |

| *Core Math Course: 22M:034 Differential Equations* | Topics covered during class | Relevance to course (0 to 10) | Student preparedness (0 to 10) |
|---|---|---|---|
| 1) | Classification of differential equations; direction fields | | |
| 2) | Exponential growth and decay; related physical phenomena | | |
| 3) | Linear equations and integrating factors | | |
| 4) | Separable equations | | |
| 5) | Reduction of order, application of nonlinear equations: Bernoulli and logistic equations, gravitation | | |
| 6) | Sample computer lab assignment: direction fields; integration and differentiation; solution of first-order differential equations and initial value problems. Mechanical and electrical oscillation: modeling by initial value problems | | |
| 7) | Linear, constant-coefficient second order equations: homogeneous case; the characteristic polynomial | | |
| 8) | The method of undetermined coefficients | | |
| 9) | Oscillation and resonance (plus amplitude modulation and other phenomena) | | |
| 10) | The Laplace transform L; definition and foundations; some table entries; 1st differentiation rule | | |
| 11) | Solving initial value problems using Laplace and inverse Laplace | | |
| 12) | Sample computer assignment: Laplace transform (beyond constantcoefficient equations and beyond the familiar table entries); undetermined coefficients; amplitude modulation. | | |
| 13) | More on the Laplace transform: 1st and 2nd shift rules, 2nd differentiation rule, discontinuous inputs, periodic functions, impulse functions, convolution, impulse response, transfer function | | |
| 14) | Linearity; the Wronskian | | |
| 15) | Use of a known homogeneous solution to find another; variation of parameters | | |
| 16) | Topics chosen from: (I) Systems: generalities, reduction of higher-order equations to first-order systems. (II) Linear systems: homogeneous with constant coefficients; eigenvalues; the cases of complex and repeated eigenvalues; non-homogeneous systems; simultaneous differential equations. (III) Brief introduction to nonlinear second-order equations and first-order systems; phase plane and energy methods; the pendulum; predator-prey and competing species; nonlinear oscillators; autonomous systems and stability | | |

| Course # | Course title | Prof. Fall 2004 |
|---|---|---|
| 051:040 | Biological Systems Analysis I | Joe Reinhardt |
| 051:050 | Biomechanics | Nichole Grosland & Madhavan Raghavan |
| 051:060 | Fundamentals of Biomedical Imaging | Ed Dove |
| 052:041 | Process Calculations | David Murhammer |
| 052:161 | Mass Transfer & Separations | Audrey Butler |
| 052:171 | Thermodynamics/Transport Lab | John Wiencek |
| 052:185 | Process Dynamics & Control in Design | Victor Rodgers |
| 053:015 | Civil & Environmental Engineering Prac | Eichinger |
| 053:033 | Principles of Structural Engineering | Han-Chin Wu |
| 053:063 | Principles of Transportation Engineering | James Stoner |
| 053:050 | Natural Environmental Systems | Patrick O'Shaughnessy |
| 055:032 | Intro. To Digital Design | James Maxted |
| 055:033 | Intro. To Software Design | Jon Kuhl |
| 055:040 | Linear Systems I | Gary Christensen |
| 055:041 | Electronic Circuits | Norbert Malik |
| 055:043 | Linear Systems II | S. Dasgupta |
| 055:050 | Communication Systems | S. Dasgupta |
| 055:060 | Control Systems | Er-Wei Bai |
| 055:070 | Electromagnetic Theory | Karl Lonngren |
| 056:032 | Design for Manufacturing | Richerd Jerz |
| 056:134 | Process Engineering | Andrew Kusiak |
| 056:144 | Human Factors | John D. Lee |
| 056:171 | Operations Research | Yong Chen |
| 058:032 | Design for Manufacturing | Richard Jerz |
| 058:048 | Energy Systems Design | Udaykumar |
| 058:055 | Mechanical Systems Design | Ralph Stephens |
| 058:080 | Experimental Engineering | Maria Beninati |

## **APPENDIX A -** Attachment II

### Engineering Courses Whose Instructors will be Polled

**BME**

51:040 Biological Systems Analysis I
51:050 Biomechanics
51:060 Fundamentals of Biomedical Imaging

**CBE**

52:161 Mass Transfer and Separation
52:171 Thermodynamics/Transport Lab
52:185 Process Dynamics/Control Design

**CEE**

53:033 Principles of structural Engineering
53:050 Natural Environmental Systems
53:063 Principles of Transport Engineering

**ECE**

55:032 Intro to Digital Design
55:040 Linear Systems
55:070 Electromagnetic Theory

**MIE** (Industrial)

56:032 Design for Manufacturing
56:134 Process Engineering
56:144 Human Factors
56:171 Operations Research

**MIE** (Mechanical)

58:048 Energy Systems Design
58:055 Mechanical Systems Design
58:080 Experimental Engineering

## Appendix B - Charge 3: Final Report on Global Awareness

Charge

*Establish appropriate learning goals and develop a plan that will enhance the global awareness of CoE students. As appropriate, develop a motion for consideration by the faculty to implement the plan*

Philosophy

Graduates will have an education that is supportive of a broad awareness of the diversity of the world and its cultures, and that provides an understanding of the impact of engineering practice in the global community.

Goals

- Gain an understanding and appreciation of engineering standard, infrastructure, and resource constraints in the global community.
- Develop interpersonal skills to work effectively with people from different countries.
- Understand and learn to work with cultural, social, political and economical differences on engineering practice in the global community.

The Plan

<table>
<tr><th>Level</th><th>Option A</th><th>Option B</th><th>Option C</th><th>Option D</th><th>Option E</th></tr>
<tr><td>III</td><td>5 UI seminars with Global Theme*</td><td>1 Approved 3-SH Course with Global Theme</td><td>1 Approved Senior Design Project with Global Theme</td><td>1 Approved Student Proposed Effort with Global Theme</td><td rowspan="2">1-Semester Study Abroad</td></tr>
<tr><td>II</td><td colspan="4">Professional Seminar<br>2 Lectures with Global Theme</td></tr>
<tr><td>I</td><td colspan="5">Freshman Seminar<br>2 Lectures with Global Theme</td></tr>
</table>

a) The Plan consists of 3 levels:
   - Level I – 2 mandatory lectures with global theme in the Freshman Seminar class.
   - Level II – 2 mandatory lectures on global business practices in the Professional Seminar class. These 2 classes can be handled the same way as the Tau Beta Pi Scholz Symposium that is common to ALL the Professional Seminar classes.
   - Level III – satisfied by choosing one of the 5 options.

b) Student Proposed Effort may consist of a co-op, an internship or a short course.

c) Levels II and III can be fulfilled with a semester or more of Study Abroad.

d) The student's Degree Evaluation form will have an item on *Global Awareness*. The item will be checked once the requirement is fulfilled.

* UI seminars with a global theme, e.g., UI Presidential Lecture Series, UI Distinguished Lectures, UI International Writing Program seminars, seminars offered by International Center. For each of the seminar attended students have to submit a 1-page summary containing the seminar title, time, speaker, organizing department and how the seminar contributes to the global awareness goals.