Please find attached a completed grant proposal (4 pages, plus attachments), one original and
eleven copies,
submitted to
Linda Jones, 4000 Eastman
Friday, February 16, 2001.

Project Title:

Development of an “Introduction to Mechanical Engineering Design” Course

Applicant(s):

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Department:  Mechanical Engineering  College:  Engineering
Development of an "Introduction to Mechanical Engineering Design" Course

1. Summary
The proposed plan of action is to develop a two-quarter "Introduction to Mechanical Engineering Design" course, to be offered in the second year of the Mechanical Engineering curriculum. This course will include elements of the existing Materials Processing (0304-343), Engineering Design Graphics (0304-214), and Geometric Dimensioning and Tolerancing (0304-312) courses. In addition, it will introduce the students to design methodology, application of basic analysis skills to a non-ideal situation, technical writing and presentation, basic statistics, and basic economics. This will be done in the context of a two-quarter, open-ended design project. The course will consist of both classroom lecture and lab portions so the students are able to apply what they learn in class to hands-on applications.

The students will be asked to design and build a Kube Goldberg-type machine that has to perform a specified function without human interaction. The class will be broken into groups, and each group will be responsible for designing two consecutive steps of the machine. The class as a whole will decide on boundary points between the groups so that all parts will work together when assembled. This will encourage the students to work well not only within their groups, but within the larger project as a whole.

This design course will directly address several requests by the Mechanical Engineering Industrial Advisory Board and will point RIT's Mechanical Engineering Department in the design direction that ABET is favoring. Students will be also better prepared to deal with open-ended problems they may be presented with in other classes and they will learn valuable time and project management skills that will help them throughout their education and careers. This will strengthen student performance and enhance the RIT reputation carried off campus by our graduates.

For the first implementation of the course, a pilot group of 24 students will be invited to register for this course. The performance of these students will be tracked as they progress through the five-year program. For the long term, this course sequence would eventually be required of all incoming Mechanical Engineering students.

2. Targeted Learners
This course is directed at Mechanical Engineering students at or near the beginning of their study at RIT. It will initially be offered to a small group of students as a pilot course but will eventually replace three existing core courses and become a requirement for all ME undergraduates, about 200 students per year.

3. Impact on Teaching and Learning
The impact of the new course will reach all areas of the Mechanical Engineering curriculum. In the traditional first two years of an ME curriculum, students take classes where answers are either right or wrong. A transition needs to be made to the types of problems they will be faced with upon graduation - where nobody knows the correct
answer ahead of time, and the necessary equations are not conveniently highlighted in a textbook. By exposing students to open-ended problems early on in their engineering education, they will be better prepared to handle projects in later classes, in co-ops, and after graduation with more independence.

The extensive project experience will also help the students develop basic work skills. Class presentations and project deliverables will help students' communication and help them to feel more comfortable presenting technical information in front of their peers. The integrated project will force students to work together within groups and between groups in order to make the entire project come together at the end of the quarter. RIT's industry partners will now be hiring students better able to express themselves clearly and concisely, and better able to work well with others.

4. Quantification of Results
Quantification of the impact of this new course will be done through future student performance and through course evaluations. By tracking the initial core group of students, their performance relative to their peers can be measured. Results of the pilot course offering will be presented at a faculty meeting after the initial offering, with update memos on student performance distributed once per year until the program is established as a regular course.

An additional measure of the competence level of the students will eventually be to enter the best resulting design in the National Rube Goldberg contest held at Purdue University each spring. This contest brings together design teams from across the country to enter their designs into competition with one another to perform a pre-determined task in a set number of steps without human interaction. Entry into this competition would give RIT recognition on the national level for its design program.

5. Rationale
The Mechanical Engineering curriculum suffers from a lack of formal engineering design experience in the early years of undergraduate study. Students are introduced to Mechanical Engineering through a series of courses in Materials Processing, Engineering Design Graphics, and Geometric Dimensioning and Tolerancing over the course of their first three years. While these courses present information that is critical to the design process, the material is presented in a discontinuous method relying on a "you will need to use this later" justification. In addition, these courses are spread out over quarters 1, 2, and 6 in the course sequence, with no actual application to a comprehensive design project until the 11th quarter when they take Senior Design. By teaching the same material integrated with a project, students will immediately see the value of what they are learning, and will have more motivation to retain that knowledge. Since it is impossible to condense 3 quarters of existing course material into two, in addition to adding new material, more responsibility will be given to the students. They can only be presented with the basics in each area; the rest is up to them to discover on their own as the need arises. The ability to figure things out on their own is an invaluable skill, and personal experience has shown that when students have to fight for a piece of information, they will remember it longer.
### 6. Timetable

<table>
<thead>
<tr>
<th>Month</th>
<th>Task Description</th>
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<tbody>
<tr>
<td>May 2001</td>
<td>Extend invitations to 24 students to sign up for the Introduction to Mechanical Engineering Design course.</td>
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<tr>
<td>June 2001</td>
<td>Begin developing course outline, project, and lecture notes. Work out logistical classroom and lab space details.</td>
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<tr>
<td>July 2001</td>
<td>Continue work on lecture notes, begin developing lab activities. Work out logistical details with machine shop.</td>
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<tr>
<td>August 2001</td>
<td>Continue work on lecture notes and lab activities.</td>
</tr>
<tr>
<td>September 2001</td>
<td>Offer course for the Fall 2001 quarter for the first time.</td>
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